**Question 1.**

**Considering the Bus Rapid Transit (BRT) Peshawar, what were the risks involved during construction Associated with the technical aspects of the project? Support your answer with logical and factual arguments along with references. State how we could counter the risks associated with the technical aspects.**

Hint: You can take help from book “Risk and Insurance in Construction” by Neal G. Bunni

BRT (Bus Rapid Transit) Peshawar an overview:

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| Date of Initiation | 29th Oct 2017 |
| Length | 27 KM |
| Execution Body | PDA (Peshawar Development Authority |
| Financers | Asian Development Bank (ADB) |
| Estimated Budget | ₨41 billion (US$290 million) |
| Modified Budget | ₨71 billion (US$500 million) |
| Number of Stations | 31 |
| Number of Buses | 255 |
| Deadlines | (Six Months) 29th October 2017 Lapsed |
| 2nd Deadline | 20th April 2018 |
| 3rd Deadline | 20th May 2018 |
| 4th Deadline | 20th June 2018 |
| 5th Deadline | 31st Dec 2018 |
| 6th Deadline | 23rd March 2019 |
| 7th Deadline | This April 2020 |

Data collected Information Source: <https://en.wikipedia.org/wiki/TransPeshawar>

***Flaws of the Projects***

Opening Deadlines of BRT Peshawar, has been lapsed many times (above figures), due to many technical aspects, some of these flaws are as below.

1. Inferior Quality Material used, putting assets and lives at risk.
2. Due to inaccurate calculation and analysis, threshold width of road constructed at Stations 10, 12, 15 and 26 are less then minimum required i.e. 6.5 meter, resulting in possibilities collision of buses.
3. Improper Docking of buses at station also could results in injuries to passengers.
4. Lack of adequate construction supervision and communication.
5. Slippery floor tiles were used compromising safety of passengers.
6. Directional floor tiles were also replaced with tapped arrows, deviated from the proposed proposal.
7. Curb design between platform and vehicle was deviated and does not meet the required project proposed (Kassel Curb Design).
8. Ineffective Curb will results inefficient and potential damaging to Vehicle tyres.
9. Station Roof were not build as per proposed designed the passengers are exposed to rain while boarding.
10. Fencing were used deviated from the proposed anti-cut and anti-climbing fencing, due to which mostly were broken and stolen.
11. Quality of work was compromised by Changes in pit design at Chamkani depot and station number 1, to provide adequate drainage.
12. Corrugated Steel were used at ticketing kiosks, reported as inferior quality used in report.
13. There were difference in Stair Steps heights considerably, resulting safety problem for walking Citizens
14. Flooring Material were also sub-standard, utilized on ramps and stairs.
15. Pillars or Stairways do not aligned properly, at certain stations the stairs and escalators have been built in the middle of the stations, obstructing walking space.
16. Footpath are blocked by placing public toilets and stairways making hurdles for the people.

Information reference source: <http://www.transparency.org.pk/adb-finds-deadly-flaws-in-peshawar-brt-project/>

***Extended duration of construction***

According to the theory, all those projects, where duration is extended, there is a great impact on their results and output. Considering the case of BRT Peshawar, and above mentioned deadline variations, shows that the project duration had not only being extended once but had been extended several times, due to above reasons of sub-standard work mentioned in points, along with allegation of corruption. Due to these extensions, many of the modules are either became wastage, broken or stolen.

***Technical complexity and innovation in design requiring new methods of construction and/or erection***

The proposal which was approved by the competent authorities was deviated, and the theme of the project was changed. All those changes were then highlighted by Asian Development bank which were not listed in proposal/ PC1 and had been changed, looking above points, it is clear mentioned that all those points were highlighted because they were either not in proposal PC1 or had been changed for corruption purpose.

***Removal of support***

In Many cases, considering BRT project, where the lender objected that some of the material were used where lives of passenger are at risk. Which are also mentioned in the above points. i.e. ramp, floor were made of inferior material and in future after operation would results in damage to the constructed site and also results in lives losses. Some of the passenger pathway the stairs length was not according to standard which is also a Question mark for the support for passengers.

