Environmental management and monitoring for education building development

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Abstract. The purpose of research were (1) a conceptual, functional model designed and implementation for environmental management and monitoring for education building development, (2) standard operational procedure made for management and monitoring for education building development, (3) assessed physic-chemical, biological, social-economic environmental components so that fulfilling sustainable development, (4) environmental management and monitoring program made for decreasing negative and increasing positive impact in education building development activities. Descriptive method is used for the research. Cibiru UPI Campus, Bandung, West Java, Indonesia was study location. The research was conducted on July 2016 to January 2017. Spatial and activities analysis were used to assess physic-chemical, biological, social-economic environmental components. Environmental management and monitoring for education building development could be decreasing water, air, soil pollution and environmental degradation in education building development activities.

1. Introduction
Irizarry, Zolfagharian, Nourbakhsh, Zin Jusoff, and Zakaria published about a sustainable-construction planning system development. Construction process and environmental impact and environmental risk assessment were topics which discussed. Construction process through survey, investigation, design, land acquisition, construction, operational and maintenance (SIDLaCOM). Risk level of environmental impacts is using Likert Scale. The level of frequency and severity has scale, severity, description and frequency field. Scale 1 is insignificant severity, minimal impact description, and never frequency. Scale 2 is minor severity, short-term impact description, and unlikely frequency. Scale 3 is moderate severity, significant impact description, and possible frequency. Scale 4 is major severity, major short-term impact description, and likely frequency. Scale 5 is catastrophic severity, major long-term impact description, and always frequency [1].

Christini, Fetsko, and Hendrikson published about environmental management systems and ISO 14001 certification for construction firms. Characteristic of environmental management system, ISO 14001 environmental management system standard, ISO 14001 environmental management system in construction, and elements of ISO 14001 environmental management system for construction firm were presented. Environmental policy, planning, implementation and operation, checking and corrective action, and management review were included by the ISO 14001 elements of an environmental management system. They commented about develop complete company environmental policy, plan must conform to company’s environmental policy, implementation and
operation of environmental management system must be well documented, company must monitor and measure effectiveness through checking and correction, and environmental management system review by top management is imperative [2].

Selvakumar and Jeykumar published environmental impact assessment (EIA) for building construction projects. EIA-terminologies, rapid EIA, comprehensive EIA, EIA scenario, need of EIA for building construction projects, environmental clearance for building construction projects, scoping, public consultation process, validity of environmental clearance, and environmental appraisal were discussed. Important components of quality of life for building construction projects are summarized as environmental, physical, built, social and economic components [3].

Dutta and Sengupta presented review paper about environmental impact assessment (EIA) and construction. The term of EIA, EIA beneficiaries, types of EIA, the complete process, applicability of EIA to small and medium projects, and environmental impacts of construction. The EIA process have the eight step that are screening, scoping, impact analysis, mitigation, reporting, review of EIA, decision making, and post monitoring [4].

Ijigah, Jimoh, Aruleba and Ade published EIA of building construction projects. EIA could be considered as the appraisal of the probable impact that a proposed project may have on the natural environment. A task which needs to be accomplished for the realization of an effective environment is indicated by building construction project possible impact identification on the environment. The risk to human and ecological health are indicators for the environmental impact. The dangers and changes to the quality of life are included the risks which are determined by physical, chemical, biological, and psycho-social factors. Land use and ecological impact, space condition and lighting impact, material impact and resource use, and visual impact are environmental impact classification [5].

Tiwari, Verma, Kumar and Gupta published about construction projects environmental impact assessment a review. Types of EIA, objectives of EIA for construction projects, need for environmental clearance, basic principles of EIA, environmental impacts, parameters to determine the significance of the identified impacts, participants in EIA process, and environmental impacts of construction project were presented. Technology assessment, strategic impact assessment, social impact assessment, risk assessment, health impact assessment, environmental management system, environmental auditing, economic, ecological impact assessment, developmental impact assessment, demographic impact assessment, climate impact assessment are several types EIA. EIA objectives for housing projects are predicting environmental impacts, considering costs and benefits projects to environment, reducing adverse impact, ensuring the environmental consideration into the development and process, avoiding adverse ecological components, protecting natural system capacity and productivity, and promoting sustainable colonies and optimizing resource management in the future [6].

