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# Identifying the environments of construction projects

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*A systematic technique for identifying the environments of construction projects is described. It provides a method for isolating the major variables surrounding construction projects, and is briefly applied to the industries of Britain and Jamaica to illustrate its application. From this, it is inferred that the environment of a Jamaican construction project in systems terms is broadly similar to the environment of a project in Britain.*

**Keywords:** Jamaica, construction industry, systems analysis, environment

## Introduction

The approach presented in this paper has been developed during a study at Liverpool Polytechnic of the organizational analysis of construction project management structures. The views of the Jamaican construction industry were developed during a short study visit funded by Liverpool Polytechnic's Department of Surveying. The information was collected through structured interviews with members of the Jamaican construction industry, and from published sources.

## Systems analysis and project management

In order to understand the way in which the building industry is organized, it helps to analyse projects using concepts from systems analysis, and techniques for doing this already exist (Walker and Hughes, 1984; Walker, 1984). The systems of building projects can be seen as a response to environmental factors, and the interaction of projects with their environments are reciprocal. The study of construction projects as systems of organization requires that the environment of the project is defined. In systems terms, the environment of a construction project can be extremely complex. The following discussions detail an analytical framework which will provide a common basis for describing project environments. The description of the environment can subsequently be used in an analysis of the organizational structure, which is the factor that relates the project to the environment within which it operates. In order to analyse the organizational structure effectively, it is essential to have a systematic method of describing the environment that will serve to indicate the salient features of the environment. This environmental analysis must be at a greater level of detail than has been the case in the past.

### **Types of environmental factor**

Taking Walker's (1984) description of the environment as a starting point, there are several types of environmental influence on a construction project: political; legal; institutional; cultural; sociological; technological; economic and competitive. As Walker points out, they can be classed in a variety of ways, and can be identified and analysed for each project. In practice, this approach is fairly loose and does not provide a sufficient level of detail. Walker's work has shown that by leaving the description of the environment to be dependent entirely upon the merits of each case makes it difficult to relate the environment to the organizational form.

It is proposed that the environment should be defined in a more structured way, and that the list of criteria should be examined to ensure that any observable environmental phenomena may be classified into one or more generic groups of environmental forces. The groups offered are based upon an extended set of Walker's ideas, and are shown in Table 1. The relationship of these environmental factors to construction projects is shown in Fig. 1.

### **Variability of environmental factors**

Each of the environmental factors are subject to degrees of variability. The extents to which they vary can be classified in terms of their degree of definition, stability, certainty, simplicity and the ease with which they can be mitigated. These variables are defined below.

#### *Definition of the environment*

Each environmental factor will be more or less well-defined from one project to another. The effects of each environmental influence will be related to its degree of definition. One test of this degree of definition could be to look at the extent to which the contributors perceive the effects of environmental influences upon the project. This perception may be seen as the extent to which the contributors to a project acknowledge that there is an influence.

#### *Stability of the environment*

Environmental factors may be seen as tending towards either stable or unstable. Each factor could be in any state along a continuum of stability–instability. Additionally, the degree of stability could change during the life of a long project. The largest influence on stability is the timing of changes in the environment, relative to the duration of the project.

#### *Certainty of the environment*

Each factor can be affected by the degree of certainty surrounding it. What matters about the certainty of the environment is the extent to which it can be predicted. The less certain the environment is, the more difficult it will be to predict problem areas.

#### *Simplicity of the environment*

Any of the environmental criteria may tend either towards complexity or simplicity. Each factor must be analysed in terms of its complexity or simplicity, and some judgement must be

Table 1. Types of environmental factor

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**Cultural.** This describes society's acceptance or tolerance of certain modes of behaviour. It covers such phenomena as 'peer group pressure'. It can have a great effect upon the industrial relations scene within a project, and on the 'informal systems' which are often acknowledged to exist within formal organizations.

**Economic.** This includes the level of general economic activity, as well as the question of the economic resources available to carry out the work, including the economic competition which exists to varying degrees around the appointment of all of the parties to the building project.

**Political.** This is concerned with government policy and the effect of political decisions upon the project. It also covers the sometimes large influence that strong individuals can have over a project.

**Social.** This term describes the social environment within which the project is operating. There may be a specific social need for a project, or conversely, a building may be having adverse social consequences.

**Physical.** This relates to the physical conditions on the site. There may be difficulties associated with the site, or the climate may be bad; thus inclement weather is included in this category. Each contributor to the project will also have their own physical environment.