***Dangerous substances and items during construction and/or commissioning***

It is also mentioned in above points, that many of the items were installed which could results dangerous like slippery tiles, no proper sign boards, etc. curb design not up to the mark, improper docking of buses could result in passenger injuries, collision of buses as mentioned. And even vehicles malfunctioning due to improper curb etc.

***Defective design***

There is no doubt the designing phase of BRT Peshawar not accurate, designing route for buses was a big blunder, which was to be designed for passing over for 2 buses sidewise at a time, but as per the designed route, only one bus could hardly pass through. Secondly a big defect was found in designing the elevators, Station roof was exposed to rain, toilets were built on footpath etc. the designer of the project was not according to international standard.

***Defective workmanship and material***

The project is mostly depended on providing best Human Resource and also best materials to be used to strengthen the theme of the project, but looking toward the mentioned project in depth, we can easily calculate that from the higher authorities, engineers and even labors were not technical sound, because the project is in failure stage till now because of these modules. Using incompetent staff/labors/engineers but also substandard material.

***Defective design, workmanship and quality control***

While Designing phase or even in construction phase, the Quality control was not functional properly, because all those flaws that came out at the end, was due to lack of Quality Control, none of the project can be achieved by compromising the Quality. In BRT Peshawar the Quality control seems handicapped.

***Inadequate site management***

If the project was executed with all these flaws, the main blame will be upon site management, because the site where the project is executed need vigilances and transparencies, Site management if were properly supervised and communicated then many of these hurdles would have been neglected.

***Vibration and oscillation***

As mentioned in flaws, Pillars or Stairways do not aligned properly, May results in vibration and oscillation, also the ramp which was constructed with inferior material could be the reason of oscillation.

***Defective temporary works and their design***

One of the reason, BRT Peshawar was stopped by the Asian Development Bank, was that the design and work was defective and was considered temporary bases, it was not considered as to be the international standard project, but it was taken as temporary basis and source for corruption.

**Question 2**

**Risk matrices, also called heat maps, are basically tools for representing and displaying risks by defining ranges for consequence and likelihood as a two-dimensional presentation of likelihood and consequences. According to this method, risk is characterized by categorizing probabilities and consequences on the two axes of a matrix. Risk matrices have been used extensively for screening of various risks. They may be used alone or as a first step in a quantitative analysis.**

Hazardous event =15333/6585200 = 0.00232

Which fall under category C, VERY UNLIKELY

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| ***Likelihood categories for a RISK MATRIX*** |
| Category Description Annual probability range    A Likely ≤0.1 (1 in 10)    B unlikely ≤0.01 (1 in 100 ) but <0.1    C very unlikely ≤0.001 (1 in 1000 ) but <0.01    D doubtful ≤0.0001 (I in 10,000 ) but <0.001    E highly unlikely ≤0.00001 (1 in 100,000 ) but <0.0001    F extremely unlikely ≥ 0.00001 (1 in 100,000 ) |

Now according to given data the cost of loss is = 45,275,000 US$

Which fall under Category 4, Significant Loss

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| ***Example consequence categories for a Risk Matrix in Monetary Amount ( US$ )*** |
| Categories Description Cost US$  1 catastrophic loss ≥ 10,000,000,000  2 Major loss ≥ 1000,000,000 but < 10,000,000,000  3 serious loss ≥ 100,000,000 but < 1000,000,000  4 significant loss ≥ 10,000,000 but < 100,000,000  5 minor loss ≥ 1,000,000 but < 10,000,000  6 insignificant loss ≤ 1,000,000 |

Now in below the Risk Matrix are Given (LOW, MEDIUM AND HIGH) having two above parameter i.e. Probability and Consequences Category.

According to given data the Risk Matrix Found to be “LOW”

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| ***Probability***  ***Categories*** | |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | A | L | M | M | H | H | H | | B | L | L | M | M | H | H | | C | L | L | L | M | M | H | | D | L | L | L | L | M | M | | E | L | L | L | L | L | M | | F | L | L | L | L | L | L | |  | 6 | 5 | 4 | 3 | 2 | 1 | |
|  | Consequence categories |