VIII. Operations and Maintenance

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Why is provision for operations and maintenance often inadequate? Why have donors failed to make provision for the recurrent cost implications of aid-financed projects?
Can the flow of resources for operations and maintenance be increased? What are the constraints? How can these be overcome?
What factors have to be considered in formulating an operations and maintenance strategy?

Operations and maintenance (O&M) expenditures are recurrent outlays necessary to sustain a project or program at the intended level. **Operations** usually refer to the procedures and activities involved in the actual delivery of services to the public, while **maintenance** refers to the wide range of activities aimed at keeping the infrastructure in a serviceable condition. Operations expenditures are generally recurrent in nature while maintenance expenditures can be both recurrent (as in the case of routine and periodic maintenance) and capital (as in the case of rehabilitation). For some public services like roads, drainage and sewage systems, etc., the physical condition of the capital infrastructure effectively determines the quality of service. These services tend, therefore, to be relatively maintenance-intensive. The provision of other services, such as health and education, requires the use of labor and other intermediate inputs, and hence the role of the associated capital infrastructure is more variable in its significance. These services are naturally relatively operations-intensive. Others, such as irrigation facilities, require the intensive application of both operations and maintenance.

Over the last decade, problems have emerged in the provision of O&M, with governments tending to concentrate their efforts on new investments and failing to provide adequately for the recurrent costs of operating and maintaining previous projects. Sectors in which there have been the largest shortfalls in O&M expenditure are, typically, road networks, public and government buildings, agricultural equipment, and communications equipment. Failure to provide adequate O&M has economic consequences for the level of public output, for the capital endowment of the economy, and the implied rate of return associated with public investments. In the past, the O&M problem in developing countries had been viewed as a problem of planning and budgeting, that is, a failure to ensure that the O&M implications of a new investment are considered when a project or program is evaluated. In recent years, the problem has also become one of providing for adequate expenditure on the O&M of existing programs and infrastructure, and to redress the effects of past failures to provide O&M.

Causes of the Problem

A number of factors contribute to inadequate provision for O&M expenditure. A shortage of funds for existing O&M and for newly completed projects may arise from overall budgetary pressures owing to limited resources, and/or excessive levels of expenditure on other programs. Also, O&M expenditures often have a low priority in government budgets as they are politically less appealing and visible than new investment projects. In addition, since poor maintenance and inadequate operations have delayed consequences or less

equivalent to 2.6 percent of GDP; this compares with actual O&M outlays in 1986/87 of Rp 900 billion, or 1.1 percent of GDP.

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obvious effects, expenditure on these items tends to get postponed. Moreover, external donors have facilitated the efforts of countries to mount ambitious investment projects while providing little support for recurrent costs, thus creating the basis for subsequent O&M problems. Inadequate understanding of the costly downstream consequences of neglecting maintenance, lack of local expertise, and unclearly delegated responsibilities and accountability also contribute to the problem of inadequate O&M expenditure and inefficient use of O&M funds.

Overall budgetary constraints

Inadequate expenditure on O&M may arise both from insufficient overall revenues and from inadequate revenue generation by the project itself. Budgetary inflexibilities with respect to the reallocation of funds to offset deficiencies in specific sectors would compound this problem. An O&M problem may also arise from excessive expenditures on non-O&M items such as the military, interest payments, and subsidy and transfer payments, which are often subject to significant political and social pressures and may therefore be difficult to control. Another factor that may give rise to inadequate expenditures, particularly on maintenance, is lack of foreign exchange. Balance of payments difficulties may impose limits on the availability of imported inputs for projects, thereby skewing the mix of O&M inputs towards labor and nontradable goods. A dramatic and permanent change in the economic environment that a country faces may require a re-ordering of budgetary priorities which may or may not be feasible. Finally, ongoing pressures to invest may also adversely affect outlays on O&M. In many cases, however, the importance given to curtailing current expenditure in favor of investment expenditure reflects a failure to recognize that the rate of return to some types of O&M expenditures may be considerably higher than that on new investment.

