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PRECISION OF IMPACT IDENTIFICATION IN ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REPORTS AND THE IMPLICATIONS

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ABSTRACT

One of the main objectives of Environmental Impact Assessment (EIA) is to identify the probable impacts of the proposed development on the environment. In theory, the impacts must be precisely identified in order for EIA to serve its purpose. This paper presents the nature of impact identification in the EIA reports based on an analysis done on a sample of 50 EIA reports. The implications of the present-state-of-the-art impact identification in EIA reports on the effectiveness of EIA as a tool for environmental project management are also discussed.

Key words: Environmental Impact Assessment; Monitoring and Audit; Content Analysis

INTRODUCTION

The aim of this paper is to discuss the precision of impact identification in Environmental Impact Assessment (EIA) reports and the implications. To achieve this aim, this paper has the following objectives:

a) To review the Malaysian EIA system with special emphasis on the legislative, administrative and the procedural aspects;
b) To discuss the principles and characteristics of impact identification based on theory and the requirements of the Malaysia EIA procedures and guidelines;
c) To review the related earlier research carried out by other researchers;
d) To describe the data collection methodology;
e) To present results and findings of the research;
f) To provide general discussion and conclusion

The discussion on the precision of impact identification is based on an analysis on a sample of 50 Preliminary EIA reports approved by the Department of Environment (DOE). The implication of the quality of impact prediction on the effectiveness of EIA as a tool for environmental management, particularly for environmental management of development project is discussed based on literature review and interviews with the DOE State Office officers.

THE MALAYSIAN EIA SYSTEM

The intention of the Malaysian government to introduce EIA was first formally announced in the Third Malaysia document (GOM, 1974). The main purpose of introducing EIA was to balance between development and environmental conservation. In 1985, the Environmental Quality Act 1974 was amended. Through the amendment, Section 34A was introduced which made EIA mandatory for certain projects. However, the projects that require EIA were only specified later through subsidiary legislation, that is the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987 (referred to hereafter as EIA Order 1987) which was made effective on 1st April 1988. The broad categories of activities that require an EIA are listed in Table 1, and the details on size, quantum and criteria of these projects that determine the EIA requirement can be found in the EIA Order 1987.

Table 1: Categories of Activities Requiring EIA

1. Agriculture	11. Mining
2. Airport	12. Petroleum
3. Drainage and Irrigation	13.Power Generation and Transmission
4. Land Reclamation	14. Quarries
5. Fisheries	15. Railways
6. Forestry	16. Transportation
7. Housing	17. Resort and Recreation
8. Industry	18. Waste and Treatment Disposal
9. Infrastructure	19. Water Supply
10.Ports	

The DOE, which is part of the Ministry of Science, Technology and the Environment, is responsible for overseeing EIA implementation. The DOE has established a State Office in all states in Malaysia. Besides the Evaluation Section under the Prevention Division in the headquarters, the State Office oversees the EIA system (DOE, 1995).

The EIA process is outlined in the Handbook of Environmental Impact Assessment, which has been revised and updated (see, for example, DOE, 1988, 1990). These are general guidelines applicable to all types of development proposals. Besides these guidelines, the DOE has also produced EIA guidelines for specific projects including those projects listed under the EIA Order 1987. There are two types of EIA, namely Preliminary EIA and Detailed EIA. The project proponents can choose to prepare a Preliminary EIA or a Detailed EIA. To assist the project proponent, the EIA guidelines identified the situation whereby a Detailed EIA has to be prepared. The DOE has also prepared a list of projects that require a Detailed EIA without preparing a Preliminary EIA before hand. The Preliminary EIA report has to be submitted to the State DOE Office for review and approval except for projects in the Exclusive Economic Zone (EEZ) and for interstate projects. The Detailed EIA report and Preliminary EIA report for projects in the EEZ and for the interstate projects are submitted to the DOE headquarters to be reviewed. The Preliminary reports are processed in-house, that is by the State DOE officers with consultation with other agencies. The Detailed EIA reports are reviewed by the panel of experts that are established at the DOE headquarters. The panel of experts makes recommendations and the decision to approve the report is made by the Director General of the Environment (DOE, 1988, 1990).