**Aesthetic.** There will be some sort of aesthetic influence around a project; whether it is through 'fashion' in building design, or whether it arises through the conscious choice by a client of a particular designer.

**Financial.** Financial limits always seem to exist on building projects. They are often clearly specified, but they may be based on inadequate information. Financial environmental forces are distinguished from economic ones on the basis that economics is to do with the deployment of resources, whereas financial limitations are strictly to do with money.

**Legal.** Legislation affects the client's activities directly, through factors such as safety, planning law, building regulations, etc. It also influences the contractual relationships within a project.

**Institutional.** This covers the influence that professional institutions can have over the conduct of the professional consultants. It affects conditions of engagement, fee scales, etc.

**Technological.** This aspect relates to the technology which is available to do the work, both in terms of the design work and the construction work.

**Policy.** The translation of these environmental influences will be undertaken by the client and when a decision to provide a building is taken, the interpretation of the environment will be translated into the policy for a project. This decision will have been based upon consideration of the environmental influences on the client's organization, and there may be some consideration of the project's effect upon the environment. These decisions form the immediate boundary to the building project as a system.

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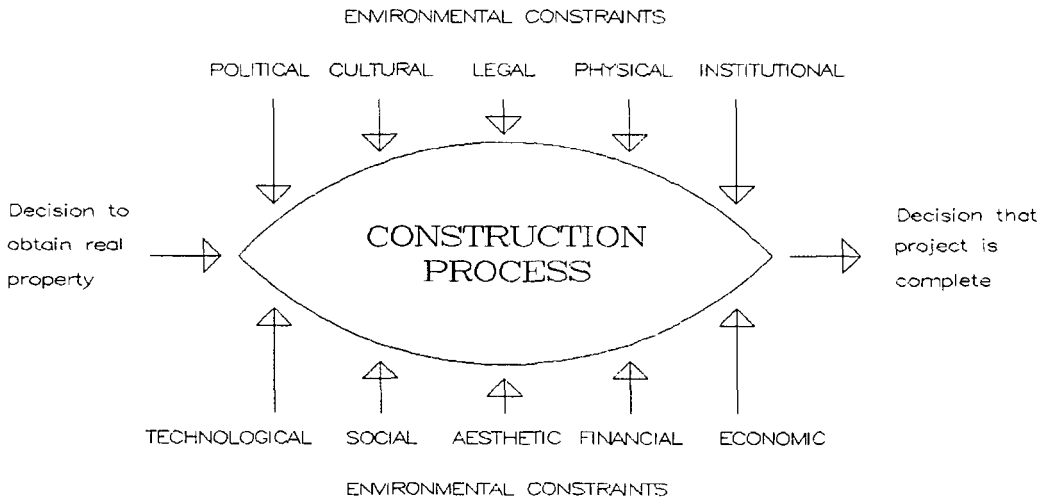


Fig. 1. Environmental influences on a construction project.

made as to the degree of complexity which exists. The term 'simplicity' is used to express the ideal state.

#### *Mitigability of the environment*

This variable is concerned with the extent to which environmental factors can be mitigated. The term 'mitigability' has been chosen after much deliberation and is used with reservations. Although it is an obscure word, no other word refers to the quality that something has when it is possible to mitigate its effects. This aspect should take account of the extent to which it is in the power of the project management team to mitigate adverse influences. Some factors may not be possible to mitigate, and would thus have a far greater adverse effect upon the project (for example; unstable politics of the nation), whereas other factors could be more easy to mitigate (for example; the effect of technological complexity could be mitigated by employing suitably experienced consultants). That some factor is mitigable does not necessarily mean that it is easy to cope with, but it does mean that the project team can attempt to reduce its adverse effects.

#### *Ideal state of the environment*

The ideal situation in terms of the preceding variables will be an environment which is defined, stable, certain, simple and mitigable. Obviously, this situation would be very rare indeed and projects will suffer difficulties though the varying effects of each environmental factor.