Misallocation of resources

Problems of inadequate O&M expenditure in certain sectors can arise from deficiencies in the process by which projects are evaluated, expenditure programs are budgeted, and overall budget decisions are made. These deficiencies arise from insufficient consideration of the future stream of O&M requirements, the traditional dichotomy between the capital and the current budget, undue political intervention, and the lack of a well-articulated overall development strategy.

The role of donors

For many years, donors did not apply pressures on governments to ensure the adequacy of recurrent funding for aid-financed projects. In recent years, however, donors have been more willing to examine this issue and to provide O&M financing, particularly when formulated as a project to rehabilitate deteriorated infrastructure. Another problem that arises from external funding of investment projects is that aid agreements often require that equipment be obtained from the donor country—so-called tied aid. Such procurement conditions have disadvantaged O&M in three ways: spare part availability is limited; the lack of standardization in the capital stock raises the unit cost of purchasing spare parts; and the lack of standardization also requires a higher level of technical manpower. In addition, the deterioration of imported equipment, due to inadequate O&M, may give rise to the need to import new equipment in the future, thus further straining an already fragile foreign exchange budget.

Immediate needs

With the exception of building maintenance, these estimates embody the assumption that such outlays could in fact be spent without a significant increase in the average cost of O&M. The estimates in respect of building maintenance come from official sources. The estimate for roads relates to what would be necessary to maintain the current condition of roads. The estimated deficiency in operational outlays in the curative health sector relates to existing norms for salary and nonsalary outlays for particular institutions. Estimates for preventive health primarily relate to the deficiency from the levels spent in the preceding year. For higher education, estimates reflect the amount of funds that would have been necessary to restore real outlays per student to the levels of 1980/81. These estimates suggest that an additional Rp 1.2 trillion could have been productively spent on O&M in 1986/87, or approximately 1.5 percent of GDP and about 5 percent of government expenditure.

Table 2. Indonesia: O&M Needs, 1986/87
(In billions of rupiah)

Immediate needs	1,187
Roads	432
Irrigation	6
Nondefense buildings	410
Health	301
Higher education	38
Rehabilitation	5,782
Roads	3,400
Irrigation	2,382
O&M needs for rehabilitated infrastructure	976
Roads	880
Irrigation	96

Source: World Bank.

Rehabilitation

Much of the existing infrastructure in irrigation and roads would require special maintenance, upgrading or rehabilitation to raise it to a level adequate for productive O&M. Approximately Rp 5.8 trillion would have been required to achieve such rehabilitation, an amount equal to approximately 7 percent of GDP in 1986/87.

O&M needs for rehabilitated infrastructure

If the road and irrigation networks were to be rehabilitated, a further Rp 1.0 trillion of O&M outlays would have been required, over and above the Rp 1.2 trillion indicated above. The total additional requirement is

Institutional deficiencies

The technical and management capacity to implement O&M is often lacking, leading to O&M outlays that do not result in any effective change in output. In addition, the lack of data on the extent and the condition of existing assets may preclude the formulation of a sectoral O&M strategy. Weaknesses in the monitoring, supervision, and auditing functions are such that failures in O&M implementation never surface and are not acted upon. Examples of such weaknesses are noncompliance with procurement procedures, poor inventory control, and misappropriation of funds. Routine maintenance suffers the most from this deficiency, since it requires the greatest degree of monitoring and supervision because of its highly labor-intensive character.

Consequences of Inadequate O&M Outlays

While the initial impact of inadequate O&M is felt at the microeconomic level in the form of deteriorated infrastructure, it has serious macroeconomic consequences as well. The payoff to increased O&M expenditure is likely to include favorable effects on growth, employment, and the balance of payments. Increasingly, it is being realized that higher growth depends as much on efforts to reduce the inefficient utilization of the existing capital stock as on the creation of new capacity. This is because poorly maintained and unreliable infrastructure and service delivery systems hamper both public and private sector activity. Also, as the maintenance of infrastructure tends to be relatively labor-intensive, increasing O&M expenditures can have positive consequences for the level of employment in the economy. Failure to operate and maintain public assets adequately also has direct and sizable consequences for the balance of payments. This is particularly important in developing countries with foreign debt problems and scarcity of foreign exchange. In many cases, proper maintenance and more efficient operations could provide additional output from existing facilities and therefore limit or eliminate the need for new facilities which typically have a high foreign exchange component. It also may facilitate the marketing of export products. Thus, efforts to improve operations and maintenance of the existing infrastructure can be seen as both an import substitution and an export promoting activity.