CHARACTERISTICS OF IMPACT IDENTIFICATION – THEORY AND PRINCIPLES

The preparation of an EIA consists of four main tasks, namely, impact identification and prediction, impact evaluation, identification of mitigation measures and identification of monitoring measures. These tasks have been outlined by many authors, including those published much earlier (see, for example, Bisset, 1984b, 1987; Biswas and Geping, 1987; Clark *et al.*, 1980; Lohani and Halim, 1987; Munn, 1979). Collection of data on the existing situation is also very important in order to provide information for impact identification (see, for example, Carpenter and Maragos, 1989; Wathern, 1988). In addition, most authors include impact communication or report preparation as part of the tasks. Therefore, the stages in EIA study are: baseline description; impact identification and prediction; impact evaluation; identification of mitigation measures; identification of monitoring measures.; report writing. Besides these, other authors (see, for example, Canter, 1996; Erickson, 1979; Morris and Therivel, 1995; Petts and Eduljee, 1994a; Rau and Wooten, 1980; Westmen, 1988) discussed EIA tasks with reference to a specific component of the environment such as air quality, water quality, social, economy, ecology and many others. This literature is equally important to understand the EIA and the characteristics of impact identification.

It is clear that the EIA process consists of a series of step and this paper focuses only on impact identification. Table 2 lists the characteristics of impact identification that are applicable to all environmental components. These characteristics are compiled from a variety of sources (Atkins, 1984;

Bisset, 1984; Burris and Canter, 1997; Canter and Canty, 1992; Canter and Kamoth, 1995; Carpenter and Maragos, 1989; Clark *et al.*, 1985; Contan and Wiggins, 1991; Culhane, 1985; Dammon and Cressman, 1995; DoE, 1995; Duinker, 1985; Erickson, 1979; Julien, 1985; Kennett and Perl, 1995; Munn, 1979; Nelson, 1984; Smith and Spaling, 1995; Sontag, 1985; Tomlinson and Atkinson, 1987; Treweek, 1995; Wathern, 1984).

Table 2: Characteristics that Should be Specified in Impact Identification

Environmental variable impacted	Geographic extent of impact
Positive or negative impact	Rate of change of impact
Magnitude of impact	Degree of irreversibility of impact
Unit of measurement to quantify impact	Uncertainty and confidence of prediction
Significance of impact	Probability of impact occurrence
Time-frame of impact	Cumulative impact
Separate assessments for different timescale of impact	Impact presented in terms of easily testable hypothesis
Intensity of impact	Straight forward presentation of impact
Population or resource impacted	Assumption should be explicit
Direct and indirect impact	

Impact identification employs certain techniques and these techniques have a significant bearing on the quality of impact identification. Petts and Eduljee (1994a) and Lee (1987) listed four main techniques of impact identification, namely, laboratory or experimental method, inventory or survey method, mathematical or physical models and prediction by analogy with other similar projects or situations, use of experts opinion or field sketches. For the purpose of this paper, the characteristics of impact identification included in the discussion are types of impacts, time of impact occurrence, sources of impact, location of impact, and method of impact identification.

OVERVIEW OF PAST RESEARCH

Past research on the nature of impact identification covers three main issues, namely the accuracy, auditability and precision of the prediction. Research on the accuracy of impact prediction involves matching the impacts identified in the EIA reports and the impacts that actually occurred during project implementation. The aim of the research is to investigate the accuracy of the impact identified. Research on the auditability of impact looks into the nature of the impacts identified in the sense whether the impacts can be audited. Such research might involve investigating the actual impacts that occur during project implementation. Study on the precision involves only evaluating the impact predicted in the EIA reports as those carried out for the study on the auditability but never involves matching the identified impacts with impacts that actually occur during project implementation. In reality, most research covers more than one issue (see, for example, Buckley, 1989, 1991a; Culhane, 1985, 1987; Leistritz and Chase, 1982; Murdock *et al.*, 1982).

With regard to the precision of impact identification, a study on auditing of 15 artificial waterway developments in Western Australia reported by Bailey *et al.* (1992) showed that most impact prediction (91%) did not indicate the time scale of the predicted impact while 88% were expressed in qualitative terms. Nearly two thirds (62%) were based upon general knowledge of the subject or local experience or upon literature review. Very few predictions were based upon models, but those that were, tended to be the more important issues. Read (1994) reported on an audit of the fauna component of the Olympic Dam project. The audit exercise aimed at determining how effective the EIA report was at predicting the diversity and status of the local fauna based on ten years monitoring and research subsequent to the preparation of EIA report. The research also found that impact predictions in the EIA reports are sometimes imprecise.

