TIME AND COST RELATIONSHIPS OF PUBLIC HOUSING CONSTRUCTION IN NORTHERN NIGERIA

Disssertation submitted for the award of the Degree of Doctor of Philosophy
in
Construction Management

BY

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APPROVAL PAGE

This thesis entitled "TIME AND COST RELATIONSHIPS OF PUBLIC **HOUSING** CONSTRUCTION IN NORTHERN NIGERIA." by Timothy Chukwuemeke Mogbo meets the regulations governing the award of the degree of Doctor of Philosophy, of Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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I certify that the work reported in this thesis is my own independent work, except where stated in the acknowledgement, and that it has not been submitted in whole or in part of any award at this or any other University.

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DEDICATION

This Thesis is dedicated to my parents

(1) The Late ALBERT CHINWEOGO

&

(2) Mrs. ESTHER NWUDUOFUFE

For

Their Love and interest in My Education.

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GLOSSARY

SMM - Standard Method of Measurement of Building works (4) edition published by the Royal Institution of Chartered Surveyors, London.

JCT - Joint Contracts Tribunal

QS - Quantity Surveyors

BQ - Bill of Quantities

TIME - Period in weeks in which a building operation would last or had lasted.

COST - Financial expenses in (naira) incurred by a building contractor in the Execution of a building project and includes expenditure on:- (Materials, labour, plant Overhead) as well as profit.

PRELIMINARIES - The first part of a bill of quantities that prices the cost of overheads, temporary works and legal obligations imposed on a contractor.

U.K - United Kingdom

U.S.A - United States of America

G.N.P - Gross National Product

G.D.P. - Gross Domestic Product

"EFFICIENCY" PARAMETERS - are as follows:

Time Efficiency - $\frac{\text{Final Time}}{\text{Initial Time}}$

Cost Performance - $\frac{\text{Final Cost}}{\text{Initial Cost}}$

Final Cost Intensity - $\frac{\text{Final Cost}}{\text{Final Time}}$

Initial Cost Intensity - $\frac{\text{Initial Cost}}{\text{Initial Time}}$

RelativeCost Intesity - $\frac{\text{Final Cost Intensity}}{\text{Initial Cost Intensity}}$

A B S T R A C T

TIME AND COST RELATIONSHIPS OF PUBLIC HOUSING CONSTRUCTION IN THE NORTHERN PARTS OF NIGERIA

The successful implementation of public housing policy hinges on the affordable cost and the timely completion of construction work. Literature survey suggests that there are staggering differences between the initial and final project cost and the initial and final construction times. A need therefore arise for systematic studies to be undertaken into time - cost relationships of housing construction projects in Nigeria.

Data on construction cost and time of 240 bungalow units of same quality and design were collected on a random basis from certified final valuation certificates. On the cost aspect, the data collected were:- Initial contract cost, Final contract cost, Variation cost and Fluctuation cost and on the time aspect, the following:- Initial Time, Final Time, Total Delays, delays due to the execution of variation, payment and other factors. The instrument for analysis was simple correlation and regression. Testing of data was at .05 significant level.

The following were the outstanding features of the findings:- (a) the final cost had no significant relationship with the Final Time, (b) Fluctuation cost had significant relationships with Final Time, Total Delay Time, Payment

Delay Time and Variation Delay Time - as well as Delay Times due to (administrative, climatic and other) factors, (c) both Variation cost and the Initial Cost each had no strong relationships with any of the time components, (d) considering the components of delays, payment delay times had the strongest relationship with Fluctuation Cost, (e) significant increase in Payment Delay Time gave rise to significant decrease in cost - time efficiency.

It was recommended that :- (1) the following data be assembled on past projects:- Total Floor area, height, Final Cost, Initial Cost, Variation Cost, Fluctuation Cost, Final Time, Initial Time, Time Expended in the execution of variation, delays due to payment, and delays due to (management, climatic and other factors), (2) the formulation and use of suitable statistical packages based on the above could assist in forecasting of likely increases in both cost and time, (3) the statistical model for ranking contractors' tenders should be based on studies of simple regression and correlation co-efficients obtained by correlating Cost Performance i.e. (Final Cost/Initial Cost) against each of the following:- Final Time, Total Delay Time, Payment Delay Time, Variation Delay Time and delay time due to other factors.

