The Study of CIA System Based on the Regulatory Detailed Planning

The Necessity of Establishing CIA System Based on the Regulatory Detailed Planning

1. Introduction

The concept of cumulative impact originated form U.S.A. The Council on Environmental Quality (CEQ) regulations defines "cumulative impact" In 1978 as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions.... Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." (Grothaus, J., 2007) .

In the past 30 years in China, the urban development and urban sprawl have put tremendous pressure not only on the ecological system and natural environment, but also on the artificial environment such as transportation, infrastructure, and public facilities, etc. The cumulative impact accumulated over time and space by many different projects can pose very serious threat to the environment, and must be evaluated and controlled in an effective way.

The Environmental Impact Assessment (EIA) system currently implemented in China has played a major role in alleviating the environmental pollution, but still with the deficiency of controlling the cumulative environmental impact caused by the development projects. As the major planning tool in the Chinese land use control, the Regulatory Detailed Planning (RDP) has an inherent advantage in the development review process to manage the cumulative impact. However, RDP lacks explicit control intention and effective control measures on the proposed projects at present, which can result in the rapid degradation of the natural and artificial environment with the accelerating speed of urbanization.

2. Problem Analysis

2.1 The Main Problems of the Existing EIA System

The EIA system currently implemented in China rarely considers the cumulative impact, and needs to be improved. First, the EIA system emphasizes the direct, but neglects the indirect and cumulative environmental impacts, while the latter also poses a tremendous threat to the environment. Second, the existing EIA system emphasizes the impact on natural environment but neglects the impact on artificial environment, whose quality is vital to support the operation of the proposed project and the functioning of the entire city. Third, the current EIA system emphasizes the impact of large scale projects, but neglects the impact of small scale projects which account for a great proportion of development projects. Even though they may be insignificant by themselves, combined impacts over time, from more than one source, can result in the degradation of the environment.

2.2 The Main Problems of the Existing RDP

The development activities are mainly controlled by the RDP through the indicator system. It

can be grouped with eight categories, among which two are related to the environmental protection. One is the “Environment Capacity Control”, which is designed to control the development intensity, and the other is the “Environment Protection Requirements”, whose main purpose is to control the heavy-pollution industries. None of the indicators in the two categories looks from the perspective of controlling the cumulative impacts. Furthermore, the existing indicators are too rough and fragmental to effectively control the cumulative impacts even though they indeed help in practice.

All the analysis shows that it is necessary and urgent to establish an integrated CIA system based on the RDP to alleviate the environmental impacts.

Establishing the CIA System Based on the Regulatory Detailed Planning

To build the CIA review system in the regulatory process of RDP, two components should be established. The first is the assessment system. It includes review components and legal framework. The system provides consistent regulations from the perspective of RDP, on the specific criteria and legal requirements of the assessment. The second is the implementation system. It includes technical measures and procedural design. This system suggests the control methods and available mitigation measures to alleviate the cumulative impacts, and coordinate the responsibility and power between the environmental protection and planning department in the review process of RDP.

1. Review Components

1.1 The Component analysis of Impactor and Impactee

The CIA system consists of two fundamental players. One is the *impactor*, which is external to the original environment and makes impact on the environment. The other is the *impactee*, which is the entity receiving the impacts created by the impactor. The purpose of CIA system is to alleviate the environmental cumulative impacts by the control of impactor.

1) Impactor

In the process of vacant land being changed to urban uses, the impactor makes cumulative impacts on the proposed development site. From the perspective of RDP, the impactor can be divided into two types -- project and behavior.

Project

Project includes building engineering and site engineering. As a leading element, the building engineering includes building foundation, building structure, and the accessory equipments. The site engineering includes road, parking lot, green space, and municipal infrastructure. As external artificial elements, building and site engineering will impact on the soil, geology, topography, vegetation and wildlife of the site as well as the peripheral areas.

Behavior

Behavior mainly refers to the user activities on site and within building after the proposed project is complete. Behavior includes traffic activity, user behavior, and waste disposal, etc. Behavior will impact on the site environment and its vicinity once the building is put into use.

The combined impacts of multiple sources should be mainly considered in CIA. Most of the single proposed project, except some heavy-pollution industries, will not result in obvious damage to the environment. While the compounding effects of many development projects, such as the traffic activities within a particular area and during a period of time, would affect the environment significantly.