#### **Variability of environmental factors in Britain and Jamaica**

The environmental factors will vary a great deal throughout a particular country on construction projects. Research has shown that they often vary considerably during the life of a project (Walker and Hughes, 1980–83). The variables can be quantified for their relative

importance. The current proposal is that the values given to each variable are subjective, as little will be gained at this stage by attempting to rate them through some exhaustive quantification method. The aim of the environmental analysis is only to provide an indication of the complexity of the environment, and some vehicle for describing what is observed. It also helps to highlight those areas that will require most attention and expertise. This externalization of the analyst's observations provides a base from which to compare alternative projects, or industries, and their organizational demands. With this in mind, the scales used for rating the five degrees of variability only consist of three points; favourable, moderate and unfavourable, equating to 0, 1 and 2 respectively. The five degrees of variability are added together for each environmental factor, thus the larger numbers indicate the aspects that are expected to place the most demands on the organization (see Table 2). Examples of the degrees of variability for Jamaica are outlined below, and compared with the situation in Britain.

### *Cultural*

In Britain there are many slight cultural differences around the country. Historically there have always been cultural differences between the various races which have combined to form Britain. More recently, with the influx of immigrants from ex-British colonies, we have continued our multi-racial traditions. Thus, there can be cultural differences over short distances in Britain. Jamaica seems to have a culture which, although eclectic in origin, is more uniform throughout the island, except that there are the usual differences between urban and rural communities. The issue of culture would not normally be of great consequence in terms of a construction project, except in the cases of international projects. In such cases it is essential to ensure that the project management team is not alien to the culture in which it is to work.

For both countries this factor is stable and certain. It is not simple in either case, nor is it easy to define. The mitigability would be directly related to the project team's familiarity with the culture, and as such attention should be given to this point when designing the organizational structure. These judgements are scored in Table 2.

### *Economic*

The economy of Jamaica is in dire straits. Inflation has made most construction schemes uneconomic and has precipitated some interesting financing and construction arrangements. The economic situation is more or less the same throughout the island, whereas in Britain it can vary from one region to another. In both countries, wealth is concentrated in the cities.

Investigation shows that the problems of the Jamaican construction industry are quite staggering – more intense and advanced than they are in Britain. In Jamaica, real GDP growth was a negative figure for 1984 and 1985. Inflation has been erratic, rocketing from 6.6% in 1982 to 29% in 1984, and then dropping from 27% in 1985 back to single figures in 1986. The government is committed to reducing the inflation level, and according to the Planning Institute of Jamaica (1986), the recent recovery is because of the cumulative effect of such factors as the stabilization of the exchange rate, government strategies for economic stabilization and structural adjustment, as well as the fortuitous reduction in the price of oil. The value of the Jamaican Dollar has fallen to one third of its 1982 value through several devaluations.

Table 2. Environmental factors for Britain and Jamaica compared

Great Britain	Environmental factors	Jamaica
A historically mixed race with a developed and varied culture. Increasingly multi-racial and tolerant of variety. A large number of sub-cultures. De St Ce Si Mi Tot 2 0 0 2 1 5	<b>cultural</b>	Strong cultural identity; a small number of sub-cultures. Increasing influence of American culture, especially in the media. De St Ce Si Mi Tot 2 0 0 2 1 5
Economy has suffered in the recent past but seems to be improving. Large variation between regions of the country. De St Ce Si Mi Tot 0 1 1 2 1 5	<b>economic</b>	Economy devastated by inflation and devaluation. Costs of most building schemes are prohibitive. Shortage of skills. De St Ce Si Mi Tot 0 2 0 2 2 6
Predominantly a two party system, with other parties contributing. De St Ce Si Mi Tot 2 1 1 2 2 8	<b>political</b>	Two party system consisting right wing Socialists and left wing Nationalists. De St Ce Si Mi Tot 1 2 1 2 2 8
A large variation throughout the country. Widely differing levels of affluence. Housing is essential for survival. De St Ce Si Mi Tot 2 1 1 2 2 8	<b>social</b>	Little variation throughout island. Some pockets of wealthy people. Poor population. Housing not essential for survival. De St Ce Si Mi Tot 0 2 2 2 2 8
Varied terrain. Plentiful supply of building land. Complex and unpredictable climate. De St Ce Si Mi Tot 0 0 0 2 2 4	<b>physical</b>	Mountainous terrain covered with thick vegetation. Access to much of the island difficult. Stable tropical climate. Earthquake tremors, typhoons and hurricanes. De St Ce Si Mi Tot 0 1 0 2 2 5
A variety of building materials and styles. Large variation in tastes. De St Ce Si Mi Tot 2 2 2 2 2 10	<b>aesthetic</b>	Limited availability of materials. Buildings tend to reflect a fairly uniform style. De St Ce Si Mi Tot 1 1 1 1 2 6
Finance available for most schemes. Property development profitable. Increasingly international. De St Ce Si Mi Tot 0 1 1 2 2 6	<b>financial</b>	Finance very difficult. Large schemes not viable. Little international construction. De St Ce Si Mi Tot 0 2 2 2 2 8
Standard Forms of Contract National Building Regulations. De St Ce Si Mi Tot 0 0 0 2 1 3	<b>legal</b>	Standard Forms of Contract Local Building Regulations. De St Ce Si Mi Tot 0 0 0 2 1 3
Professions represented by national professional institutions. De St Ce Si Mi Tot 0 0 0 1 1 2	<b>institutional</b>	Professions represented by national professional institutions. De St Ce Si Mi Tot 0 0 0 1 1 2
Progress in all aspects of technology. New materials and methods being introduced. De St Ce Si Mi Tot 2 2 2 2 1 9	<b>technological</b>	Progress slow, but increasingly influenced by US and UK. Traditional construction methods. De St Ce Si Mi Tot 1 1 2 2 1 7