In addition to its macroeconomic consequences, adequate O&M expenditure has a beneficial impact on social welfare. In many developing countries, the delivery of essential social services—such as education, health, water and sanitation—is adversely affected by inadequate O&M. Therefore, devoting additional resources to improving service delivery will not only have desirable distributional consequences in general, but will also help protect the poor during periods of adjustment.

Issues in the Formulation of an O&M Strategy

While the underlying basis for the choice of an O&M strategy is technical, it will ultimately reflect economic considerations. In principle, given a thorough understanding of the underlying production relationships, the guiding economic framework is the cost-benefit analysis of the various policy options. The present cost of providing operations and maintenance must be compared with the benefits derived at present and in the future (both in terms of deferring the time when expensive rehabilitation is necessary and of realizing economic and social objectives). A number of issues arise in making such cost-benefit calculations.

These coefficients are drawn from a very restricted sample of developing countries and are meant to illustrate the observed variability across sectors and projects. On the basis of these coefficients, one may, for example, estimate that a building that cost $1 million to construct would entail $10,000 in O&M expenditures each year to operate the facilities and maintain the building.

One caveat in interpreting these quantitative dimensions of the O&M problem is that one is often forced to rely on data on the average cost of maintenance of particular types of infrastructure or operations of particular program or projects. However, the marginal cost of maintenance per unit of infrastructure does not remain constant. Given that there may be diminishing returns to O&M expenditures with a given amount of technical and managerial ability, the marginal cost of O&M will increase. Also, it is important to point out that increased spending on O&M by itself does not guarantee significantly improved operations and maintenance of public infrastructure, without concomitant improvement in the efficiency of O&M.

A Strategy for Action on O&M Expenditure

First, governments should develop a national policy on O&M expenditure, stressing the importance of maintaining the quality of public infrastructure and of realizing the maximum productivity in its use. This necessitates reforms of the planning and budgeting process. In this context, a number of initiatives should be considered. There should be a single locus of responsibility to assess the adequacy of resources devoted to O&M, to evaluate the use of these resources, and to advise decision makers on policies to increase the flow of resources to O&M. Efforts should be made to ensure that the government accounting system facilitates the identification of the magnitude and composition of sectoral outlays for O&M. Project evaluation procedures should include projections of O&M requirements. Some effort should be made to assess the medium-term O&M implications of the investment program. Lastly, sectoral data bases describing the nature of assets, and their age, condition, and maintenance history, should be developed.

At the sectoral level, O&M objectives need to be defined, with detailed estimates of O&M costs and staffing requirements, together with indicators of operating effectiveness. Over the medium term, the institutional infrastructure will need to be strengthened, ensuring that biases against O&M are eliminated. Also, the monitoring and supervision of O&M will need to be strengthened. Finally, external financing agencies should place increased emphasis on estimating the recurrent cost implications of projects. Donors should also play a more active role in post-project performance audits, with particular reference to O&M issues.

Country Illustration

O&M needs in Indonesia

Overall, O&M needs can be divided into three categories: (i) immediate needs; (ii) rehabilitation; and (iii) O&M needs for rehabilitated infrastructure. Reflecting the judgement of sectoral specialists, Table 2 provides a quantitative indication of these various needs in five sectors in 1986/87.

