

$$\text{The mean weight, } \bar{B} = \frac{\text{Total weight}}{\text{Number of respondents}} \quad (5)$$

$$\text{Percentage weight, } B \% = \frac{\text{mean weight}}{\text{maximum score (four)}} \times 100 \quad (6)$$

This percentage weight gives the average consequence level of the respondents and equally indicates the level of importance.

Column C indicates the most affected project objectives, where

- 1 = Cost implications
- 2 = project delivery period, and
- 3 = quality

The respondents indicate the most affected project objective if a particular hazard occurs by ticking either of the numbers 1, 2 or 3 in the last row of the questionnaire.

RESULTS AND DISCUSSION

The results obtained were from analyzing responses to the questionnaire given to project practitioners. Table 2 shows the respondents and their years of experience.

Table 2: Respondents with years of experience

Years of Experience	No. of Respondents	% Respondents
2	5	11.90
4	7	16.67
6.5	11	26.19
12	10	23.80
16.5	5	11.90
20.5	4	9.52
Total	42	100

The hazard level of the various factors in the project is shown in Table 3, the hazard factor consequences levels are shown in Table 4 while the project objectives mostly affected by the different hazard factors are shown in Table 5.

Table 3: Hazard Level of various hazard factors in engineering project

S/N	Hazard Factor	Hazard level (average of mean weights)	Percentage weight (%)
1	Technical Hazards	3.42/4	85.50
2	Commercial Hazards	3.15/4	78.75
3	Economical/Financial Hazards	3.49/4	87.25
4	Social/Political Hazards	1.91/4	47.75
5	Legal Hazards	1.67/4	41.75
6	Shareholders Hazards	2.29/4	57.25

Table 4: Hazard factors consequences level

S/N	Hazard Factor Consequence	Consequence Level (Average of Mean Weights, B)	Percentage (%)
1	Technical Hazards	3.16/4	79.00

2	Commercial Hazards	2.87/4	71.75
3	Economical/Financial Hazards	3.50/4	87.50
4	Social/Political Hazards	2.20/4	55.00
5	Legal Hazards	2.14/4	53.50
6	Shareholders Hazards	2.63/4	65.75

Table 5: Hazard factor effects on engineering projects

S/N	Hazard Factor	Project Objective Mostly Affected
1	Technical Hazards	Quality and Cost
2	Social/Political Hazards	Delivery schedule and cost
3	Economical/Financial Hazards	Cost of execution
4	Commercial Hazards	Delivery schedule
5	Shareholders Hazards	Cost, quality and delivery
6	Legal Hazards	Delivery schedule

The different hazard factor items for each hazards factor and their hazard levels and consequences are shown in Tables 6 to 10; that of legal hazard is not shown separately .because it has only one item which hazard level and consequences is same as those shown in Tables 3 and 4 respectively.

Table 6: Technical hazard factors items, their hazard levels and consequences

S/N	Hazard Factor Items	Hazard Level, %	Consequence level, %
1	Subsurface uncertainties	88.4	73.5
2	Use of new technology	96.2	87.5
3	Complexity of technical solution	85.8	77.5
4	Material defect and failure	76.6	73.7
5	Loss when new project fails	97.9	95.3
6	Procurement logistics	77	67.3

Table 7: Commercial hazard factor items, their hazard levels and consequence

S/N	Hazard Factor Items	Hazard Level, %	Consequence level, %
1	Contractors Hazard	91	89.6
2	Changes in contracting policy	66	47.5
3	Loss of customer to competition	84	82

Table 8: Economic and financial hazard items and their hazard levels and consequences

S/N	Hazard Factor Items	Hazard Level, %	Consequence level, %
1	Material price variation	95.4	93.9
2	Currency fluctuation	88.7	84.8
3	General inflation	87.5	92
4	Funding hazard	83	84.8

Table 9: Social-Political Hazard Items and their hazard levels and consequences

S/N	Hazard Factor Items	Hazard Level, %	Consequence level, %
1	Labour market fluctuations	59.4	40.4
2	Changes in contracting policy	47	49

Table 10: Stakeholders hazard items and their hazard levels and consequences

S/N	Hazard Factor Items	Hazard Level, %	Consequence level, %
1	Changes in requirement	68	87.7
2	Hidden Agenda	49.8	47.2

The technical hazards and the economic/financial hazards have the highest hazard level as well as consequence eve. Leal hazard has the lowest hazard level and lowest consequence level as well. This is similar to the risk analysis results obtained in Ref [21]. Unlike the risk analysis results obtained in Ref [21] where the hazard level for each risk factor is always greater than the consequence level, the results of the hazard analysis in this work shows that for some hazard factors, the hazard level is greater than the consequence level while for others, the consequence level is greater than the hazard level. Figure 1 shows this occurrence.