Topics for further research were suggested, the outstanding being the studies on:- (a) time - cost relationships of labour cost and final time, (b) the relationship between the loss in profit of contractors and the prolongation of projects.

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CHAPTER ONE

INTRODUCTION

1.1 PUBLIC HOUSING IN NIGERIA

The acute shortage of houses in Nigeria necessitated the formulation of a policy whereby the government had to design and construct different types of housing units to accommodate its officials who serve in many rural and urban centres of the country. That policy was first formulated by the British colonial government and was continued by the Nigerian government whose post civil war reconstruction and development programme incorporated an enormous volume of expenditure on public housing schemes which had never been known in Nigeria.

In many parts of Nigeria, there exist in the old European quarters (now called Government Residential Areas), some old colonial types of residential buildings. However, they are being replaced by more modern West-European modelled housing. The common contemporary designs for the senior staff are in the following categories:- (i) three and four bedroom bungalows, (ii) three and four bedroom duplexes in a bungalow or in two storey formations, (iii) for the Junior and intermediate staff they vary from two bedroom apartments to one bedroom apartment.

Contractors were Nigerians or foreigners who were selected on tenders based on bills of quantities and the British Joint Standard Form of Contract (with some amendments).

Fluctuation and variation clauses were always honoured. The payment of fluctuation claims helped to ensure the smooth progress of work distortions in the market prices. Funding of the various projects were from public funds which depended principally on the fluctuating oil revenues of the Federal Government. So, once, there was a shortage of cash, the progress of work was impeded. However, the slow down of work may also be due to non-availability and improper management of labour, extra time devoted to execute variation, administrative and climatic factors. Therefore, what featured prominently in the construction scene was, (a) increase in the initial contract sum and (b) increase in the initial contract time.

1.2 BACKGROUND OF THE PROBLEM

At the time of entering into a contract to build a house for a client by a contractor, it is normally agreed that the contract sum is to be a given amount and that the work is expected to be completed within a given time period. Cost and time are therefore two important elements in a construction contract.

Under the JCT Form of Contract, payments are due to a contractor within thirty days of the issuing of a certified valuation. The JCT Form of Contract, generally provides that money shall be paid for all work properly executed and for materials on site as well as variation and fluctuation. Thus, in ideal situations, work-flow is usually designed to match the cash-flow pattern. In such cases, once the cash-flow pattern is distorted, the work-flow pattern and the timing of the project may be affected.

Public housing is funded largely from public finance. The complex of problems that centre around the revenue -

expenditure process of government is referred traditionally as "public finance". Authorities* on the public finance of developing countries argue that the revenue, expenditure and money supply bases of different countries lie on unstable bases. Importantly, also, they suggest that the financial planning of projects in developing countries often do not recognise the effects of unstable financial resources and thereby fail to take into account, the adverse side effects of time lags or time over-runs on projects.

Musgrave (1959) opined that public and private demand draw on the same total endowment of resources and share in the same output. Therefore, they jointly determine relative prices of products and factors, the uses to which resources are put, and the way in which income is distributed. Similarly, the flow of public and private expenditures and receipts join to determine aggregate demand and hence the state of employment and the general level of prices.

Chellal (1969) explained that underdeveloped countries are as much subject to economic fluctuations as advanced industrial countries are. But the major fluctuations do not originate in underdeveloped countries themselves. They originate in the more advanced countries and are then transmitted to the less advanced through foreign trade transactions. As is well known, many of the underdeveloped countries are export economies and a substantial part of their national income are derived from the export of a few primary products. In this situation, the state of foreign demand for exports determines to a large extent the state of the economy. Fluctuations in foreign demand immediately set up inflationary or

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* Chellal, Mc Queen, Priest, Adedeji, Okigbo

deflationary movements. Thus a sudden boom in exports, through the operation of the foreign trade multiplier, leads to a rise in national income and prices; the converse happens when there is a fall in exports. On monetary instability also, Chellal (1969) pointed out that many developing countries indulged in considerable amounts of deficit financing, first for prosecuting a war, and later for purposes of reconstruction. This resulted in a good deal of inflation and monetary instability.