An EIA process values are integrity, utility, sustainability, purposive, rigorous, practical, relevant, cost effective, efficient, focused, participative, inter-disciplinary, credible, integrated, transparent, and systematic. EIA categories actions are grouped to beneficial or harmful; reversible or irreversible; repairable or irreparable; short-term or long-term; temporary or continuous; construction or operational phase; local, regional, national or global; accidental or planned; direct (primary) or indirect (secondary), and cumulative or single. Identified impacts the significance affecting factors are limit of threshold, EIA effectiveness, and measures of mitigation, size of study area, relative contribution, species rarity, local effects significance, change magnitude, induced actions creation, and existing disturbance degree. Parties who are involved that are the project proponent, the competent authority, the impact assessment agency, and the public. Phases make up the EIA process that are screening, scoping, baseline data collection, impact prediction, alternatives assessment, public hearing, environmental management plan, decision making, and monitoring the clearance conditions [6].

Makhelouf published building construction impact assessment. High-rise tower effect on temperature, high-rise buildings response to wind speed and direction high-rise buildings effect on precipitation, and high rises effect on the pollution distribution were discussed [7].
Pratibha, Sonal and Archna published about EIA-decision making tool for project approval. EIA concept, origin, principles, process, benefits, and drawback were presented. Human and social, economic, natural aspects are included into EIA. Risk assessment, environmental management system, health impact assessment, developmental impact assessment, project assessment, climate impact assessment, social impact assessment, technology assessment, ecological impact assessment, demographic impact assessment, economic and fiscal impact assessment, environmental auditing, environmental impact assessment, public consultation, public participation, strategic assessment well recognize processes. The EIA steps are screening, scoping, public involvement, impact analysis, mitigation, report, EIA review, decision-making, and post monitoring. Specific legal requirements, mitigation cost, public views and complains, geographical extent of the impact, reversibility of impact, duration, likelihood or occurrence probability are determined as criterion for EIA [8].

Husin, Rahman and Memon published issues and challenges of the way forward in sustainable construction. The topics that discussed were issues in construction industry, towards sustainable construction, green buildings, tools and techniques to achieve sustainable and green construction. Time overrun, cost overrun, construction waste, excessive resource consumption, and threat to environment were presented in issues in construction industry. Sustainable construction involved economic, environmental and social sustainability. Sustainable construction principles are environmental, economic, and social aspects. Green buildings have benefits which could reduce 25% to 50% energy use, 33% to 39% CO2 emissions, 40% water use and 70% solid waste. Green building standards developed in various country accordance with their environment [9].

Wayakone, Makoto and Harashina published about a comparative study on the gaps between procedures and practice with reference. EIA potential purposes are improving information for decision makers, governmental democratization, and discursive modes promotion, a forum provision for bargaining, legitimating development, protecting the environment and promoting sustainable development [10].

2. Methods
The method used is descriptive and correlative for activities and spatial analysis. The descriptive method was applied to the analysis of activities which using approach of matrix. Phases of activities analysis are identifying user needs for building construction; studying environmental impact assessment references and regulations; inventorying study location and building construction design, making and validating instrument for gaining primary data; collecting data which linked with building construction design, that are physic and chemical data (climate, air quality and noise, physiography and geology, earth quake, waste water quality, transportation), social-economic data (demography, man power, education, gross regional domestic product), biology data (terrestrial flora and fauna); data analysis (fresh water demand, reservoir capacity, fresh water supply, run off, infiltration wells design, septic tank design, traffic generation rate, traffic attraction rate) and making TOR (term of reference) report; field surveying, observation and ground check; environmental impact assessment which caused by building, data structuring and discussing; determining conclusion and recommendation; making progress report of environmental management and monitoring for building construction design; presenting progress report; feedback and revision; Submitting final report.

The correlative method was implemented to the spatial analysis using digital mapping and geographic information system. Spatial analysis steps are user need identification; data collection and classification based on types and hierarchys data; conceptual model made referred to international and national map standard; base map determination; functional model design referred to conceptual model; analog data conversion; data base management system; input, process and output implementation; maps, tables, and charts production.
3. Results and Discussion

Figure 1. Satellite image map of cibiru upi campus 2017 (google earth, 2017).