2) Impactee

The *Technical Guidelines for Environmental Impact Assessment-General Principles* amended in 1994 in China classified the environmental elements into air, surface water, groundwater, noise, soil and ecology, human health condition, etc. According to this, and combined with the existing environmental indicators in RDP, the impactee can be divided into the natural environment, the artificial environment, and the social environment in the future CIA system.

The Natural Environment

The elements of the natural environment include soil, geology, air, water, vegetation and wildlife, and circulation system, etc.

The Artificial Environment

The elements of the artificial environment include municipal infrastructure, transportation facility, and public facility, etc.

The Social Environment

The elements of the social environment include the community characteristics, community network, and human psychology, etc.

1.2 The Relationship Analysis between the Impactor and the Impactee

Project and behavior are different in nature, and therefore create impact on different targets. Project as static entity mainly acts on the natural environment. For example, the building impacts on the geology and topography, and the pavement impacts on the vegetation and groundwater. The impacts will persist, even beyond the life cycle of the project.

The behavior mainly impacts on the artificial and the social environment. The impacts imposed on artificial environment, for example, water supply and drainage puts pressure on sewage; vehicular traffic puts pressure on transportation facilities, will vanish as soon as the behavior disappears. However, the impacts imposed on social environment will persist for a long time even after the behavior disappears. For example, new residents of a neighborhood could alter the community network and disrupt its cultural continuity (See Table 1).

Table 1 The Relationship between the Impactor and the Impactee

		Impactee		
		Natural Environment	Artificial Environment	Social Environment
Impactor	Project	×	○	—

Behavior	○	×	○

Note: × means serious; ○ means moderate; — means slight or none.

2. Legal Framework

2.1 The Assessment Components and Emphasis

The assessment components of CIA should cover both impactor and impactee. Meanwhile, Impactor and impactee should be treated separately in determining the assessment emphasis. For the impactor, it is essential to combine the function of development project with the environmental targets. For example, a transportation project mainly impacts on the natural environment, such as topography and water, and the relevant mortality from road kills affects the artificial environment, such as the human psychology. A housing and commercial project impacts on the artificial environment, such as transportation facilities, and alteration of community structure, etc. For the impactee, the concerned aspects of environmental control may be different. To be specific, the natural environment often corresponds with quality control; the artificial environment corresponds with capacity control, and the social environment likely corresponds with the community network and cultural continuity. Therefore, it is necessary to define, from the legal perspective, the specific components of assessment for impactor and impactee.

2.2 The Assessment Range

The cumulative impacts are different from the traditional environmental impacts. They may be insignificant by themselves, but cumulative impacts accumulating over time, from one or more sources, can still result in the degradation of target resources. Therefore, it is essential to define appropriate geographic boundaries and time period in the assessment.

The definition of assessment range may vary according to different characteristics of impactee. To the natural environment, the geographic boundaries may be large and the time period may be long; to the artificial environment, the geographic boundaries may be small and the time period may be short; to social environment, the geographic boundaries may not be large, but the impacts may persist for a long time. The assessment range may be defined quantitatively or qualitatively.

In the CIA statement, the environmental goals and objectives of natural, artificial, and social environment should be depicted respectively, and the available measures to achieve the goal should be suggested quantitatively or qualitatively. It may help the urban planning review department to control the cumulative impacts effectively (See Table 2).

Table 2 The Components and Emphasis of CIA Based on the RDP

Environment	Environmental Goal	Regional Boundary	Time Period	Measures
Natural	Protect quality	Large	Long	Available measures consistent with goals (Discussed in 3.2)
Artificial	Control capacity	Small	Short	

Social	Preserve Characteristics	Small	Long

2.3 The Legislative Institute

In 1993, *the State Environmental Protection Administration (SEPA)* of China adopted the *Technical Guidelines for Environmental Impact Assessment -- General Principles*, in which the principle, methods, components, and requirements of the EIA for proposed development projects are regulated. Hereby, the making of technical guidelines of CIA should be directed by the SEPA, who will regulate the environment goals, assessment criteria, assessment ranges, and the available mitigation measures. In order to make the guidelines' criteria agree with the goals of land use control, the urban planning department should assist the SEPA in the legislative process.

In the development review of various projects, the main difference lies in the form and criteria of the assessment. For project with large scale, long-lasting and widespread effects, or with environmental sensitive location, a CIA statement report is necessary, and the review criteria list is comprehensive. For other kinds of project, such as small project with minimal impacts that are of short-duration, the review criteria list is simple, and a CIA statement sheet is adequate to specific the control emphasis and suggest the available mitigation measures. The CIA statement is the basis for the management and control of cumulative impacts. Only through the statement, can we clarify where and how to control the impact, and find scientific and specific ways to deal with the problem.