The above explanation by Chellal (1969) appears to be true in the Nigerian situation because the national income rose appreciably during the oil boom period of the early and mid 1970's and the converse was the case when export earnings from oil fell in the late 1970's to the 1980 - 90's. Chellal's opinion also appeared to be illustrative of the Nigerian economy which faced the trauma of a civil war (1967 - 70) and which mounted a considerable volume of construction work during the post war period.

Shoup (1969) argued that if prices have been rising at, say, 50, 75 or 100 per cent a year for a good many years, better results may be obtained, paradoxically, by a shorter period of transition than that allowed when checking a rise of 20 or 30 per cent a year. The pressure of a very rapid rise in prices tends to break down the structure of the economy, and to liquefy it. The fortunes of various sectors fluctuate widely, as it becomes more difficult for anyone to foresee the changes in receipts-costs relationships. Resource transfer to the stable-price pattern is easier. The public finance measures for a transition from very

rapid inflation to price stability may accordingly be somewhat less selective, somewhat more uniform and general; they would be appropriate for transition from a substantial but not exceedingly rapid inflation. Shoup (1969) also argued that the simplest way to avert a decline in the domestic price level is of course devaluation, assuming the relevant elasticities are appropriate. The question remains whether public finance measures can maintain internal price stability or at least slow down the rate of decrease of the internal price level if the currency is not devalued. It seems that this is not possible with any public finance measures that are not themselves covert devaluations: for example, a subsidy on exports and tax on all imports. The role of public finance in preventing or reducing the rate of decline in the domestic price level of an underdeveloped country therefore appears to be a minor case.

Shoup's (1969) argument may be controversial, but his ideas appear to be applicable to Nigeria. The various governmental measures taken to control the rising prices of construction resources, have always failed for example, the price control decrees established in the 1970's could not succeed. The devaluation of the naira since 1986 could not steady the rising cost of construction resources.

Bromilow (1971), observed that a characteristic complaint in building is that payments to the main contractor by the client are often slow and uneven because of late valuation or honouring of certificates. This in turn causes delays in payments to suppliers and sub-contractors. In consequence, both the client and the

obliged to use more short-term finance than should be necessary. The period from the time a builder or a sub-contractor first acquired a piece of material from a supplier to the time he receives money generated on account of that specific purchase can be far longer than one month or even two or three months. The scope for delay at any stage is considerable for reasons which may be quite unconnected with the particular item and is sometimes exploited ruthlessly. In the long run, failure to pay at the agreed date has disrupted the stability of the whole industry and sometimes even caused technically competent operators to go bankrupt.

Mc Queen (1973) reviewed the structure of government revenues in underdeveloping countries and emphasised that the obvious feature of government revenues in those countries is the heavy reliance on indirect taxes, typically accounting for 60 to 70 percent of revenues, compared with a proportion of 40% in the U.K. He cited a U.N. study which found out that between 15% and 40% of total tax revenues of developing countries came from import tax revenues with a generally much smaller proportion coming from exports. Once income growth slows down or falls, then the growth of tax revenue will decline as imports fall. This source of revenue will also be on a shrinking base if the economic growth is constrained by shortage of foreign exchange.

Myint (1974) reviewed the instability of revenue and expenditure of underdeveloped countries via the concept of market mechanism and economic development theories. He opined that there is a widespread and influential belief that the underdeveloped countries should rely less on the automatic market forces and more

on deliberate state action to promote economic development. The distrust of the market forces in many underdeveloped countries arises so much from considerations of economic growth as from considerations of economic equality and security.

Prest (1975) also pointed out that some investigations over a twenty four-year period (1930-53) in the Carribean area showed that there were large errors of estimating with a strong tendency to under-estimate both revenue and expenditure and the former relatively more so than the later. A study of Columbia's case also showed substantial errors in the direction of over-estimation on the expenditure side. The large discrepancies between these sorts of findings and those for a country like the U.K. can be explained either in terms or deliberate policy, or the difficulties of accurate forecasting in the light of frequent unexpected changes or incompetence.

