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SUBJECT: Risk and Disaster Management in Construction

QUESTION 1 (ANSWER):

Risks involved during construction associated with the technical aspects of the project “Bus Rapid Transit (BRT) Peshawar”:

Extended Duration of Construction:

According to Neal G. Bunni the longer the period of construction, the greater is the probability of occurrence of the hazards to which a project is exposed. Same situation occurred in BRT project. The project was started in October 2017 with one year completion time. Till now more than three year has passed and only 60 % of the work is executed and the remaining 40 % is expected to complete in 2 years. From this the project completion date rise from 1 year to more than 5 years. These hazard which occur during this period are rainfall, temperature changes, flood, storm and wind are called seasonal hazard because it require special precaution if the project delayed. According to Dawn news BRT project were delayed for 6 months because of the flood occur during the rainy season in last 3 years. This event occur in March, April, June and July of the year 2018 and 2019. [1][2][11]

Technical Complexity and improving in Design Require new method of construction or/and Extension:

According to Neal G. Bunni when traditional materials or methods are used in construction, the familiarity of those involved with the design or the work itself may permit an occasional ambiguity in the drawings or specifications without them being misinterpreted. It may even provide correction of a mistake. However, in a novel or relatively new design, material or construction method, what is needed is precise and thorough communication between the designer, manufacturer or contractor, as the case may be, and others involved in the construction process. The same situation applies here in BRT. Throughout KPK it is one of the first unique project that will build which is 49 % elevated, 38 % at grade and 17 % via underpass. The main Problem occur

was new design for local engineers. The elevated section design was new and risk of collapse of structure were high. [1][2][3][11]

Removal Of support:

The risk of removal of support has usually very serious consequences, even in minor parts of the work, as we have seen in Grade structure in whole project like in execution of flyover and Bridges. The form work that are used in BRT are called “FALSE WORK”. False work can include the use of scaffold, timbers, temporary steel work, bamboo, etc. to support components of a structure, prior to completion. During execution of false work in section 2, several risk of collapsing the fly over and bridges were countered. The plywood that support the structure in several point of flyover near Phase 3 collapse several times. The big reason why the false work in BRT collapse due concrete placing methods or the use of form vibrators which can transmit compressive waves to the outermost members of the false work.

Dangerous Substances and Items:

A crane driver was injured after heavy metal plates of an under-construction track of the Peshawar Bus Rapid Transit project collapsed and fell on a parked car due to defective temporary works. The vehicle was crushed but no casualties were reported.

Another incident that took place in the Shoba Bazar area where heavy metal plates for the elevated cycle track collapsed. The driver of the vehicle managed to escape unscathed. The crane driver, however, was injured.

Defective Design:

With the provincial government hoping that the BRT does for them what the Metro Bus project in Punjab did for the PML-N in the last general elections, a senior engineer working on the project in Peshawar has warned against constant tinkering in the design of the project to make sure it is completed on time. The continuous amendments to the design of various aspects of the Peshawar BRT project is seriously jeopardizing the completion of the Peshawar Sustainable BRT Project within the specified time limits. In just the six months since the government started work on the project, the project design has been changed at 11 different points. As a result, work on several sections of the project has yet to get underway such as work on the Gulbahar flyover. The government had initially decided to build a BRT corridor here at ground level.

However, the designers later realized that this would rob Gulbahar and Sikandpur residents of key U-turns while the existing Arbab Sikandar Khan Khalil flyover would lose its utility. The design was hence altered. Similarly, work on the Level-II Pir Zakori Bridge has yet to start. Construction of the elevated corridor in Tehkal was decided months after the civil work on the project kicked-off. Later, with work on an underpass at Aman Chowk almost complete, it had to be dismantled and rebuilt owing to design flaws. Moreover, the government has now decided to make a station at Karkhano Market. [2]

