Conflict and Choice: Technology Transfer and Architechtural Practice in Developing Countries

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Although architecture is fundamental to the creation of the built environment, the number of buildings in the world designed by trained architects is in fact relatively small. This has led to the 'lay' view of architecture as an elitist activity, more concerned with the creation of prestige and complex buildings, than those buildings and built environments which are most directly experienced by people. This is reinforced by a perception of architecture which is rooted in the 'beaux arts' tradition.

Technology is typically seen as the knowledge required to create physical entities; products, systems and processes. Consequently, the relationship between the role and function of architecture and the production and use of technology, is considered to be tenuous. Thus the transfer of building technology is seen as less the concern of the architect than it is of the engineer, contractor and producer of building materials and components. In this paper we shall examine these preconceptions and specify a function and role for architects and architecture in the process of technology transfer.

It has been argued that the architect is committed to a view of architecture which is concerned with form rather than structure. For example

"...most of the time there is clearly an infatuation with form and an overriding interest in the esthetic". (Langley, 1977) However, this does not square with the view of those architects in professional practice, who adopt a more pragmatic definition of function.

We start from the assumption that architects, in designing buildings, define the parameters which condition both product and production technologies. Although this may be passive, or even by default, the architect is as responsible for the technologies in use, as are the other 'actors' in the process of building.

Technology, as a concept, is subject to a variety of interpretations. As a working definition, we use that provided by Edquist and Edqvist in *Social Carriers of Techniques for Development.*

"Regarding technology, ... we follow the tradition of using it in a more vague and comprehensive sense, including, besides techniques, also immaterial aspects, such as technical know-how, management, organisation of work, etc."

We classify technology as 'hard' and 'soft'; 'hard' technology being related to product and production as physical entities, and 'soft' technology to systems and processes. 'Hard' construction technology is related to the product, its associated materials and components and the techniques of production, while 'soft' technology is related to the wider environment, which conditions the construction process.

Although 'technology', as knowledge of the practical arts, is central to our concern, it is examined in the context of those economic and political factors which condition and constrain its implementation. In the developed countries architecture is produced in an ambience where technological sophistication is the 'norm', which is particularly apparent in terms of both the 'hard' and the 'soft' technologies. This is based on a strong research input, a well developed industrial base for the production and development of building materials and components and high levels of training and skills of workers. These, together with the standards demanded for the quality and performance of buildings and government policies, with respect to construction, allow the architect a degree of freedom not existing in the developing countries.

The 'typical' developing country is characterised by a relatively low level of efficiency and a general level of technology which, although not necessarily unsophisticated, is not comparable to that used in the developed countries. Their construction technology is either imported from the developed countries, temporarily expedient, or traditional. Consequently, their construction sectors are weak and not well adapted to satisfying the demands for construction, which are a logical requirement of the development process.

Architecture is not therefore a detached process, unrelated to the social and economic forces which define the context in which the built environment is created. Rather it accommodates these forces and, as a result, becomes an important component of this environment. This is accepted in the developed countries, in both the practice of architecture and the training of architects. However, in developing countries, although there is always some local architectural tradition, or design culture, this reflects social and economic forces within the country, which are at variance with those in the developed countries.

As such, the architecture of the developed countries cannot be transferred without a sensitive accommodation of both building forms and practices in the 'host' developing country. Therefore, we are interested in the total environment which conditions the design and production of the buildings. That is technology transfer related to the dynamic process of development.

Consequently we must consider:

- the nature of construction techniques and their potential for development and application in developing countries,
- the balance between domestic and imported construction resources, which is achievable and compatible, respect to national development strategies.

Choice of technique is an important component of industrial policy. Different 'technologies' can effect significant shifts in the structure of input requirements. Many see this as an argument for 'appropriate technology' which, in some ways and in certain circumstances, is true. However, technology is 'appropriate', only to the extent that it enables an objective to be satisfied, with the minimum of 'opportunity cost' to the economy as a whole.

We prefer to see the problem as articulated by Frances Stewart. A body of knowledge (technology) exists from which a particular sub-set is available, at a given time, for specific projects, in particular countries. (Stewart 1977) A set of decisions will be made, by the various 'actors' involved in the building process, which will determine the actual techniques which are to be used. We shall argue that the architect has a primacy in this function, but that their freedom of action is constrained by the end-product and the social and economic environment which conditions the production of the built environment.

For any specific building the implicit and explicit performance requirements will involve the solving of the technical problems associated with the 'production' of the specified services, at a given physical location. The implicit performance requirements may involve satisfying certain

social or economic objectives, consequent on a particular development strategy; for example employment generation and maximising the use of indigenous resources. The architect in defining form and product technologies influences and constrains the choice of production technologies.

This distinction between product and production techniques is important, because they do not necessarily have similar levels of sophistication. Many sophisticated product technologies can be achieved using relatively unsophisticated resources, while many apparently unsophisticated product technologies imply the use of relatively sophisticated resources.