Prest (1975) strongly argued that the public finances of underdeveloped countries are liable to suffer severe short-term embarrassments. These may take the form of reductions in the proceeds on taxes levied on the profits of exporters, or taxes on the exports leading to a reduction of imports. This may also cut government revenue severely if it is heavily dependent, as so often is the case, on import duties. Fluctuations in export prices are common in developing countries. These fluctuations may be due to changes on the supply side or the demand side, or a mixture of the two. On the demand side, there are two reasons for violent fluctuations; first, exports are frequently a high proportion of GNP and secondly, one or two commodities often bulk

large in export. Therefore, changes in demand conditions for one or two commodities may be sufficient to generate large changes in incomes. He explained that an important consideration in budget planning in developing countries is the time horizon. There are several sub-questions:- the length of any one budgetary period (twelve months, or more or less), the number of such period considered in any one budget and methods of linking one set of estimates with another. It is sometimes argued that one can avoid all problems of expenditures straddling different periods by extending the length of a given period. This is clearly not so; however long the period one takes, one can still have projects being started at the end of it and overlapping into the next one. Different projects need very different lengths of time for their execution.

Okigbo (1981) showed that there was seasonality in the movement of money in Nigeria between 1970 to 1979. April to September seemed to be the slack season while October to March appeared to be the busy season, with the trough resting between May and June and the peak between December and January of each year. What accounted for the increase in money supply in the busy season was two-fold. Firstly, the buying season for a number of agricultural commodities fell within the period; October to April, and, therefore required substantial holding of cash resources to enable the licensed buying agents to pay the farmers and the agricultural merchants. Secondly, public construction works were usually undertaken in the dry season leading to substantial outlays of public funds for work done. It was also the time when merchandise trade was mostly suitably carried out; this accounted also for the growth in demand deposits within that period.

Okongwu (1984) reviewed the unstable pattern of Nigeria's public finance for the period 1978-82. He observed that there were discountinuities induced by changes in the resource picture which was dominated by income which are principally, federally collected revenues from oil proceeds. He further noted that those changes had impacted virtually cyclically every year on the economy directly and indirectly through the annual federal budget and its complex problem of direct and indirect controls.

Figure 1.1* shows the fluctuation trend in the money supply pattern. From 1970 to 1972, there was a decline which rose and dropped dramatically in 1974. At the end of 1974, it rose again and it reached a peak in 1977 at the end of which it maintained a trough.

Figure 1.2* showed the profile of Crude Petroleum, Construction and Housing measured as GDP at current cost factor 1978-82. Revenue on Crude Petroleum dramatically rose between 1978 to 1980 and dropped steeply between 1980-82. Also, construction rose almost steadily from 1978 to 1981 with a slight decline between 1981 to 1982. It is however interesting to note that although crude petroleum rose sharply and fell sharply between 1978 to 1982, within that period, construction maintained a steady increase. That phenomenon may be due to the priority given to the housing sector and also for the fact that external loans might have been used to finance the housing projects within that period.