A study on an evaluation of the match between impacts forecast in a representative set of 29 EIA reports and the impacts that actually occur following project implementation showed similar results (see, Culhane, 1987). The impact forecasts were often vague, lacked quantification, were vague about impact significance and likelihood of occurrence and, occasionally ambiguous about the direction of impacts. Imprecise impact prediction was also reported by Friesma and Culhane (1976). The Centre of Environmental Management and Planning, University of Aberdeen, United Kingdom conducted a study on impact prediction in EIA for three major projects in the United Kingdom and reported that the impacts predicted are not satisfactory. The impacts prediction techniques are not appropriate, the impacts are imprecisely described, the assumptions made are not realistic while the time frame of impacts occurrence are not specified (see, Bisset, 1984; Clark *et al.*, 1985).

METHODS

The data presented in this paper were obtained based on an analysis on a sample of 50 EIA reports. The report selection was made based on the following criteria. First, EIA reports selected were from five types of development proposals, namely, mixed development, industrial estate, resort and recreation, industry and quarry. Limiting the reports only to five categories of projects reduce report variability. Secondly, only Preliminary EIA reports were chosen. Detailed EIA reports are not included to reduce report variability. Thirdly, only reports that have been approved by the DOE are chosen in order to reflect the required Malaysian standard. Finally, for the same category of project, reports prepared by the same consultants, as far as possible, were avoided.

The analysis was done using a specially developed report review package based on the work of Russell (1994). Other researchers have used the same approach but with a different emphasis (see, for example, Glasson and Heaney, 1993; Leahey, 1996; Radcliffe and Edwards-Jones, 1995; Sims, 1993; Sucliffee, 1995;Treweek *et al.*, 1993). Several sets of predetermined criteria were developed and these criteria represent the quality of the impact prediction. The criteria were developed based on the review of EIA literature that reflect international best practice and the requirements of the Malaysian EIA procedures. The review package was developed based on the content analysis methodology which allows systematic, objective and quantitative analysis on the characteristics of the impact identification (see, Holsti, 1969; Kerlinger, 1973; May, 1997). This research also involved interviews with the DOE State Office officers using unstructured questionnaires.

RESULTS

The types of impacts identified are divided into direct, indirect, short-term, medium-term, temporary, permanent, positive and negative impacts (see, for example, Atkins, 1984; Chereminoff and Moressi, 1977; Glasson *et al.*, 1994; Therivel and Morris, 1995). Table 3 shows the results of the analysis. The total number of impacts identified (632) is higher than the number of impact descriptions (473) because for a single impact description, more than one type of impacts can be identified. The table shows that negative impacts are most recorded (82.7%). The occurrence of other types of impacts is much less frequent than negative impacts with the next most frequent indirect impacts (17.6%), positive impacts (16.1%) and short-term impacts (10.6%). In general, the percentage of negative impacts for all environmental components is high. The percentage reporting of positive impacts are low (below 20.0%) except for socio-economy which is exceptionally high (90.0%) followed by landuse (60.0%). The highest percentage of identification of indirect impacts is for solid waste (42.2%).

Impacts occurrence are identified according to project stages. Based on Munn (1979) and Burdge and Vanclay (1995), eight stages of project development were identified, namely, site investigation, site preparation, construction, operation, secondary activities, decommissioning, abandonment, and reconstruction (see Table 4). The table shows that a higher percentage of the impacts description identified impacts during construction (63.0%) and operation (59.2) compared to other stages of project development. Geology and soil, water quality, air quality, hydrology and drainage, socio-economy and ecology are among the highest. The impacts on water quality, air quality, noise and socio-economy are still high during project operation.