Product and production technologies are conditioned by many factors such as:

- form;
- the balance between capital costs, costs in use and maintenance costs;
- time, which defines speed of construction; and
- the planned life of the building.

Each of these has implications for choice of technique and raises problems which have to be solved, by one or more of the 'actors' involved in the building process. The way in which they solve these problems is conditioned by their access to knowledge and previous experience, the possibility of applying a specific solution in a particular context and the formal organisation of the process. This latter point is of importance, because typically the construction process is disaggregated and the time flow of direct intervention by the different 'actors' is conditioned by the form and content of their contractual relationships with the client. An optimal choice function requires a level of interaction between the 'actors', which rarely exists in practice.

In most developed countries the criteria used to determine choice of technique are more limited than in developing countries. Where technological innovations have been introduced to effect changes in the resource inputs for building, it has usually been related to observed deficiencies in the supply of traditional skills. For example, dry finishings, where the technology shift was stimulated by the shortage of skilled operatives, at a time of full employment of domestic resources. Other innovations have been related to changes in the relative prices of factor inputs; for example innovations in the design of steel structures consequent on the apparent price advantages of reinforced concrete.

In developing countries the potential range of criteria is more extensive; for example, employment generation, the development of the local construction resource base and satisfying the objectives of external funding agencies. These problems are compounded by the prevalence of non-indigenous 'actors' in the choice function. There are few ground rules to

guide decision makers who, typically, fall back on well tried solutions, which frequently have been proved in very different social and economic contexts.

Stewart argues that the knowledge of what is available is conditioned by availability and flows of information. Consequently, we must explain the nature of information flows and the choice mechanisms relevant to building.

Here there is a paradox, although the world's body of construction knowledge is overwhelmingly related to the needs and requirements of developed countries, the most urgent construction requirements reside in the developing countries. The 'opportunity cost' of importing technology can be prohibitive, as can the costs of developing new technologies. Imported technologies are frequently specified by default. Knowledge of techniques is not sufficient, a system of production and distribution is essential for the enhanced use of materials and components compatible with national development objectives.

Choice of techniques can be used as a policy variable for maximising domestic inputs, but only if a wider programme of development for the manufacture and distribution of building materials runs ahead of the more readily identified programme for building.

Given the physical nature of the building 'product' and its impact on the 'immediate and intermediate environments', the interest groups involved are diverse, both in terms of function and power. The product is dependent upon, and constrained by, physical, social and legal factors and the 'actors', whose joint impact can be positive, achieving better building, or negative, constraining the development of local building capacity.

Edquist & Edqvist uses an 'actor' based approach, which not only provides a conceptual framework for the analysis of building technology, but also confronts the many problems associated with choice of technique and in determining which 'actors' make the choice. They start from a self-evident, but frequently ignored, proposition: "Choice of techniques is not the primary choice. Techniques are the means to reach certain goals. Usually the choice of product comes first, i.e. the choice of goal or results."

Techniques have intrinsic properties which are founded on the laws of nature and their implications for social structure are conditioned by, "... complexity, scale and spatial extension".

Building, although frequently considered to be simple, is in fact marked by its complexity, large-scale and spatial extension. Designing and managing the production process is complex, a complexity which is compounded when the process of manufacture and distribution of the

building materials and components is included. The spatial extension is also obvious both with respect to the project and the inputs for that project.

Their key concept is that of a 'social carrier of techniques'. This is defined as "... a social entity which chooses and implements a certain technique". A number of conditions are posited which must be satisfied for a technique to be "... chosen and implemented in a specific context or situation:

- the technique must actually exist somewhere in the world,
- a social entity must exist that has an interest in choosing and implementing the technique,
- this entity must be organised to be able to make a decision,
- it (the social carrier) must have the necessary social, economic and political power to be able to implement the technique chosen,
- the social entity must have information about the existence of the technique,
- it (the social carrier) must have access to the technique in question,
- the social entity must have, or be able to acquire, the needed knowledge about how to handle the technique."

An actual carrier of technique is one that satisfies these conditions.

Certain individuals and groups have 'potential' as carriers but, at a particular point in time, lack the power to choose and implement a specific technique. Sometimes a technique is carried by different 'actors' through different stages of the process of technical change as a whole; 'linked carriers' of techniques. In building, where interactions between research institutes, designers, manufacturers of building materials and components and contractors, are frequently involved in the development of techniques, 'linked' carriers may be the 'norm'.

The case is made for concentrating on choice of technique rather than on the development of new techniques. They argue that "... less than 5% of global research and technical development is undertaken in developing countries. Therefore, the part of the process of technical change that is most relevant for the developing countries today is the choice between alternatives - foreign and indigenous - and the implementation of the techniques chosen. As a consequence, a very important mechanism for the introduction of new techniques in developing countries is the transfer of existing techniques from industrialised countries".

