Consulting and Engineering Design in Developing Countries

Edited by Alberto Aráoz
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CONSULTING AND ENGINEERING DESIGN IN DEVELOPING COUNTRIES

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CHAPTER 2

GUIDELINES FOR A CASE STUDY OF CONSULTING AND ENGINEERING DESIGN ORGANIZATIONS

ALBERTO ARÁOZ

Case studies are useful for researchers just beginning to analyze complex situations where many variables and decision centres are present. They detail individual situations that incorporate the complexity, and they provide insights into the interrelations among all the elements. They rely on inductive reasoning and do not imply the collection of data for testing conjectures and hypotheses. Although they are not a basis for conclusions of general validity, they do provide a basis for conceptual interpretations and hypotheses that may be submitted to corroboration by statistical evidence.

The CEDO case studies were not carried out with the purpose of giving answers to a list of carefully formulated questions. Although many useful insights and some preliminary conclusions were obtained, the principal aims were to identify the different instances of decision, the participants and the problems they faced, and the influences at work; to define hypotheses that may be subjected to verification; and in general to contribute to a better formulation of the CEDO project. At the same time, the task allowed national teams to get acquainted with research on CEDOs and to train their personnel on the subject.

There is, therefore, a strong exploratory flavour in the case studies. The methods were flexible; there were suggestions on the scope and content but even these were regarded as guidelines, not compulsory procedures, because the output was to be questions rather than answers.

SUBJECT AND STRUCTURE

It was suggested that the case studies be of a reasonably mature, locally owned, independent CEDO, private or public, and that they include the CEDO's past development and present functioning, with an example of a recent investment project in which the CEDO played a major role, especially in formulation and execution. Such information was sought so that a close look could be taken at aspects of the CEDO's developing stage and of its mature state so that hypotheses about some of the issues could be made and, later, researched. It was believed that, by studying a particular investment project, one could identify the principal participants and pose questions to them about alternative courses of action.
The investment project was to be medium sized — U.S. $10–50 million — anything smaller lacks complexity and larger projects are likely to be too complicated for adequate analysis. The client was to be a private investor or a public enterprise or agency. To facilitate cross-country comparisons, it was suggested that the project be in the chemical process industry and that the project be completed recently so that relevant information would be relatively easy to obtain.

A brief examination of, perhaps, six investment projects, and the CEDOs participating in them, was suggested as a means for choosing the subject of the in-depth case study. The preliminary study was to be an abbreviated form of what was to be done later and was to be conducted along the same lines, key participants being interviewed about the CEDO's development and operations. The result was to be very sketchy case studies that would be useful indicators of relevant issues and hypotheses. Once the main case study was made, the next step suggested was that the results be discussed with those who had been interviewed in the first round, so that the findings could be contrasted with other cases and experiences, and the final report enriched thereby.

The empirical information for the in-depth study was to be collected through interviews with key informants and through the study of reports, records, and other documents. A tentative timetable was 18½ weeks — 2 weeks for the preliminary analysis, 6 weeks for accumulation of details on the CEDO's development, 6 weeks for examination of a recent investment project, ½ week for discussions with key personnel of other investment projects, and 4 weeks for the preparation of a report. A minimum staff was considered to be one researcher with the aid of one research assistant for at least 12 weeks. For a more complete work, and for training purposes, a larger team was recommended.

THE CEDO AND ITS DEVELOPMENT

The first step was to characterize and describe the CEDO as it is — the principal aspects of its "anatomy," its "physiology," and the relations with its environment. (This examination would be considerably expanded during the second part of the case study.) The following step was to analyze the main features in the CEDO's development, from its beginnings, to find out about the principal decisions, the most influential factors, the relative success of strategies employed, etc. It was hoped that the information derived would indicate the salient questions and issues related to development so that they could be subjected to research later on. The conceptual framework in the previous chapter details the types of issues that might be identified.

Some of the principal points to be covered in the first step were:

- Characteristics: ownership; dependence on other firms or agencies; parameters of size: capital, stable personnel, person-hours per year, number of projects handled and their value, sales; branch or branches it attends and their main characteristics; type of clientele;

- Output: structure of the services produced; approximate proportion of effort in preinvestment, design, construction, and supervision; other services (see Malhotra's classification); degree of specialization of the CEDO; the way in which it envisages and accomplishes the functions that
make up its social role, such as formulating appropriate investment projects, opening technology packages, seeking appropriate technology, adapting foreign technology, acting as a link between local R&D and industrial users of technology, acting as a link between industrial investors and the capital goods producers, contributing to technology diffusion, etc.;

- Market and clients: characteristics of demand, in size, diversity, growth, fluctuations, and discontinuities; characteristics of clients in nationality, ownership, size, technical level, etc.; attitudes and biases of clients; relations with clients through marketing practices and other means; types of contracts, bid presentations, formal and legal practices in this respect; commercial relations with other CEDOs as collaborators or subcontractors to them; exports of services;