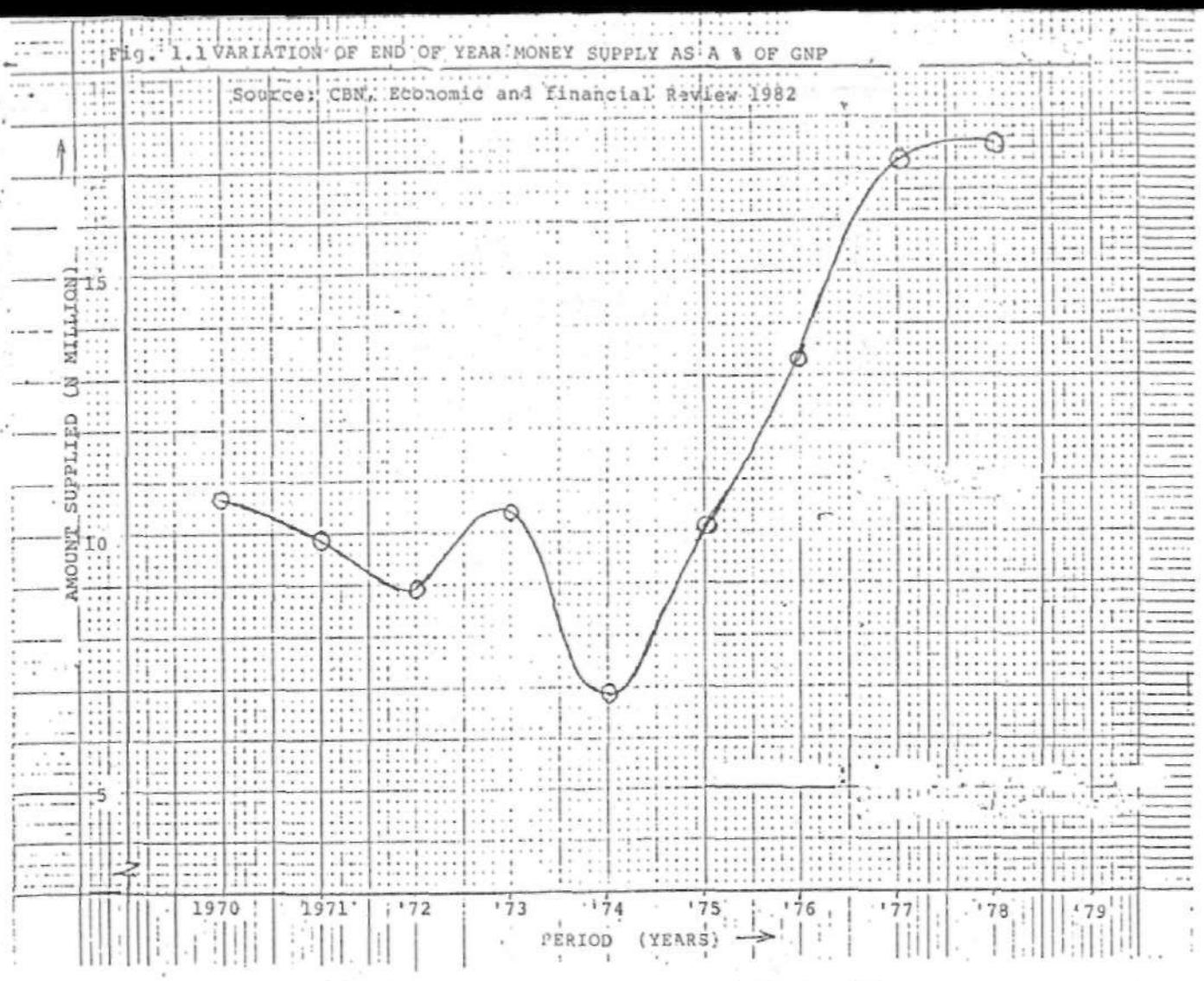
Figure 1.3* describes the factors affecting money supply and 1970-1979 and indicate the rise and fall of net foreign exchange assets of the bank credit to private sector and net credit to government. It is important to note that between 1973 to 1976

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* The views held by Priest, Okigbo & Okongwu are being supported by information contained in figs 1.1, 1.2 & 1.3.