Figure 1 satellite image map of Cibiru UPI Campus presented location where would be built new building construction for education and learning process. The location of development of Universitas Pendidikan Indonesia (UPI) Cibiru Campus is at Jalan Raya Cibiru KM 15, Cibiru Wetan Village Cileunyi District Bandung Regency. The area of land that will be used as a development site is the land owned by the initiator. Geographically the area is at the coordinates of south 6049’ - 701’ and east 107014’- 1070 56’.

Project site boundaries are north by the border with Cibiru Highway access Pandan Wangi through Cibiru Indah Housing; south bordering with Cibiru Indah Housing and Mekar Wangi Estate; the western side is bordered by Cibiru Hilir road; the east is bordered by housing the Blue Gem.

Development of Universitas Pendidikan Indonesia (UPI) Cibiru Campus includes the construction of new building six (6) floor area + 7,928.00 m². Facilities and infrastructures of UPI Campus Cibiru stand on an area of 60,027 m².

Table 1. Matrix field structure of Environmental management plan

| Impact source | Impact type | Impact indicator | Objective of environmental management plan | Environmental management effort |
|---------------|-------------|------------------|--------------------------------------------|--------------------------------|
| A. Construction phase (a new building development) | B. Operational phase (a new building development) | | | |

Table 1 matrix field structure of environmental management plan consists of two phases, that are construction phase and operational phase for a new building development. Impact sources in construction consist of three sources, that are manpower mobilization, instrument and material mobilization, and heavy instruments and vehicles operation. Impact types consist of three types, that are work and business increased, air quality decreased, and noise increased. Impact indicator consist of 3 types. First is a population, regional minimum wage, business opportunities for the community and business opportunities for the local entrepreneurs. Second is dust concentration not bigger than ambient air quality standard. Third is noise intensity not bigger than noise quality standard for school. Environmental management effort consist of four types. First is focus group discussion, industrial relations, utilization of local workforce, coordination, socialization of business opportunities,
socialization of standards, empowering local entrepreneurs, coordination with cooperatives and small and medium enterprises. Second is mounting barrier, heavy instrument schedule regulation, use of personal protective equipment, installation of job announcements, and maintain shade plants. Third is installation of a barrier, heavy instrument schedule regulation, use of personal protective equipment, installation of job announcements.

Table 2. Advanced of matrix field structure of Environmental management plan

| A. Construction phase (a new building development) | B. Operational phase (a new building development) |
| Location | Period | Environmental management institution |
| Executor | Supervisor | Reporter |

Table 2 advanced of matrix field structure of Environmental management plan consists of two phases, that are construction phase and operational phase for a new building development project. Location of environmental management effort consist of three locations, that are community, campus boundary, and project location. Period of environmental management effort consist of three types, that are in early and final the construction project, routine and continuously during the construction project, and routine and continuously during the construction project. Executor is UPI Kampus Cibiru, supervisors are village heads, sub-district heads, social offices, and environmental institutions.

Table 3. Building data of Cibiru UPI Campus

| No | Field | Information |
|----|-------|-------------|
| 1  | Utilization | Offices and lectures |
| 2  | Number of floors | 6 floors |
| 3  | Wide per floor | 1.320 square meters |
| 4  | Building area | 7.920 square meters |
| 5  | Net building area | 7.128 square meters |
| 6  | Offices area | 2.851.20 square meters |
| 7  | Lectures area | 4.276.80 square meters |
| 8  | Density of offices building | 8 square meters / person |
| 9  | Density of lectures building | 0.7 square meters / person |
| 10 | Building users number plan | 6.466.11 persons |

Table 3 building data of Cibiru UPI Campus consists of ten fields, that are utilization, number of floors, wide per floor, building area, net building area, offices area, lectures area, density of offices building, density of lectures building, and building users number plan. Building data were used for analyzing fresh water demand, reservoir capacity, run off, infiltration wells design, septic tank design, traffic generation rate and attraction rate.