- Structure, operating procedures, management: physical resources (buildings, equipment, instruments, etc.); information resources (books and periodicals, special technical files, etc.); human resources (structure of staff, qualifications); stable and temporary employees; turnover of personnel; seniority of present employees; salary levels and salary structure; organizational structure (has a foreign model been adopted?); capabilities; range of skills; internal procedures and production techniques compared with those employed in top foreign CEDOs (for instance, planning and programming; use of computers for calculations and for drafting; use of advanced quantitative methods for simulation, analysis of data, design, scheduling); structure of costs (labour, support services, overheads, etc.); structure of finance; management methods employed (and opinions of how far usual management methods for normal enterprises apply to a CEDO in a developing country); internal communications, motivation of personnel, promotion of creativity; critical resources: human resources — patterns of recruitment of personnel; training of human resources (academic, on the job, with foreign associates; problems in this training); technology and information resources — patterns of access to technology and to specialized expertise; links with foreign CEDOs and foreign technology owners; identification and procurement of domestic technology; setup for feedback from clients; access to economic and technical information through literature, documentation centres, trips, meetings, contacts with universities and research centres, etc.; storage, internal distribution, and utilization of information;

- Environment, influences received: local institutions and type of relations maintained — government ministries and agencies, universities, professional associations, financial institutions, CEDOs, equipment makers; contextual factors, implicit policies, and explicit policies that have a bearing on the CEDO's performance and on its current development; efforts of the CEDO to change in its favour its domestic environment by itself or through associations with other CEDOs; characteristics of and relations with foreign CEDOs (collaboration/competition), experts, equipment makers, technology owners; influence of foreign and international banks; relations with CEDOs and other institutions in developing countries; and

- Problems, obstacles, opportunities — the main factors contributing to the CEDO's success, such as a monopolistic situation in the local market,
special relationships, dynamic management, continued access to know-how, etc.; the main obstacles and problems to be overcome to improve further the social efficiency of the CEDO (in its three components, see conceptual framework), and what government policy can do to help; the opportunities the CEDO perceives in the near future and how it can profit from them.

These facts about the mature CEDO were to serve as a point of departure for the second step — study of the past development. They would provide a basis for questions such as how each main characteristic has evolved, how the critical resources have been procured, what opportunities have been used, how obstacles have been overcome, etc. They needed to be supplemented by questions on:

- Origin: Was it a new firm and, if so, what was the previous experience of the founders? Was it a spin-off from a government agency or a manufacturing firm? Why were a particular technical field and technical services chosen? What were the main characteristics of the CEDO in its very beginnings? What were the initial assignments?
- Paths of growth: What were the industrial branches and other customers served, and types of services rendered? Were there trends toward diversification or specialization? What quantitative indicators evolved? What influenced the gaining of expertise, or learning process — repetitive work, collaboration with foreign CEDOs, recruitment of new, specialized personnel, training of staff? When did access to technology increase? How did the CEDO’s own technology or production procedures evolve? How did it establish an image, create confidence among clients and other participants, develop clientele?
- Strategies and policies for development: What was the model for the type of institution the CEDO aspired to become? What were its objectives at different times? What were the principal obstacles, critical problems, and key opportunities in the development process? What were the solutions in terms of strategies and policies?26
- Support received from the government and other participants: Which government policies have helped? (The policies that have hindered development will have been examined as obstacles.) Have government-awarded contracts been key inputs in the CEDO’s development? What role has political support played? What support has come from financial institutions and from industry? What other help would have been useful in hastening and improving the development process?

**ANALYSIS OF AN INVESTMENT PROJECT**

The main purpose of analysis of an investment project is to obtain detailed knowledge about how a mature CEDO performs in a particular

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26 One strategy merits special analysis: a developing CEDO in association with a foreign CEDO. This has been characterized by K. Mariwalla as having three phases: (1) a division of activities between foreign and local CEDOs, and supervision by the former of the latter’s work; (2) most work carried out by the local CEDO, but the highly specialized work done by the foreign CEDO, which also oversees the complex work done by the local CEDO; (3) responsibility with the local CEDO, which may consult occasionally with the foreign CEDO.
instance, how it relates to other participants, and what influences it so that
the principal questions and policy issues will emerge and shape further
research on the performance of a mature CEDO and the conditions it
needs to achieve a high social efficiency.

The questions to be asked related to the aspects identified in the
conceptual framework presented in the previous chapter: determination
of the “products” to be produced, production, distribution, characteris-
tics of the environment, and internal characteristics of the CEDO. Some
sort of judgment should have been passed by the research team about the
social efficiency of the CEDO in the particular investment project, the
components of that parameter (social utility, productive efficiency, dis-
tribution efficiency), the influence of external factors, particularly explicit
policies, implicit policies, and contextual factors, and the adequacy of the
salient internal characteristics of the CEDO.

Alternative courses of action at different points in the investment
project sequence were to be identified and questions asked about the
reasons that they were not chosen. A further question was how far work on
the project had meant a significant learning experience for the CEDO, had
allowed it to increase its expertise, improve its organization, made it able
to offer a wider range of services; and in how far such ameliorations had
permitted the CEDO to tackle successfully more complex assignments.