Key: De=definition; St=stability; Ce=certainty; Si=simplicity; Mi=mitigability; Tot=total; 0=favourable; 1=moderate; 2=unfavourable.

In published figures the Jamaican construction sector's contribution to GDP in 1985 was J\$99.7m or 5.4%. This represented a 13.5% drop from J\$115.27m (6% of GDP) in 1984 (at constant prices) (The Economist Intelligence Unit, 1987). By comparison, the UK's construction sector contributed £18,536m (6.4%) to GDP in 1985 (approximately J\$131,235m), a drop of only 3% over the same period (Central Statistical Office, 1987).

The industry relies heavily on imported materials – indeed one of the complaints frequently voiced in Jamaica is that it is an end user of foreign exchange. Thus the effects of repeated devaluations have been to dramatically increase prices e.g. the price of cement increased by 33.5% in June 1985 alone, and the cost of paint increased by 47% in the same period.

The high interest and mortgage rates have proved prohibitive to development and have had far reaching effects on finance in the industry. 1985 saw a severe contraction in the amount of finance being made available for construction. Net resources advanced to the sector by major financial institutions fell from J\$416m in 1984 to J\$164m in 1985, a decline of 61%.

The major financial worry of the Jamaican administration is the large external debt. At the time of writing, more than 40% of fiscal revenues are used for debt servicing. Consequently there are severe financial constraints on the country's social and economic progress.

As Table 2 shows, the definition of the economic problems both in Britain and Jamaica is quite clear. The Jamaican inflation figures demonstrate how very unstable the Jamaican economy is, whereas the British economy is reasonably stable. It is almost certain that the Jamaican economy is going to remain unstable, but the British situation is prone to uncertainty. Both countries are economically complex, and this is difficult to mitigate, but because of the relatively easier position in Britain, the mitigability is judged to be reasonable.

### *Political*

The politics of Jamaica are broadly familiar to the British in that there are two parties, the government and the opposition. The parties are right wing Socialist and left wing Nationalist, a confusing contradiction to British people! The government often intervenes directly in the construction industry, just as it does in Britain, although the nature of the intervention often seems to be more severe in its effects on the industry, probably because of the severity of the economic situation. The government intervention occurs through the control of large public building programmes, particularly for housing and factories, which form a much larger proportion of the industry than they do in Britain. The government has removed the ceiling on interest rates for deposits with building societies, so there has been a corresponding increase in the charge for mortgage loans. Thus the number of loans advanced to members has declined.

The definition of the political system is not as difficult in Jamaica as it is in Britain (for instance, try defining the British constitution!). In Jamaica, the stability of the political situation is often threatened by violence, particularly at elections, whereas in Britain, although there are problems such as the inner cities and terrorism, the situation is perhaps a little more stable. Both countries have a similar degree of uncertainty, for different reasons, and both countries have a high degree of inherent complexity. The political situation is very difficult to mitigate.



### *Social*

There is an enormous range in the degree of social need in Britain. Different parts of the country have widely differing levels of affluence. In Jamaica, however, there is social deprivation all over the island. There is only a small percentage of the population that are economically self sufficient. One fundamental difference in social conditions relates to the climate. In Jamaica people don't die of Hypothermia, although diseases take their toll as would be expected in the tropics. Thus the social demand for basic housing, whilst severe, is not quite the same as the demand in Britain, with the emphasis being on sanitation and basic shelter, rather than weather-proofing.