3. Technical Measure

The cumulative impacts caused by project and behavior can be controlled in RDP by the following four technical measures. The first is the indicator system, which mainly controls the proposed project. The second is the mitigation and compensation measures, which mainly regulate the behavior. The third is the technical specifications, which are the scientific basis in the design and review process. The fourth is the incentive policy, which acts as a complimentary component.

3.1 Indicator System

In the *Technical Guidelines for Environmental Impact Assessment in Urban Planning* adopted in 2003, it was emphasized that the planning activities of RDP had created significant impact on the environment. Meanwhile, the environmental goals and assessment criteria have been authorized aiming at the comprehensive planning, the RDP, and the infrastructure planning from seven aspects, including water, air, noise, solid waste, natural resources and ecological protection, shoreline management, the potential ability of ecological protection and sustainable development. The assessment criteria mentioned above are compiled from the perspective of total amount controlled at the regional or city level, and can't be used to control each proposed project directly. Nonetheless, these criteria could provide reference for the establishment of CIA indicators based on RDP.

Among the seven aspects mentioned above, the "water", "natural resources and ecological protection", and "the potential ability of ecological protection and sustainable development"

are relevant to the majority of development projects in the process of site planning. The related cumulative impacts are comparatively strong and extensive. The control of site planning is easily to be carried out but rather weak now in the development review process of RDP. So, it seems practical and feasible to establish an indicator system, and regulate the site planning from the aspects of topography, soil and vegetation, greening, and water balance, in order to control the cumulative impacts in RDP.

1) Topography

Landforms are the product of the local balance between weathering, erosion and deposition. The existing natural landform has been stable for years and should be protected as much as possible. But developers tend to provide large and level base for building construction by deep cuts and fills, hence the ecological balance on site is destroyed. Such things often happen in the process of vacant land being changed to urban uses, especially in mountainous cities. It is essential to regulate such developments to minimize adverse environmental impacts.

A good grading must consider many factors and solve many problems. The existing RDP mainly controls the minimum slope of 2%, to ensure surface drainage, and the maximum slope of 8% to facilitate safe driving. Based on this, two more indicators should be considered. The first is the area prohibiting construction, which defines where is permitted or not permitted to change the topography. For example, some areas, with a slope gradient of more than 35 degrees, or with environmental fragile or critical resources, should be prohibited for construction activities. This indicator should be regulated in the RDP, and be embodied in RDP plans. The second indicator defines how much is permitted to change the topography. Grading should be designed to minimize the use of terraces, banks, and similar structures. The natural grades should be maintained especially near trees and plants as much as possible. Additional cuts or fills are prohibited if the landform has already been shaped to meet the minimal driving requirements or surface drainage requirements.

2) Soil

As a fundamental site amenity, soil strongly influences not only the location and form of human settlement, but also the vegetation and wildlife which should be viewed as an interdependent association. While as a medium for the support of plant life, the soil, especially the surface soil is frequently changed from the original state to the sealed urban ground in the process of site planning.

According to different site features, two main indicators should be controlled in order to maintain the balance between soil and vegetation in the process of RDP. One is the earthwork, by using the indicator “earthwork balance rate”, which is the earthwork import and export for the site / the total cut-fill volumn on the site (%). The ideal cut and fill volume should be in equal measure, and it also prevents the introduction of foreign soils into the site area. The other is sealing area, by using the indicator “sealing area rate”, which is the sealing area / the site area (%). The sealing area should be minimized and the soil area should be maximized.

3) Vegetation and Wildlife

All plants on the site are a delicate balance, occupying three levels in the habitat: trees, shrubs, and ground cover, and displaying three types of forms: ground greening, vertical greening, and roof greening. They play a major role in keeping the delicate balance between the soil, water, and wildlife, and act as buffer for noise and air pollution. The ground cover is already emphasized and controlled by the existing RDP, through the indicator of "open space percentage", which is the total area of open space / the site area (%). Unfortunately, the trees and shrubs, which are better in keeping ecological balance but usually higher in cost than ground cover, are commonly ignored in the development review and neglected by developers. Therefore, it is essential to add the indicator "tree cover percentage", which is the area of tree canopy / the green space (%). The tree canopy area can be calculated assuming all the trees are grown into an average size.