The characteristics of other participants and the relations of the CEDO
with them were also to be studied, particularly in the case of the client;
other CEDOs, local and foreign; technology owners; the local R&D
institutions. The client was to be examined from the point of view of its
technical capabilities, past record on technical matters, and the effect of
the project in increasing its skills and organizational capacity. Another
important aspect was the utilization by the CEDO of local R&D organiza-
tions; in many developing countries this utilization is very meagre, and the
reasons for this should be tentatively explored.

To take these aspects into account in an orderly manner, the first step
suggested was to identify and describe carefully the “decision chain” of
the investment project, i.e., the series of points where critical decisions
were made from the moment the project was identified until the resulting
installations were operating to specifications. At each point in the decision
chain, various elements would be identified: the participants involved;
the alternatives considered at the time of decision and how they were
identified and formulated; the alternatives not considered and the
reasons; the decision method employed, explicit or not; the information
used for decision-making; and the principal influences at work — explicit
and implicit policy, contextual factors, motivation and attitudes of the
participants, characteristics of the production branch, etc. — that have
operated directly (i.e., through the information employed for decision-
making) or through the participants (i.e., affecting their behaviour).

It was suggested that the resulting descriptions be summarized in a
table that would permit fruitful discussions with the participants them-

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Table 2. Analysis of an investment project.

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<tr>
<th>Critical decision</th>
<th>Decision adopted</th>
<th>Participants present</th>
<th>Participants that might have been present</th>
<th>Alternatives not considered</th>
<th>Methodology of decision</th>
<th>Information for decision</th>
<th>Influences at work</th>
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<th>Other observations</th>
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<td>Preinvestment work: whether to do it; choice of who will; depth and scope of work</td>
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<td>Guarantees asked of the CEDO selected</td>
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<td>Choice of technology and how to obtain it</td>
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<td>Size, location, product mix, and other parameters</td>
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<td>Structure and sources of financing</td>
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<td>Detailed engineering and who will do it</td>
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<td>Where the equipment is to be procured and how</td>
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<td>How the equipment will be inspected: (a) while being manufactured, (b) upon delivery</td>
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<td>How the construction and assembly will be done and by whom</td>
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<td>How personnel will be recruited and trained</td>
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<td>How to carry out the commissioning</td>
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<td>How to supply follow-up technical services</td>
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<td>How to carry out feedback from operations to designer/engineer</td>
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efficiently) and social objectives (keeping decisions in national hands, using more adequate technology, maximizing favourable impacts on local production and engineering, etc.). Of particular interest are the limits imposed by various circumstances (explicit and implicit policies, contextual factors, characteristics of the branch, etc.) on the action of local participants. Another interesting point is the relations between participants; for instance, CEDO—client, CEDO—foreign CEDO, CEDO—R&D system, etc.

In some cases, it was possible to suggest alternative decisions and actions that could have been taken to improve the project’s success. This aspect comes out more clearly when several national case studies are analyzed side by side.

The set of all possible decisions may be said to make up a “decision tree.” To examine the alternatives, one must start at the first point in the chain and identify alternative decisions that may be taken — those explicitly considered by the participants as well as those not considered but possible. Each outcome branches out into two or more possibilities, and so on. The usefulness of this representation may be improved if alternatives are qualified and ranked according to the degree to which they are expected to enhance the social efficiency of the investment activity (Fig. 5).

This decision tree cannot in practice be constructed except in very simple cases because of the large number of links in the decision chain; the possibility that one must go back and change decisions; and the likelihood that social efficiency is to be measured ordinally rather than cardinally. However, the concept of a decision tree of this nature allows interesting discussions to take place with the key informants. For instance, it would be possible to specify a “best” chain of decisions in the sense that at each point an alternative is chosen that will mean maximum social efficiency (Fig. 6).

In practice an optimal sequence may not be feasible, and the reasons for not adopting the “best” decisions should be examined. Some people feel that one of the main influences behind a near-optimal decision sequence is the positive attitude of the main participants — principally the client and the CEDO — and that without a favourable philosophy on their part it is easy to fall back on decisions that maximize private but not social efficiency.

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![Decision tree - ideal representation](image)

**Fig. 5.** Decision tree — ideal representation.

![Decision tree - optimal sequence](image)

**Fig. 6.** Decision tree — optimal sequence.
It is easier to achieve a high overall efficiency of the complete investment project (once the decision chain has been gone through) when the first few decisions are optimal. This is in line with the proposition in the literature that decisions taken during the preinvestment period largely set the stage for later decisions — the choice of a local consultant, for instance, would make it much more probable that the technology chosen will be more adequate, that local capital goods and other inputs are fully employed, etc.

At some decision points, the outcome of certain alternatives may limit the choices in later decisions and be strongly negative for social efficiency. This would particularly be the case with the election of the source of finance. A decision to accept supplier credit, for instance, would throw the sequence into a tailspin.