Officials working on the project say that the constant changes in the design are not only delaying the project but are also adding to its cost. Meanwhile, PDA Director General Israrul Haq has admitted that the project is facing delays and that people should not expect it before May 20, a month over its prescribed deadline. The PDA chief added that work on the Pir Zakori Bridge is expected to start in a day or two and the project will be completed within three months. However, he was quick to clarify that the bridge is not a part of BRT, thus it will not affect that project's overall completion deadline. He also admitted that the cost of the BRT project will rise due to the design changes, but he tried to downplay them by terming them 'nominal escalation which promises more benefits'. [2]

A senior management official of the BRT, explained that the engineering design of the project was based on a pre-feasibility study. In other words, work had begun on the project without the nitty-gritty of design and its impact being sorted out. [3]

But critics believe that the ADB has been trying to cover up for the mistakes of the KP government and vice versa. This assertion is based on hundreds of emails sent by the Project Management Unit (PMU) to the project heads pointing out mistakes and irregularities in the design. These pleadings fell on deaf ears. This matter had actually been brought to the forefront earlier in an October 23, 2018, meeting called by the additional chief secretary. During the meeting, officials discovered the U-shaped girders, which currently lay dumped on the Northern Bypass in Peshawar, were built and carried to the site for installation without realizing that it was only a conceptual design not meant for implementation. There was also no provision in the revised PC-I for installation of louvres and sound barriers at the elevated portions of Reach-II of the project, which are required to safeguard the privacy of nearby buildings and counter the noise pollution in the vicinity.

Moreover, the drainage system for the elevated portion of the BRT project also needed to be properly designed. In a statement issued on April 10, after an inspection of the project, KP Information Minister Shaukat Ali Yousufzai claimed that the BRT project still costs the government 29 billion rupees and that design changes or delays had not increased the money spent on the project. The other money, according to him, was for buying buses (8 million rupees), construction of plazas (10 billion) and road construction and repairs (11 billion). [3]

Defective Material and Workmanship:

The ADB stopped the provincial government from making future payments to contractors because of the poor quality of material were using. The ADB loan will not be disbursed further until the provincial government introduces changes in the design to address “critical” deficiencies. [4]

The audit report held on Peshawar BRT by ADP also highlighted the quality related issues and noted the use of cheaper material for bus stations sheds along the entire BRT corridor. It added, “Poor quality and design of guardrail/ fence along BRT Corridor, comprising road safety in future. ADB team instructed PIU/ PMCSC to ensure provision of anti-climb and anti-cut fence in the remaining sections of corridor, as the existing fence was prone to vandalism. [5]

The report also talked about substandard construction of Transoms along the BRT Corridor. The Audit report also pointed out “Honeycombing of columns at Dabgari Staging Facility and using low standard material compromising strength of the construction and leading to failure of structure.” [5]

Mechanical and Electrical Breakdown:

Mechanical breakdown occur in BRT several times. The pavement works generate gas and odor from the asphalt works and vibration from the compaction of the new BRT road pavement. Emissions from powered mechanical equipment will be superimposed on the already high traffic pollution but is expected to disperse rapidly. [9]

Site operations are becoming more dependent on plant and equipment, the breakdown of which forms a major risk element. [1] The standard definition of 'mechanical & electrical breakdown' in

most homeowner's insurance policies is defined as: “The sudden and unexpected malfunction of mechanical and electrical equipment.”

Inadequate Site Management:

Inadequate site management in BRT Peshawar has been held several times. Traffic system in the city is totally mess with thousands of motorist suffering due to poor management of BRT site works. Traffic congestion on the roads of Khyber Pakhtunkhwa’s capital of Peshawar is worsening day by day as the daily number of vehicles was more than seven times the capacity of the city’s roads. With the BRT project still incomplete, posing more problems for commuters than solving them, incumbent Chief Minister Mahmood Khan also directed the city’s deputy commissioner and the traffic police apparatus to implement the traffic management plan. [6]

. According to Dawn news due to faulty planning of BRT Peshawar, 21 of 12 meter size buses have reached Peshawar. That is why the administration was thinking of buses services only for women and children. Under the BRT project, 220 buses were to be purchased: 65 of them with 18-metre size for the main corridor, while 155 buses of 12-metre size were to be run on feeder routes. However, until now only 21 buses of 12-metre size have reached Peshawar. It has become a real headache for the Transport Department and Trans Peshawar how to manage running of only 21 buses on 27-km long route. [6]

Ground Movement:

Ground movement could take place from a number of causes, including landslides, frost heave, earth slips and ground pressure leading to collapse. [1] Ground movement in BRT Peshawar has only occur near Hayatabad Depot during construction of flyover.