The social environment in Britain is the result of a very long social history and may be for that reason alone more stable and certain than Jamaica's. The social history of the Jamaicans is relatively short, since the indigenous population were wiped out by the European settlers.

In Britain the social environment is variable and therefore difficult to define, whereas the Jamaican social problems are well-defined. The stability and the certainty are both very difficult to gauge in Jamaica, contrary to Britain. The social environments are not simple or mitigable in either country.

### *Physical*

The terrain of Jamaica is fairly mountainous. The bedrock is predominantly limestone and it has been subject to upthrusts fairly recently in geological terms. The hills, therefore, are very steep and sharp because there has not been much time for erosion to take place (Donovan, 1987). Large tracts of land are inaccessible due to the extremely dense vegetation, and the irregularity of the surface. An example of this is the 'Cockpit Country', so called because of the resemblance of the large number of hills to aircraft cockpits. The island is also subject to frequent mild earthquakes. Being in the tropics the climate, although extreme by British standards, is very stable and predictable.

For both countries, the physical environment is easily defined and certain. Jamaica is unstable because of its earth tremors. Both countries have complex physical constraints which are difficult to mitigate where they are unfavourable.

### *Aesthetic*

This factor has almost no impact on the current Jamaican building scene. It is a luxury that cannot really be afforded. In general, the aesthetics of the Jamaican built environment are very much dictated by the small range of building materials and techniques available to the industry. In Britain, the situation is more complex because of a wider range of materials and techniques, as well as a higher level of affluence, and a longer historical tradition of building.

The British situation is difficult to define, unstable, uncertain, complex and difficult to mitigate, whereas the Jamaican aesthetic environment is more favourable on all counts except mitigability, which remains difficult. This is expressed numerically in Table 2.

### *Financial*

The techniques of financing construction schemes in Jamaica are of a similar nature to those in the Britain. However, there are methods of financing small scale building projects

(particularly domestic) which have no parallel in Britain. One of these schemes, for example, takes account of two facts which militate against low income earners from securing a house. One problem is that there is a credit squeeze which forces people to find large deposits when they want a loan (particularly for housing), and another is that there is no rented accommodation available. It seems that so many tenants refused to pay their rent when it was due that it was totally uneconomic to try and provide rented accommodation. To counter this, private house builders run a scheme whereby the occupier pays rent for up to 5 years to the developer. At the end of this time, the money that has been paid as rent becomes a down-payment for a mortgage. Thus it is in the interest of the occupier to pay the rent, and house builders are able to lower the earnings threshold of their potential customers, increasing the size of their market. So, although there is not much finance about, there are schemes which provide access to finance for people who are not very well off by UK standards.

An example of how financial difficulties have affected the building industry in Jamaica is the price of a typical 'starter' home. Five years ago it would cost about J\$10,000 to buy a small house. The same design of property now costs in the region of J\$60,000–J\$70,000. (Five years ago there were J\$1.78 to US\$1, and at the time of writing there are J\$5.47 to US\$1, thus a large proportion of the increase in house prices is due to devaluation of the Jamaican Dollar (The Economist Intelligence Unit, 1987).) Incomes have not risen to keep pace with this massive increase and it is now extremely difficult for first time buyers to get into the housing market (Goldson, 1985). The way in which this has been mitigated is by offering a starter home which only contains one living room, a kitchen and a bathroom. The purchasers can elect to finish off some of the work on their own, thus reducing further the initial purchase price. At a later date, when the occupier is in a better financial position, he/she can extend the home and add a bedroom. The houses are designed on a modular basis so that up to three bedrooms can be added, one at a time, as the occupier can afford them. Sufficient land is provided between the units in order that this can take place. In this way, housing estates tend to grow as their occupants rise up the financial ladder, and the housing developers only provide an extremely basic level of accommodation.

This is by stark contrast with Britain, where the concept of a starter home is one where the occupant moves to a larger property when they can afford to.

The financial environment in Jamaica is well-defined, but unstable, uncertain, complex and difficult to mitigate. In Britain it is also well-defined, complex and difficult to mitigate, but reasonably stable and reasonably certain.