Operations outlays

Outlays on operations reflect the purchase of goods and services (labor, materials, and supplies) to facilitate the contemporaneous production of public output. The physical relationship between the inputs and current output with a given capital stock effectively defines a significant part of the payoff to increasing or decreasing the funding for operations. However, since decision-makers often have very limited information, they are not always able to apply cost-benefit analysis on the basis of underlying technical relationships. As a result, they may establish operational norms for certain services that have been known to yield acceptable results. While such norms are usually a reasonable compromise, they may make it very difficult, particularly in periods of fiscal retrenchment, to assess the benefits of shifting resources for operations within and between sectors. All that they allow is a reasonable sense of the likely outcome for a specific level of spending.

Maintenance outlays

Proper maintenance brings immediate and future benefits by enhancing current productivity and retarding the depreciation of assets. **Routine maintenance** is meant to protect the usefulness of infrastructure and assets; **periodic maintenance** addresses actual breakdowns and **rehabilitation** corrects major problems and wear-and-tear so as to restore a facility to good working condition. These different forms of maintenance are complementary and each by itself has limited benefits. Current failure to maintain infrastructure will render future maintenance less productive and of lower value. The two halves of operations and maintenance are obviously interdependent: the greater the use of the infrastructure, the more rapid its deterioration and the greater the need for maintenance. While operations can be relatively independent for a short period of time—that is, the lack of maintenance may not reduce productivity immediately—a balanced approach will be more cost effective over the medium term.

New investment versus rehabilitation

While both have the same nominal effect of increasing the public sector's aggregate capital stock, new investment adds to the stock of infrastructure that would need maintenance, while rehabilitation strengthens the quality of existing facilities, without necessarily increasing the overall need for maintenance. As with other aspects of the O&M question, the choice between the two will depend on the net present value of new assets compared with the costs associated with the failure to prevent the deterioration of existing capital assets.

Financing O&M expenditures

The main sources of funding for O&M expenditure are: direct cost recovery through user charges; earmarked levies on specific beneficiaries; allocations from general revenues; counterpart funds from external assistance; and foreign borrowing.

Measuring the size of the O&M problem

Five measures of O&M need can be distinguished. These measures are not necessarily alternatives and may need to be used jointly. It is, however, difficult to have one single measure of the need of a given stock of public infrastructure and services for O&M. Which measure is used depends on the particular objectives of the government.

(i) The amount of additional O&M outlays that could be spent productively, given the physical condition of the existing capital stock. This measure presumes that infrastructure which is in need of rehabilitation is not brought up to the requisite standards and that maintenance on such deteriorated infrastructure would be done only to the extent that some minimal functioning of the infrastructure is required. In operational terms, this measure would depend on the demand for public goods and services and the desire of the government to respond to this demand.

(ii) The amount of maintenance or rehabilitation expenditure required to rehabilitate infrastructure that has prematurely deteriorated.

(iii) The additional amount of operations and maintenance expenditure that would be required if the rehabilitation described in (ii) was undertaken (for example, including the maintenance of the rehabilitated network of infrastructure).

(iv) The additional O&M outlays required if significant improvements were made in the efficiency of O&M spending. While O&M spending is clearly needed, the marginal outlays required would be substantially reduced if existing amounts were spent more efficiently.

(v) The increase in O&M outlays required to meet the O&M implications of the present investment program. This abstracts from the underfinancing of O&M on existing infrastructure and programs. A useful concept in this context is the *r* coefficient, or the ratio of net recurrent expenditure requirements to the total investment cost of a project. Given these coefficients for each project, an examination of the long-term fiscal consistency of a country's public sector investment program can be made using data available to the Fund and the World Bank. Simulations of the fiscal impact of shifts in the level and sectoral composition of the program could then be made. Table 1 reports some typical *r* coefficients.

Table 1. Selected *r* Coefficients for Developing Countries

Sector	*r* Coefficient
Fisheries	0.08
Agriculture	0.10
Rural development	0.08-0.43
Primary schools	0.06-0.70
Secondary schools	0.08-0.72
Rural health centers	0.27-0.71
Urban health centers	0.17
District hospitals	0.11-0.30
Buildings	0.01
Feeder roads	0.06-0.14
Paved roads	0.03-0.07

Source: Heller (1979).