Table 5 shows identification of sources and location of impacts. Quite a high percentage of impact descriptions identified the sources of impacts. For all (100%) of the impact identification of groundwater, coastal features physical marine environment, flyrock and hazardous waste, the sources of impacts were identified. The percentages for other environmental components are also high except for utility and amenity, that is below 70%. One reason for the high identification of impact sources is the requirements for the impacts to be presented in a matrix, which relates the project activities and the impacts identified. The sources of impacts are largely identified in terms of project activities which are normally divided according to project stages such as site clearing and project construction. Such identification is not sufficiently clear, as it does not indicate the activities that cause the impacts. For example, all reports for industrial estate and mixed development that include industrial activities failed to provide clear identification of the sources of air pollution. However, for proposals of specific industries like a petrochemical plant, the sources of air pollution are normally more specific. It can be seen that, for some developments, detailed specifications of the proposals have not yet been finalised and, thus, identification of the exact sources of impact is very difficult.

For only 17.3% impact descriptions were the location of impact identified (Table 5). None of the impact descriptions for seven environmental components identified the impacts' location. For the remaining environmental components locations were identified, but the percentages were generally low and the locations are also poorly identified. Only a general location such as "nearby," "surrounding," "adjacent," "immediate area," "at the project site," "external roads," and "nearby stream." Calculated distances and maps or plans are the most specific presentations of impact location and largely used for impacts on noise, air quality; vibration, flyrock and ecology are more limited.

The methods of impact identification included in Table 6 have been described in the literature (see, for example, Canter, 1985; Glasson *et al*,. 1994; Lee, 1987; Petts and Eduljee, 1994a). Table 6 shows that the impacts were characterized suing descriptions (81.4%). The overall percentage for quantitative methods is 33.2%. For other methods the percentages are very much lower. The use of qualitative methods is the highest for all environmental components. Geology and soil and air quality make the most use of models. Expert description which is less used refers to impacts which are identified based on experts' view, either through consultation or from literature. Comparison was made based on studies and experience locally and also overseas.

DISCUSSIONS

In general, impacts in the EIA reports are not precisely identified particularly with respect to the nature of description, impact occurrence, impact location and sources of impact. This affects the overall quality of the reports. Based on interviews carried out with the EIA officers at the DOE State Offices, poor quality of the reports contribute to the delay in report review process. This is because unsatisfactory reports take a longer time to review.

The most common type of impact identified is negative impact followed by positive impact, but of much lower occurrence. Identification of other types of impacts: direct; indirect; short-term; medium term; long-term; temporary; and permanent; is very low. Effective mitigation measures can be identified and instituted if detailed information on the nature of the impacts is known. Impact and compliance monitoring carried out during project construction and operation also requires detailed information on the nature of the predicted impacts.

Identification of impacts occurrence is low and the impacts occurrence is mostly identified during project construction and operation. The neglect of impacts during project decomissioning and abandonment especially for industrial projects, quarries, industrial estate and mixed development reflects the lack of concern on the after-operation stage of the projects. Identification of impacts occurrence based on project stages is inadequate. For example, as project operation normally covers a longer time period, indicating project operation as the time-frame of impact occurrence is not sufficiently clear. Impact time-frame should be stated more explicitly, such as in terms of years of project operation. Imprecise identification of impact occurrence will lead to poor impact monitoring during project operation. It also limits impact audit (Bisset, 1984; Petts and Eduljee, 1994b).

Sources of impacts must be identified to ensure effective post-monitoring in order to control and manage impacts, as well as to assess the effectiveness of mitigation measures. Although only 10% of the impact descriptions do not identify sources of impacts, the percentage is comparatively high for utility and amenity and for ecology. The analysis also revealed that for some environmental components, the sources of impacts are poorly identified. Overall identification of location of impacts is low and for those that the locations are identified, only a general identification of the location is provided. This does not encourage post-monitoring and audit during project implementation.

The widespread use of descriptive impact identification methods does not provide the opportunity for impact audit. Descriptive impacts are difficult to verify and, thus, impact verification audit cannot be carried out. Hence, there is no opportunity for learning from past experience and, consequently, the quality of impact predictions cannot be improved.

CONCLUSION

The research presented in this paper provides information on the precision of impact identification in the EIA reports. The implications of the quality of impact predictions on the EIA practice are discussed based on theoretical understanding of the author and the actual experience of the DOE officers gathered by the author through interviews. With regard to the analysis on the precision of impact prediction, the finding is limited to the indicators chosen. Some indicators are not included due to various technical and managerial constraints. The technique used in the analysis allowed the researcher to look into the presence or absence of particular features of the impact description. During the analysis, the analyst did not attempt to use his opinion or judgement. Therefore, the analysis was done to a certain level of detail. The analysis did not consider the terms of reference of the EIA study. Therefore, research with different approaches and using other techniques of content analysis should be carried out. Nevertheless, this paper reveals some important characteristics of impact identification in EIA reports and indicates the consequences of the present-state-of-the-art impact identification.