Table 4. Fresh water demand of Cibiru UPI Campus

| No | Calculation | Result |
|----|-------------|--------|
| 1  | Ratio of offices fresh water demand | 20 liters/person/day |
| 2  | Ratio of students fresh water demand | 10 liters/person/day |
| 3  | Number of water demand | 96,991.71 liters/day |
| 4  | Number of water demand per hour | 4,041.32 liters/hour |
| 5  | Densest used time | 2 hours |
| 6  | Densest fresh water demand | 12,123.96 liters |
| 7  | Emergency and static fresh water demand (30 %) | 29,097.51 liters/day |
| 8  | Total fresh water demand | 126,089.23 liters/day |
Table 4 fresh water demand of Cibiru UPI Campus consists of eight calculations, that are ratio of offices fresh water demand, ratio of students fresh water demand, number of water demand, number of water demand per hour, densest used time, densest fresh water demand, emergency and static fresh water demand, and total fresh water demand.

Table 5. Reservoir capacity of Cibiru UPI Campus

| No | Calculation           | Result                |
|----|-----------------------|-----------------------|
| 1  | Water supply          | 126.09 cubic meters   |
| 2  | Peak used             | 12.12 cubic meters    |
| 3  | Emergency             | 29.10 cubic meters    |
| 4  | Reservoir capacity    | 37.47 cubic meters    |

Table 5 reservoir capacity of Cibiru UPI Campus consists of four calculations, that are water supply, peak used, emergency and reservoir capacity.

Table 6. Fresh water supply of Cibiru UPI Campus

| No | Calculation                                | Result                |
|----|-------------------------------------------|-----------------------|
| 1  | Pump capacity                             | 50 liters/second      |
| 2  | Time interval of reservoir stock          | 824.43 seconds        |
|    |                                           | 13.74 minutes         |

Table 6 fresh water supply of Cibiru UPI Campus consists of 2 calculations, that are pump capacity and time interval of reservoir stock.

Table 7. Run off analysis of Cibiru UPI Campus

| No | Calculation                                | Result                |
|----|-------------------------------------------|-----------------------|
| 1  | Existing Land                             | 2,000 square meters   |
| 2  | Land area                                 | 0.5                   |
| 3  | Coefficient of water flow                 | 0.01667 mm/day        |
| 4  | Rain intensity                            | 16.67 cubic meters/day|
|    | Residential Land                          | 1.320 square meters   |
|    | Land area                                 | 0.90                  |
| 3  | Coefficient of water flow                 | 0.01667 mm/day        |
| 4  | Water discharge                           | 19.80 cubic meters/day|
|    | Volume of Waste Water                     | 14.04 cubic meters/day|
| 1  | Waste water discharge                      | 33.84 cubic meters/day|
|    | Total Water Discharge                      | 4.50 cubic meters     |
| 4  | Infiltration Wells Design                 | 1.00 meter            |
| 5  | Length                                    | 1.50 meters           |
| 6  | Width                                     | 3.00 meters           |
| 7  | Height                                    | 4.50 cubic meters     |
| 8  | Infiltration wells capacity               | 4 units               |
| 7  | Number of wells                           | 0.6                   |
| 8  | Infiltration coefficient                  | 30.00 cubic meters/day|
| 8  | Save discharge                            | 3.84 cubic meters/day |
| 8  | Flowing discharge                         | 3.84 cubic meters/day |
Table 7 run off analysis of Cibiru UPI Campus consists 5 fields and 18 calculations. Fields are existing land, residential land, volume of waste water, total water discharge and infiltration wells design. Existing land and residential land consist calculation of land area, coefficient of water flow, rain intensity and water discharge. Volume of waste water is calculating waste water discharge. Total water discharge is calculating total water discharge. Infiltration wells design consists calculation of length, width, height, infiltration wells capacity, number of wells, infiltration coefficient, save discharge and flowing discharge.