Fig. 1.1 VARIATION OF END OF YEAR MONEY SUPPLY AS A % OF GNP

Source: CBN, Economic and Financial Review 1982



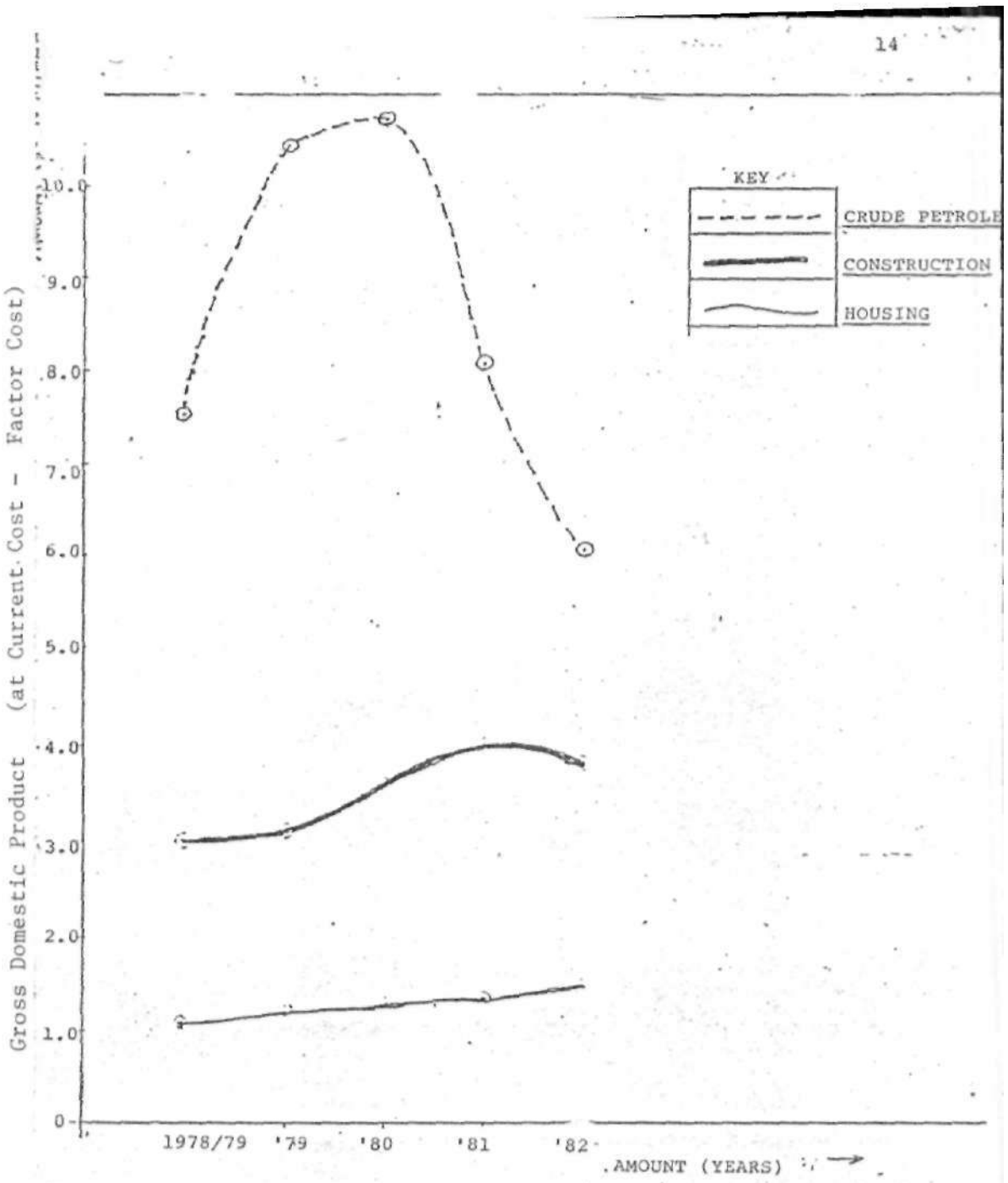


FIG. 1.2. : GROSS DOMESTIC PRODUCT AT CURRENT FACTOR COST (1978-82).

SOURCE: CBN ECONOMIC AND STATISTICAL REVIEW (1982).