The vertical greening, especially roof greening, may not be realized and accepted widely in a short period of time, due to the limitation of the existing building technology and management in China (e.g., the roof waterproof technique). The relevant indicators can be regulated based on the technical and institutional progress of local government in the near future.

4) Water Balance

Water includes surface water and groundwater. Water is an important base element on the site, and is crucial in the support of all life. By the process of infiltration, collection, and reuse, surface water turns into the groundwater. The process can alleviate the burden of storm-water engineering, and is beneficial to the flood control and drainage. Yet, human development has depleted this resource by building impervious structures that do not allow water to percolate into the soil, while the control relevant to rainwater is nearly blank in the existing RDP. Therefore, two measures are urgent to be adopted, which are improving infiltration ability of the ground and strengthening the stormwater collection and reuse.

Improving infiltration ability of the ground

Improving infiltration ability of the ground is crucial in keeping the ecological balance in urban areas where large amount of hard surface is necessary. There are two ways to improve the infiltration ability–greening and paving with permeable materials on hard ground. The permeable materials are practical and feasible choice for pavement, and can be applied to pave the pedestrian way, bikeway, parking lot, patio surface, alley, and public square.

Two indicators may be adopted in the RDP review, which are "permeability rate" and "runoff rate". The "permeability rate" is the permeable ground area / the site area (%). The permeable ground area may have two parts. First is the green space area on the ground. The green space is the area actually covered with trees and vegetation. It's permeability rate is 1, and therefore all green space counts as permeable ground area. Second is the area covered with permeable materials. The permeable ground area is calculated by applying a discount rate of permeability. e.g., if the permeability rate of the materials is 0.4, then the permeable ground area is the area with permeable materials multiply 0.4 (You, 2006). The "runoff rate" is the water runoff volume (the precipitation after evaporation and infiltration) / the total

precipitation(%). The adverse effects on environment are weaker when the “permeability rate” increases, or the “runoff rate” decreases.

Strengthening the Stormwater Collection and Reuse

Stormwater collection on the site includes collecting stormwater from rooftop and ground. Stormwater can be retained and piped into the reclaimed water utilization system for toilet flushing, cleaning, and car washing, etc, or as part of a site amenity in the forms of stream, fountain, and waterfall.

The indicator “stormwater reuse rate” may be adopted in the RDP review. The “stormwater reuse rate” is the volume of stormwater reuse / the total volume of water consumption on the site (%).

The indicators in the control of water balance depicted above can be incorporated into the category of “the environmental protection requirements” already existed in the current RDP.

3.2 Mitigation and Compensation Measures

Mitigation measures can alleviate the harmful cumulated impacts, while compensation measures react if the former measures fail. The mitigation and compensation measures could play two roles. First is to respond to the indicator system. Appropriate measures are suggested to meet the optimal indicator range. Second is to complement the indicator system. Appropriate measures can be used to control those impacts that are not applicable or feasible to be controlled by indicators.

For each indicator, mitigation measures could be provided by the RDP review department for developers to choose. Two examples on the water balance are illustrated here. If the indicator “permeability rate” is a review criteria, then the corresponding measures could be pavement with permeable bricks, or fine mix stone, or digging percolation well or water seepage ditch. (You, 2006). If the indicator “stormwater reuse rate” is a review criteria, then the corresponding measures could be adding stormwater retention pond, or incorporate it into site design features, such as stream, fountain, and waterfall. In reality, such measures are sometimes volunteered by the developer or the designer in practice. However, these voluntary activities are still rare and spontaneous, and should be mandated through future regulation.

It is noticeable that one mitigation measure may result in decreasing several adverse cumulative impacts. For example, if a large employer unit, that hires a certain number of people, provides commuter bus to its employees, not only the condition of traffic congestion, but also the problem of parking facilities with impermeable surface, and the air pollution of automobile emissions would be improved.

The compensation measures could be implemented to either restore the original form, or provide supplanting forms. For example, if a woodland is destroyed inevitably by the proposed project, the developer can either compensate with the original form, that is planting another

piece of woodland, or trade in with a different form, for example, creating a wetland (Bruns , 2007).

3.3 Technical Specifications

It is necessary to establish technical specifications supporting the *Indicator System* (3.1) and the *Mitigation and Compensation Measures* (3.2). Taking the indicator "permeability rate" for example, its corresponding mitigation measures may be pavement with permeable bricks or fine mix stone. Following different methods and materials of pavement, a set of technical specifications should be formulated, with quantitative standards (like different permeability rate for brick and fine mix stone) set up. The technical specifications can make the construction management more scientific and standardized, and also establish the regulatory basis in the project review process of RDP.