### *Legal*

The legislation of Jamaica is broadly based upon the British model, due to the fact that it is an ex-colony. The Standard Forms of Building Contract issued by the JCT in Britain have their counterpart in Jamaica, known as the JCC (Jamaican Consultative Committee). The JCC has some interesting differences from the JCT forms; for example the subcontract conditions are embodied in one large clause in the main contract. Similarities include the involvement of clerks of works, variations, certification, extensions of time, and so on. The articles of agreement and recitals are similar, and the clauses deal with similar legal points. Civil engineering works are undertaken using FIDIC. Smaller contracts, as in Britain, may be dealt with using schedules of rates and specifications. Thus, in legal terms, the administration of contracts can be said to be broadly similar between the two countries. Building regulations have been in existence in Jamaica since the Kingston and St. Andrew Building Act was

passed in 1882 (McLeod, 1986). This Act has been amended and supplemented many times since then, and the 1908 Regulations were largely based on the 1892 London Building Regulations. The responsibility for setting and enforcing the minimum standards for construction still lies with the local parish authority. A recent innovation has been the drafting of the Caribbean Uniform Building Code (CUBiC), which has still to be finalized before attempts are made to get it on to the statute book (Caricom Perspective, 1986).

The legal environment of both countries is well-defined, stable and certain, but not simple, and is reasonably mitigable.

### *Institutional*

The construction professions in Jamaica are represented by Jamaica's own national professional institutions, just as they are in Britain. The institutional environment is similar in both countries in that it is well-defined, stable and certain; whilst being reasonably simple and reasonably mitigable.

### *Technological*

Progress is taking place in all aspects of technology in the Britain, and by comparison progress in Jamaica is slow. Thus the technological environment in Jamaica is more straightforward than it is here. For example, the usual form of construction for Jamaican housing consists of a 6 inch hollow concrete block wall. This is reinforced with steel both horizontally and vertically to provide stiffness to resist earthquake tremors. Recent technological developments include the use of concrete sprayed on to an internal sheet of formwork, creating a 4 inch solid concrete wall. Larger buildings are created using established technological methods from the UK and the US, such as reinforced concrete slabs and columns for example.

The technological environment in Jamaica is reasonably well-defined, whereas the British situation is not well-defined, due to the speed of change. The British scene is unstable, with the constant emergence of new techniques and materials, whereas the Jamaican industry is more stable because of the physical limitations. Neither country has much certainty about its technology and in both cases the complexity can be high. However, the effects of technology can be reasonably mitigated.

### *Summary of the main differences*

Table 2 summarizes the main differences in the key environmental factors. This table shows that there are major similarities between the two countries in terms of the general political situation, the legal framework within which building projects are undertaken, and in the professional institutions. There are differences in detail between cultural, economic, social and political factors, but on balance the overall picture would place similar demands on a building project management team in either country. Physically the two countries are different, and as such produce differing constraints for building projects. Aesthetically, construction projects in Britain are more difficult to deal with, because the environment brings far more variables and conflicts into consideration. The financial environments are also different, making the situation in Jamaica the more difficult one. Legally and institutionally, there are not large differences in the demands placed upon a project

management team in either country. Technologically, projects are probably more easy to deal with in Jamaica than they are in Britain.

On balance, the general picture in Jamaica is slightly more straightforward than it is in Britain, with sufficient similarities to make it feasible for British people to adjust to and understand the Jamaican scene. In some areas, such as financial, there may be techniques in which the British can learn from the Jamaican experience.

## **Conclusions**

Since the data in this paper were based upon only a brief examination of the industries in general, it is not possible at this stage to conclude whether construction projects generally are more easy to manage in one country than another. Indeed, it is clear from the analysis outlined here that there are too many variables in the environment of construction projects to make such generalizations. However, the application of this technique has shown that it is a useful tool for describing one's observations of project environments, and as such it will be of enormous benefit when planning construction project organizational structures. Some of the problems of applying analytical techniques from systems analysis, mentioned at the beginning of this paper, can be overcome by following this systematic method of describing environments.

It can also be concluded that some of the environmental factors are less easy to judge than others, and some are less changeable than others. The degree of interdependency between the factors could usefully be explored, and the relevance of the quantities determined from the analysis is also an interesting topic. These issues are still under investigation by the author.

This analysis has demonstrated the possibility of using and developing analysis techniques on a smaller scale construction industry such as Jamaica's. With careful planning, techniques may be tested and proved where there are more control variables. The lessons we learn there will give us the ability to analyse our own projects with more confidence in the results.

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