Table 8. Septic tank design of Cibiru UPI Campus

| No  | Calculation                        | Result                      |
|-----|------------------------------------|-----------------------------|
|     | Total water demand design          | 126,089.23 liters/day       |
| 1   | Waste water volume                 | 100,871.38 liters/day       |
| 2   | Waste water coefficient            | 80 %                        |
| 3   | Waste water volume                 | 100,871.38 liters/day       |
| 4   | Sludge production                  | 30.00 liters/person/year    |
| 5   | Draining time                      | 5 years                     |
| 6   | Sludge volume                      | 193,983.43 liters/year      |
| 7   | Sludge volume for 5 years          | 242,48 cubic meters         |
| 8   | Septic tank volume                 | 48 cubic meters             |
| 9   | Number of septic tank              | 5 units                     |

Table 8 septic tank design of Cibiru UPI Campus consists 3 fields and 12 calculations. Fields are total water demand design, septic tank volume and septic tank dimension. Waste water volume consists calculation of waste water coefficient and waste water volume. Septic tank volume consists calculation of waste water volume, sludge production, draining time and sludge volume. Septic tank dimension consists calculation of length, width, height, septic tank capacity and number of septic tank.

Table 9. Trip generation analysis of Cibiru UPI Campus

| No  | Calculation                          | Result                      |
|-----|--------------------------------------|-----------------------------|
| 1   | Building data                        |                             |
| 2   | Number of building                   | 1 unit                      |
| 3   | Number of employees and students     | 1,621 persons               |
| 4   | Traffic generation rate              | 634.09 vehicles/hour        |
| 5   | Traffic attraction rate              | 353.04 vehicles/hour        |
|     | Total of generation and attraction rate | 634 vehicles/hour     |
| 6   | Traffic generation rate              | 353 vehicles/hour           |
| 7   | Traffic attraction rate              | 987 vehicles/hour           |

Table 9 trip generation analysis consists 2 fields and 7 calculations. Fields are building data and total of generation and attraction rate. Building data consists calculation of number of building, number of employees and students, traffic generation rate and traffic attraction rate. Total of
generation and attraction rate consists calculation of traffic generation rate, traffic attraction rate and total of generation and attraction rate.

4. Conclusion
The conclusions of this research are Cibiru UPI Campus had already been good conceptual, functional model and environmental management and monitoring effort implementation for building construction, the standard operational procedure of environmental management and monitoring effort had already formed by consultant team who sponsored by UPI director of planning and development, physical-chemical, biological, social-economic environmental components assessment could fulfilling sustainable development principles, and environmental management and monitoring effort had been already designed for decreasing negative and increasing positive impact in education building development.

5. References
[1] Irizarry J, Zolfagharian S, Nourbakhsh M, Zin R M, Jusoff K and Zakaria R 2012 The development of a sustainable-construction planning system. Journal of Information Technology in Construction (ITcon) 17 10 162-178
[2] Christini G, Fetsko M and Hendrickson C 2004 Environmental management systems and ISO 14001 certification for construction firms Journal of Construction Engineering and Management 130 3 330-336
[3] Selvakumar S and Jeykumar R K C 2015 Environmental impact assessment for building construction Projects. Advanced Science and Technology Letters 89 15-19
[4] Dutta A B and Sengupta I 2014 Environmental impact assessment (EIA) and construction International Research Journal of Environmental Sciences 3 1 58-61
[5] Ijigah E A, Jimoh R A, Aruleba B O and Ade A B 2013 An assessment of environmental impacts of building construction projects Civil and Environmental Research 3 1 93-105
[6] Tiwari V K, Verma A, Kumar A and Gupta M 2016 A review on Environmental Impact Assessment of Construction Projects IOSR Journal of Environmental Science, Toxicology and Food Technology 10 1 21-25
[7] Makhelouf A 2012 Impact assessment on the construction of tall buildings in a big town on the urban climate and their pollution E3 Journal of Environmental Research and Management 3 4 064-074
[8] Pratibha A, Sonal N and Archna A 2015 Environmental Impact Assessment (EIA)-Decision Making Tool for Project Approval in India, Social Issues and Environmental Problems 3 1-4
[9] Hussin J M, Rahman I A and Memon A H 2013 The way forward in sustainable construction: issues and challenges International Journal of Advances in Applied Sciences 2 1 15-24
[10] Wayakone S, Makoto I and Harashina S 2013 Environmental impact assessment in Lao PDR: A comparative study on the gaps between procedures and practice with reference to Japan. International Journal of Environmental Sciences 3 6 2080

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