The technical specifications should be combined with the existing specifications in China, such as specifications of utilizing recycled stormwater, and building ecological neighborhood[i]. New specifications should be adopted and expanded to meet the goals of CIA. It is a long-term and sophisticated process. All relevant organizations must be involved in, especially the environmental protection and urban planning departments. The local government should take the leading and coordinating role (See Figure 1).

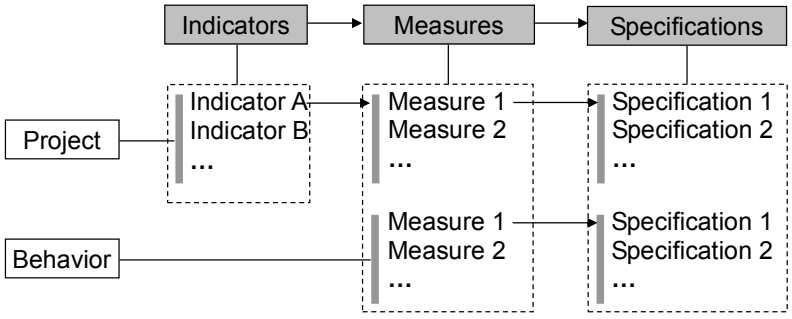

Figure1 The Relationship between Indicators, Measures, and Specifications

3.4 Incentive Policy

The Chinese central government has paid great attention to the environmental protection issues in recent years, and adopted many environmental related policies[ii]. They formed an optimistic background in the conducting of CIA. Although there are no existing regulations aiming directly toward cumulative impacts, many policies that encourage energy saving, emission reduction, and pollution control, have played positive roles in alleviating the cumulative impacts. In the future, more incentive policies should be adopted to encourage developers realizing and reducing the negative cumulative impacts.

Incentive policies have been a common tool utilized in the existing RDP in guiding the developers, and to achieve the goals of land use control. For example, when a developer contributes something beneficial to the city, such as providing an open space on site, he/she may have a FAR reward. In the RDP review of cumulative impacts, similar incentive policies could also be used if the project meets certain environmental criteria in alleviating the

cumulative impact. However, the incentive threshold must be regulated and balanced reasonably, so that the policies can not only stimulate the developer's interest, but also prevent them from taking advantage of the policy to obtain extra benefits.

Based on *Indicator System* (3.1), *Mitigation and Compensation Measures* (3.2), *Technical Specifications* (3.3)*, and Incentive Policy* (3.4)*,* a general guideline book should be developed in time, offering the most comprehensive and useful information on practical methods for addressing cumulative effects. It should enumerate all possible environmental impacts, and suggest the appropriate mitigation measures. The purpose of the guideline book is to assist the local government in providing accurate, realistic, and consistent comments to control cumulative impacts in the RDP review process.

4. Procedural Design

The existing environmental control of development projects in China has two main problems in procedural design. First, the environmental assessment and permit issuance are two stages controlled tightly by existing planning regulations[iii]. However, the implementation stage has not been covered by any clear legal requirements and procedures, which would impair the future effectiveness of CIA statement. Second, there is a lack of coordination between the environmental protection department and the planning department. The environmental protection department divides the project review process into five steps (See Figure 2), which is not sync with the six steps followed by the planning department (See Figure 3). The mismatch weaken the role of planning department in the environmental control effort.

The procedural design of CIA system based on the RDP should integrate the existing procedure of EIA system and solve the above problems. The following two factors should be considered. One is strengthening the implementation stage to ensure the realization of mitigation measures. Two is coordinating the power and responsibility between the environmental protection and planning department in the project review process.

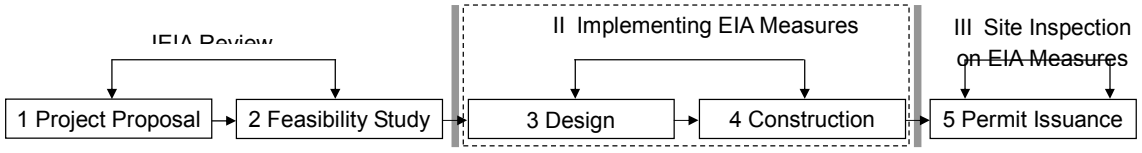

Figure 2 The Existing Five Steps of Project Review Process Established by the Environmental Protection Department and the Corresponding Stages of EIA Control