Table 3: Types of Impact

Environmental Component	Direct Impact		Indirect Impact		Short-term Impact		Medium-term Impact		Long-term Impact		Temporary Impact	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Landform/Landscape	0	0	0	0	2	15.4	0	0	0	0	1	7.7
Geology/Soil	0	0	15	33.3	6	13.3	0	0	0	0	3	6.7
Hydrology/Drainage	0	0	3	10.7	2	7.1	0	0	0	0	1	3.6
Meteorology	0	0	2	28.6	1	14.3	0	0	0	0	0	0
Noise	0	0	7	14.9	7	14.9	0	0	2	4.3	6	12.8
Water Quality	0	0	11	23.9	7	15.2	0	0	0	0	2	4.3
Air Quality	0	0	6	12.5	7	14.6	0	0	1	2.1	3	6.3
Groundwater	0	0	0	0	0	0	0	0	0	0	0	0
Coastal Features	0	0	0	0	0	0	0	0	0	0	0	0
Physical Marine Env.	0	0	0	0	0	0	0	0	0	0	0	0
Ecology	0	0	2	5.1	3	7.7	0	0	0	0	5	12.8
Landuse	0	0	3	20.0	0	0	0	0	0	0	0	0
Socioeconomy	1	2.5	6	15.0	7	17.5	0	0	1	2.5	2	5.0
Utility/Amenity	0	0	2	8.7	2	8.7	0	0	0	0	1	4.3
Transportation	1	3.0	7	21.2	2	6.1	0	0	0	0	1	3.0
Health/Safety	0	0	0	0	1	4.2	0	0	0	0	0	0
Flyrock	0	0	1	11.1	0	0	0	0	0	0	0	0
Vibration	0	0	4	30.8	1	7.7	0	0	0	0	0	0
Solid Waste	0	0	14	42.4	2	6.1	0	0	0	0	0	0
Hazardous Waste	0	0	1	16.7	0	0	0	0	0	0	0	0
Total Type of Impact	2	0.4	84	17.6	50	10.6	0	0	4	0.8	25	5.3

Table 3: Types of Impact (Continuation)

Environmental Component	Permanent Impact		Positive Impact		Negative Impact		No. of Impact Description
	No.	%	No.	%	No.	%	No.
Landform/Landscape	1	7.7	3	23.1	10	76.9	13
Geology/Soil	1	2.2	4	8.9	41	91.1	45
Hydrology/Drainage	0	0	4	14.3	23	82.1	28
Meteorology	1	14.3	1	14.3	7	100	7
Noise	0	0	2	4.3	43	91.5	47
Water Quality	0	0	6	13.0	42	91.3	46
Air Quality	0	0	5	10.4	44	91.7	48
Groundwater	0	0	0	0	1	100	1
Coastal Features	0	0	0	0	2	100	2
Physical Marine Env.	0	0	0	0	0	0	1
Ecology	0	0	3	7.7	32	82.1	39
Landuse	0	0	9	60.0	9	60.0	15
Socioeconomy	0	0	36	90.0	26	65.0	40
Utility/Amenity	0	0	0	0	13	56.5	23
Transportation	0	0	2	6.1	23	69.7	33
Health/Safety	0	0	0	0	22	91.7	24
Flyrock	0	0	0	0	9	100	9
Vibration	0	0	0	0	11	84.6	13
Solid Waste	1	3.0	1	3.0	28	84.8	33
Hazardous Waste	0	0	0	0	5	83.3	6
Total Impact Description	-	-	-	-	-	-	473
Total Type of Impact	4	0.8	76	16.1	391	82.7	