Subsidence:

In a natural example of groundwater-related subsidence, the erosion of bedrock due to moving groundwater can cause cave-ins, which are an extreme case of subsidence. [1] In BRT no subsidence occur.

Explosion and fire:

According to Neal G. Bunni the best-organized construction sites are, by their very nature, prone to fire hazards. Inflammable construction materials such as timber, shuttering, packing material,

plastic foils, fuel, paints and other hazardous material are generally found on site. The temporary nature of many items on site such as camps, stores and temporary heating and cooking facilities adds to the fire hazard. Moreover, only a few sites maintain complete and efficient fire-fighting equipment and many civil engineering projects are remote from public firefighting facilities. A project concentrated in one location can be threatened in its entirety by fire and the risk involved increases with the progress of construction. No explosion and fire incident occur in BRT Project. [1]

Vibration and Oscillation:

No vibration and oscillation incident occur in BRT Project.

Corrosion:

According to ADB the bodies of the buses are made of non-corrosive material. Similarly, the body is made up of a material which is durable enough to handle direct sunlight. The source believe that there is a risk of corrosive material that are used in BRT buses so there is a risk of corrosion.

Bus stations are also reported to be flood prone, as was witnessed during the last rains. Many stations were flooded and newly constructed roofs started leaking. This shows poor quality control of construction design and material. [7]

Collapse:

Sources have said that roof of Gul Bahar underpass is at the risk of collapsing because of seepage of water from the sewerage line. The sewerage water has started accumulating on different places in the underpass. [8]

QUESTION 2 (ANSWER):

Risk Matrix:

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. [10]

Annual probability of occurrence of a hazardous event = $14270/6585200 = 0.002166$

Then according to Table 2.1 the value is greater than .001 and less than .01 ($>.001$ but $<.01$) which fall under Category C (VERY UNLIKELY)

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 1,000) but < 0.01
D	Doubtful	≥ 0.0001 (1 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)

Let assume that the event occur, now according to given data the cost of loss is = 45,275,000 US\$

According to Table 2.2, the cost of loss is greater than 10,000,000 and less than 100,000,000 ($>10,000,000$ but $<100,000,000$) which fall under Category IV (SIGNIFICANT LOSS)

Example Consequence Categories for a Risk Matrix in Monetary Amounts (US\$)

Category	Description	Cost (US\$)
I	Catastrophic loss	$\geq 10,000,000,000$
II	Major loss	$\geq 1,000,000,000$ but $< 10,000,000,000$
III	Serious loss	$\geq 100,000,000$ but $< 1,000,000,000$
IV	Significant loss	$\geq 10,000,000$ but $< 100,000,000$
V	Minor loss	$\geq 1,000,000$ but $< 10,000,000$
VI	Insignificant loss	$< 1,000,000$

Now in Figure 2.3 Risk Matrix, on Y Axis the Probability Category of fig 2.1 is mentioned and on X Axis the Consequences Category off fig 2.2 is mentioned. As we know from result of above two figure, the Probability category is “C” and Consequences Category is “IV” which is highlighted RED in fig 2.3. These two intersect at a point “L” which is highlighted “GREEN” in below fig

Probability category	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
		VI	V	IV	III	II	I
	Consequence category						

Figure 2.3 Risk Matrix (L: Low, M: Medium, H: High)

This means that the level of risk is “LOW” It does not mean that they are not important to begin with. It’s just that the team can get to them after the rest of the risks have been mitigated.

It also indicates the risk of an event is not high enough, or that it is sufficiently controlled.

A low level of risk is one where an event is unlikely or would result in a trivial or minor injury/illness with little or no time off work. A medium level of risk is in between these two e.g. an event that is reasonably likely and could result in several days off work.

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