4.1 Strengthening the Implementation Stage

In the six steps of the project review process established by the planning department, CIA can be launched starting from step 2 – feasibility study (See Figure 3). Since the CIA statement outlines the important criteria to control the cumulative impacts, the control indicators and the available mitigation measures should be required in step 2, based on the CIA statement and the guideline book. The implementation stage includes step 3, 4 and 5, and embodied clearly in the site planning and architectural design program. To be specific, in step 3 – land-use approval, mitigation measures related to site planning should be specified in the planning

proposal; in step 4 – building approval, mitigation measures related to building design should be specified in the architectural plans and drawings. The implementation of mitigation measures in the construction phase will be controlled in step 5 –site inspection (See Figure 3).

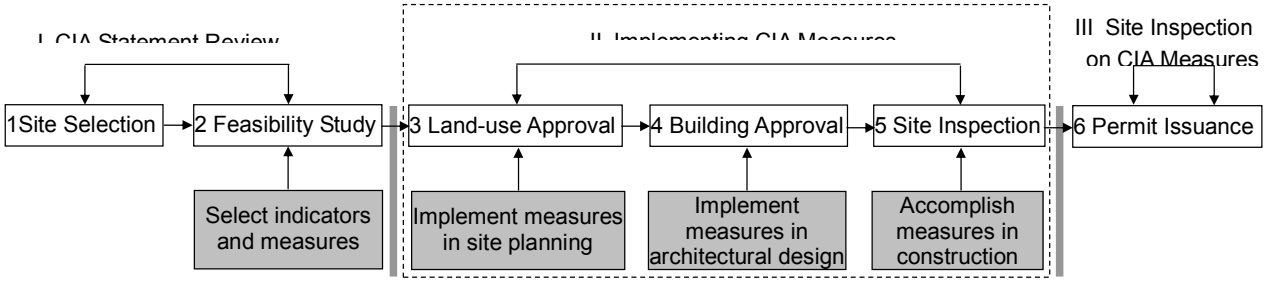

Figure 3. The Existing Six Steps of Project Review Process Established by the Planning Department and the Corresponding Proposed Steps of Cumulative Impact Control

4.2 Coordinating Departmental Power and Responsibility

The existing EIA statement only concerns about direct and serious environmental impacts, and their corresponding mitigation measures. These measures are often installing environmental protection equipments to alleviate the pollutants. Therefore, the existing agency responsible for environmental review, implementation, and permitting is the environmental protection department, and the urban planning department is not involved in the EIA review. However, the environmental objectives and control methods of CIA based on RDP are greatly different from the traditional EIA, and the mitigation measures are mainly embedded in the planning and design program. Hence, the environmental protection department may not have the resource and expertise to guarantee the measures. It is essential to determine which agency should take the responsibility of CIA based on RDP. (See Figure 4).

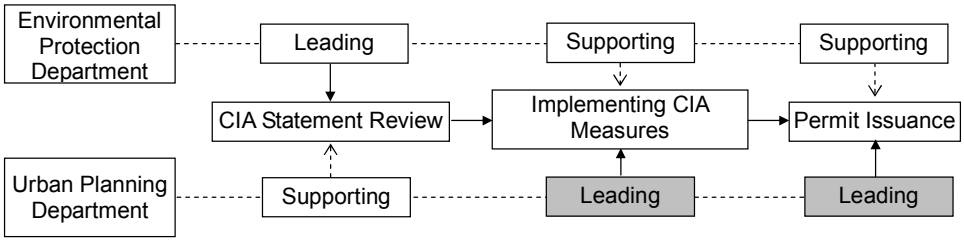

Figure 4 Coordinating the Power and Responsibility between Different Departments

Conclusion

From the aspects of the legal framework, review components, technical measures, and procedural design, this paper explores the possibility and necessity of conducting CIA in the regulatory process of RDP, and attempts to establish a threshold of the CIA review system. Additionally, the authors suggest that CIA should focus on both natural environment and artificial environment, in order to prevent cumulative impact effectively and promote sustainable urban development.

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[i] For example, *Engineering Technical Code of Rainwater Utilization in Building and Sub-District* (GB50400-2006) and *Outlines and Technical Principles for Green Ecological Residential Quarter Construction* (on trial) (2003).

[ii] See: Department of Policies and Regulations of State Environmental Protection Administration (2005) *Collection of Chinese Environmental Policy Instruments*, Beijing: China Environmental Sciences Press.

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