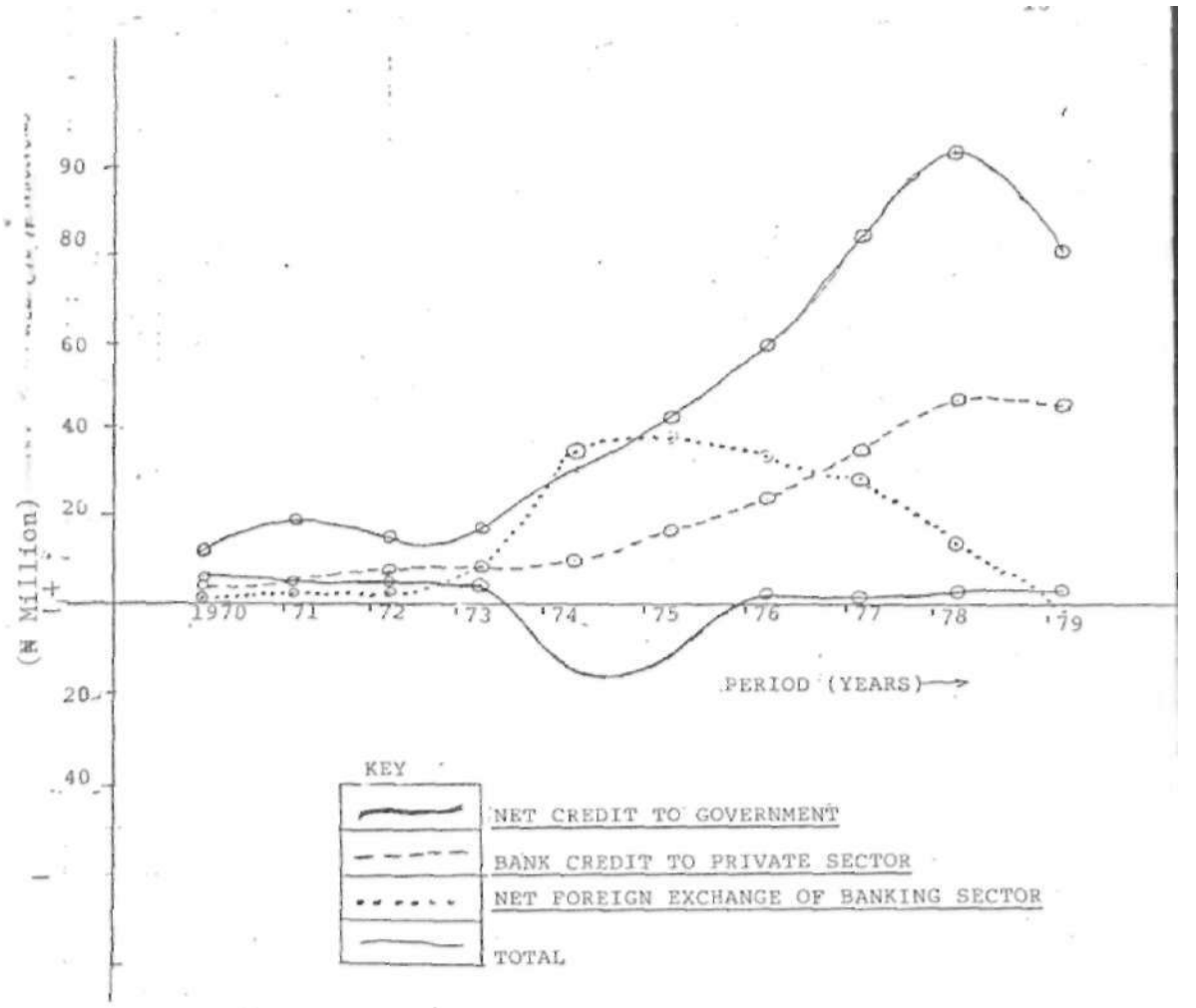


FIG. 1.3.

FACTOR AFFECTING MONEY SUPPLY 1970-79

SOURCE - CENTRAL BANK OF NIGERIA : ECONOMIC & FINANCIAL REVIEWS 1982.

the net credit to government was in the negative. That is an indicator that between 1973 to 1976 there must have been some difficulty in the funding of public housing projects without external loans.

The discussion so far held in this chapter can be summarised as follows:- (1) the various government measures to control the rising prices of construction resources have always failed, (2) a great deal of deficit financing was always used to prosecute public projects, (3) underdeveloped countries are as much subject to economic fluctuations as the advanced industrial countries, (4) failure to pay at the agreed date has disrupted the stability of the whole industry, (5) the structure of government revenues in underdeveloped countries is the heavy reliance on indirect taxes which falls as imports falls; they usually face short term financial embarrassments, (6) there are large errors in the estimating of income and expenditure (7) Nigeria public finance, like that of other underdeveloped countries, exhibits a reasonable measure of instability, and, (8) there is seasonality in the movement of money in Nigeria, the rainy season and the dry season form the peak periods for expenditure on agriculture and construction respectively.

1.3. <u>Statement of the problem:</u> From the foregoing the statement of the problem can be deduced as follows:-

(1) Cost and Time are two important elements in a construction contract.

(2) The Form of Contract allows for the payment of fluctuation charges as well as variation which are added to the initial contract cost.

(3) Fluctuation charges may rise with the elongation of a project.

(4) The elongation of a public project is primarily caused by lack of funds as at when due.

The lack of funds is due to unstable public financial base

(5) Efforts made to control the cost of construction resources by state action or public finance measures have always failed.

(6) Initial Contract Time is always not equal to Final Contract Time because of the prolongation of a contract.

(7) The errors in the estimation of project duration and cost of construction in developing countries may be due to incompetence or lack of planning.

1.4. THE NEED FOR THE STUDY.

The various problems enunciated above have given rise to the desirability of reviewing the need for the study of those problems.