Table 4: Impact Occurrence

Environmental Component	Site Investigation		Site Preparation		Construction		Operation		Secondary Activities	
	No.	%	No.	%	No.	%	No.	%	No.	%
Landform/Landscape	0	0	0	0	6	46.2	6	46.2	0	0
Geology/Soil	5	11.1	1	2.2	37	82.2	10	22.2	0	0
Hydrology/Drainage	2	7.1	0	0	20	71.4	14	50.0	0	0
Meteorology	1	14.3	0	0	3	42.9	6	85.7	0	0
Noise	6	12.8	1	2.1	30	63.8	35	74.5	0	0
Water Quality	6	13.0	1	2.2	33	71.1	39	84.8	3	6.5
Air Quality	3	6.3	1	2.1	33	68.8	35	72.9	1	2.1
Groundwater	0	0	0	0	0	0	0	0	0	0
Coastal Features	0	0	0	0	0	0	2	100	0	0
Physical Marine Env.	0	0	0	0	1	100	0	0	0	0
Ecology	10	25.6	1	2.6	26	66.7	16	41.0	2	5.1
Landuse	3	20.0	0	0	5	33.3	9	60.0	0	0
Socioeconomy	6	15.0	0	0	27	67.5	28	70.0	2	5.0
Utility/Amenity	3	13.0	0	0	13	56.5	16	69.6	2	8.7
Transportation	1	3.0	0	0	21	63.6	20	60.6	0	0
Health/Safety	0	0	0	0	17	70.8	7	29.2	0	0
Flyrock	0	0	0	0	1	11.1	3	33.3	0	0
Vibration	0	0	0	0	4	30.8	7	53.8	0	0
Solid Waste	0	0	0	0	21	63.6	22	66.7	0	0
Hazardous Waste	0	0	0	0	0	0	5	83.3	0	0
Total Impact Description	-	-	-	-	-	-	-	-	-	-
Total Identification of Impact Occurrence	46	9.7	5	1.0	298	63.0	280	59.2	10	2.1

Table 4: Impact Occurrence (Continuation)

Environmental Component	Decomissioning		Abandontment		Reconstruction		No. of Impact Description
	No.	%	No.	%	No.	%	No.
Landform/Landscape	0	0	2	15.4	0	0	13
Geology/Soil	0	0	3	6.7	0	0	45
Hydrology/Drainage	0	0	1	3.6	0	0	28
Meteorology	0	0	1	14.3	0	0	7
Noise	2	4.3	1	2.1	1	2.1	47
Water Quality	4	8.7	2	4.3	0	0	46
Air Quality	2	4.2	1	2.1	0	0	48
Groundwater	0	0	0	0	0	0	1
Coastal Features	0	0	0	0	0	0	2
Physical Marine Env.	0	0	0	0	0	0	1
Ecology	0	0	0	0	1	2.7	39
Landuse	0	0	0	0	0	0	15
Socioeconomy	3	7.5	4	10.0	0	0	40
Utility/Amenity	0	0	0	0	1	4.3	23
Transportation	7	21.2	1	3.0	0	0	33
Health/Safety	0	0	0	0	0	0	24
Flyrock	0	0	0	0	0	0	9
Vibration	0	0	0	0	0	0	13
Solid Waste	0	0	1	3.6	0	0	33
Hazardous Waste	0	0	0	0	0	0	6
Total Impact Description	-	-	-	-	-	-	473
Total Identification of Impact Occurrence	18	3.8	17	3.6	3	0.6	677

Table 5: Sources and Locations of Impacts

Environmental Component	Source Of Impact		Location of Impact		Total Impact Description
	No.	%	No.	%	No.
Landform/Landscape	12	92.3	0	0	13
Geology/Soil	44	97.8	9	20.0	45
Hydrology/Drainage	26	92.9	5	17.9	28
Meteorology	6	85.7	2	28.6	7
Noise	46	97.9	13	27.7	47
Water Quality	43	93.5	15	32.6	46
Air Quality	44	91.7	12	25.0	48
Groundwater	1	100	0	0	1
Coastal Features	2	100	0	0	2
Physical Marine Env.	1	100	0	0	1
Ecology	33	84.6	2	5.1	39
Landuse	13	86.7	0	0	15
Socioeconomy	38	95.0	3	7.5	40
Utility/Amenity	15	65.2	0	0	23
Transportation	29	87.9	7	21.2	33
Health/Safety	22	91.7	2	8.3	24
Flyrock	9	100	5	55.6	9
Vibration	12	92.3	5	38.5	13
Solid Waste	27	81.8	2	6.1	33
Hazardous Waste	6	100	0	0	6
Total	429	90.7	82	17.3	473

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