In principle, sufficient technology exists to satisfy most of our international building requirements. The issue is usually one of choice, choice constrained by economic factors and social objectives. The problem is not simply one of choice but choice in a given context.

The building process is characterised by the different 'actors' involved, with well specified functions, which have important implications for choice of techniques. The effective 'leading' function passes from one 'actor' to another as the process moves through its various stages. 'Hard' building technologies can be classified either by function, product technology and production technology, or with the principle 'actors', designers, materials and components producers, general contractors and specialist sub-contractors. There are also the 'soft' technologies, associated with user requirements, planning, project management and management in general.

Any examination of the building process suggests that discrete 'social carriers' are rare. Designers work within the constraints of planning regulations, building codes and regulations and client budgets. Contractors are constrained by the design. Materials producers manufacture to externally established performance specifications. Each becomes an agent for choice of technique, through a process of accommodation and adjustment.

Although we must expect to find 'linked carriers', the various 'actors' will, within each combination, have different weightings. The role of 'leader' changes as the process moves through its various stages. In developed countries these 'leader' roles are in many ways legally defined. Forms of contract, legal responsibilities for various aspects of the work, the definition and accreditation of professional competence, are obviously part of this mechanism. Consequently the client, designer, materials producer and contractor have 'leader' roles in the process, which are defined by their legal responsibilities. Although we do not have autonomous 'social carriers', the legal system, in defining de jure responsibilities, also defines de facto 'social carriers'.

The implications for developing countries are obvious. In legislating for responsibilities in the process they are implicitly defining function. But, by legislating in advance of an evaluation of domestic construction requirements, they will inevitably tend to borrow from the only legislative models which are available, those of the developed countries. Consequently, because the definition of functions has been imported, de facto 'social carriers' of construction technology will also tend to be imported; direct imports of materials, equipment, designers and contractors, or indirect imports through the process of educating local architects, engineers and managers, in the developed countries.

What is required is a 'construction development profile'. We define this as the system which conditions the actual technologies associated with specific projects, which includes among others:

society
traditions and culture, social and demographic structure,
economic
level of development, availability of foreign exchange,
industrial structure
structure and capacity of domestic building materials sector, capacity of domestic construction sector, (consultants, contractors, skilled workers)
legal(construction)
contracts, planning, codes and regulations,
process
organisation of the process, rigidity of the process, indigenous or imported,
project
function or end use, priority, size, (absolute and relative), location within country.
This classification and listing is neither definitive nor exhaustive, but it does provide some flavouring to the concept of a 'construction development profile'.

The system can be seen as a continuum, although the ordering of classes is open to discussion. It is, in principle, possible to weight each category and calculate the 'centre of gravity' of a specific profile. Empirical examination of actual projects is the obvious starting point for these procedures.

The system is interactive in that changes in one of the categories evoke changes in certain others; for example 'project' can be instrumentally effected by changes in 'legal' (construction). Hence, the argument that the provision of 'habitat' in developing countries is constrained by inappropriate planning requirements, building codes and regulations.

In a developing country, the closer the centre of gravity of the profile is to the 'project' category, the more likely the main agents for choice of technique will be located within the international construction system. Using designers and contractors from the international construction system increases the probability of international, imported technologies, being applied.

In developed countries the system is more integrated. More developed economies, industrial bases and legal frameworks, tend to ensure choice of building techniques which are more compatible with the use of domestic resources, and in line with the wider national political, social and economic objectives.

The problem of architecture in developing countries is therefore not uniquely that of the architect. It is a function of the political, social and economic structure of specific countries, the identification of needs, and

the availability and knowledge of those technologies which are appropriate, in the given context. This makes demands of the architect which few have the training and experience to satisfy.

The training and experiences of architects in the developed countries are related to the environment which defines architecture in these countries. There is no reason to assume that it is adequate to the needs of developing countries. However, the problem is compounded by the training of architects from developing countries, either within the Schools of Architecture of the developed countries or in Schools, within the developing countries, which have adopted a developed country educational paradigm. We must question whether this represents a particularly pernicious form of technology transfer.

In this context we need to expand our understanding of the concept of 'development'. In considering this as a process, it is reasonable to argue for 'appropriate' architecture and architectural training. That is an architecture which has an empathy with local culture and building traditions and practices. However, this presumes that such a situation exists in the developed countries, which many would argue is invalid. Some have argued that it is the 'idea of architecture' which has to be redefined; for example, those who argue the case for the 'enabling' architect.

We would argue for an architecture which consciously recognises its place in specific socio-economic contexts, yet has an intellectual base which allows the architect to produce appropriate architecture. That is architecture which has an empathy with the the role of design in the total process of the production of the built environment. Appropriate technology is then intrinsic to 'good architecture' and technology transfer would be effected, to the extent that it was pertinent to the production of 'good architecture'.

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