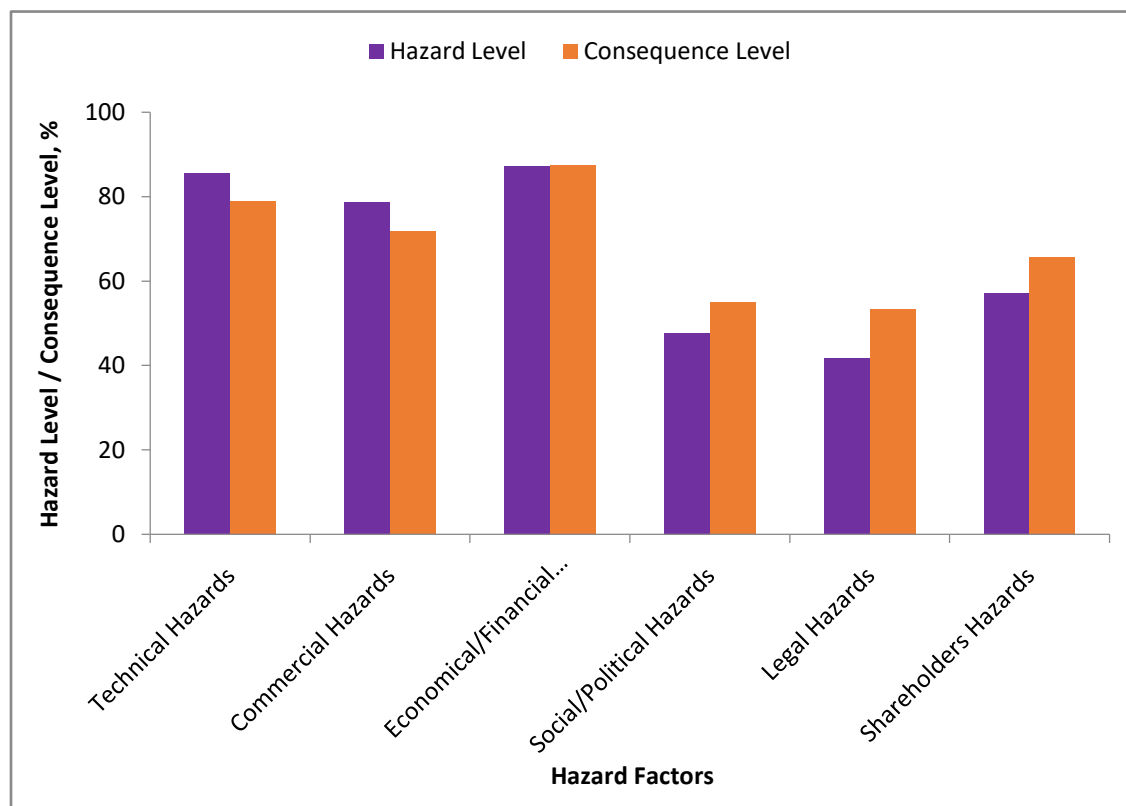


Figure 1: Average percentage hazard level and consequence level of the various hazard factors

CONCLUSIONS

The study identifies the need for control and hazard assessment in engineering projects which indicate that the problem of hazard assessment in construction/engineering project execution has its root in the attitude of the personnel/professional running the engineering projects. The investigation identified that economic/financial hazards (87.25%), technical hazards (85.50%)

and commercial hazards (78.75%) were recorded as hazards of high level. The aim of every project advancers is the realization of the project within the planed estimated schedule of the project in terms of quality, cost and time. To achieve these objectives it will require the adoption of adequate control module and hazard assessment at the time of execution of the project linked with greater discipline on the part of the project execution practitioners to stay within his estimates from inception of the project to completion. However, hazard assessment in any engineering projects is a difficult and complex process, which varies from one organization to another. It should be viewed as an ongoing process, which needs continual planning, monitoring and modification as the needs arises.

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