Housing is one of the basic necessities of life. It borders on the social, economic, political and technological aspects of any community. Housing in general and public housing in particular are always a sensitive national issue. Various studies have been undertaken and are still going on in the social, economic, political and technological aspects of both the public and private housing in Nigeria in order to provide scientific explanations to some of the problems on design and construction. The provision of houses for the public involves high capital outlay and there is always a pressure from the general public on "when will the building be available?", apart from the general bewilderment on the

excessive cost of housing projects. Therefore, from the public view, there are two essential points always raised in the housing question: "Cost" and "Time". As discussed ealier from the contractual view point, the two important components are "Cost" and "Time". As the general view is that the source of funding of public projects lie on unstable financial bases leading perhaps to the elongation of project time with the probable compensation for fluctuation, it becomes evident that scientific studies be undertaken of relationships existing between Cost and Time of construction.

The following literature opinion also support the idea of mounting some scientific studies into the relationships existing between time and cost of housing projects in Nigeria.

According to Goodacre, (1974), in the execution of public housing programme in Great Britain, some of the highlights in the post construction scene are the staggering differences between initial and final contract costs as well as the marked differences between initial and final contract times. Goodacre called for a concerted effort to explain scientifically, the patterns of differences into those construction resources. That calling provided a base line for this study.

Perry et al.(1977) noted that the time value of money assumes greater importance in the long duration projects common to the construction industry and it is essential to establish and apply sound time-money principles. This will reduce the likelihood of ill-founded decisions based on inaccurate predictions of the outcome of the project or contract. Some of the disadvantages are that it is comparatively new and tends to create organisational

empires and to over-produce paper work. Also, the system is a decision maker instead of being an aid to decision making.

Parker et al. (1972) highlighted the importance of resource-time studies in construction. They found out that the use of mathematical models based on cost-time relationships helped to improve and optimise operations particularly in the manufacturing industry. They suggested that cost-time studies should be extended into construction operations.

A World Bank Report (1984) highlighted the need for cost studies in the construction industries in developing countries so that improvements can be made on the efficiency, timeliness and quality of construction and maintenance. From the World Bank's Report, therefore, there is a need to mount studies to establish how to improve the cost and timeliness of projects.

Giwa (1988) identified the causes and magnitudes of excessive escalations in contract sums of some building projects in Nigeria. He established the fact that various final account statements attributed the increases to fluctuations 10.20%, variations 8.43%, PC sums 5.98%, Remeasurements 0.50%, Provisional sums 1.37% and others 73.52%. His studies became a very important contribution to knowledge of the pattern of increase in contract costs. However, his studies of cost patterns were not related to construction time patterns. He also admitted that his analysis did not extend to the excessive time overruns being experienced in project completion and he then recommended that the question of time over-runs be further looked into.

Husseini (1991) strongly argued that because the Nigerian construction industry has faced the problems associated with a traumatised economy, there is a need to adopt an effective

strategic planning of projects particularly with respect to financial allocation. He suggested that for all major projects, feasibility studies must be carried out to ensure their viability and funding. He warned that the rush-approach to project implementation should be stopped and that reasonable time must be provided for the design and construction of all projects. In essence, Husseini (1991) was suggesting that there is a need to properly cost a given project and to undertake a thorough review of the time constraints before commissioning the project.

The discussions in this sub-section held by Goodacre, (1994) Perry et al. (1977) and Parker et al. (1972) suggest that, (a) there is a need to study the patterns of differences existing between the initial and final contract times as well as the differences between initial and final contract sums, (b) it is essential to apply a sound time- money principle on long duration construction projects, (c) mathematical models based on cost-time relationships assist in the optimisation of operations.

As well, in this sub-section, the reviews held by a World Bank Report, Giwa (1988) and Husseini (1991) can be summarised as:- (i) there is a need to mount studies to establish how to improve the cost and timeliness of projects of developing countries, (ii) the question of excessive time over-runs should be subjected to further research, (f) cost and time constraints are two important factors for strategic planning in construction.

From the above, it is evident that there is a need to go into a research on time-cost relationships of construction in Nigeria.

Some studies on time-cost relationship had been undertaken and published in the following countries:- the United Kingdom, the U.S.A. New Zealand, Australia and Singapore. It was therefore expedient that similar studies be undertaken of construction in Nigeria. The outcome of such research work would contribute immensely to the growing pool of knowledge of time-cost relationships of the world in general Nigeria and Africa in particular.

1.5. THE OBJECTIVE

The objectives of this study are to:-

(1) Survey the literature to determine the state of the art of time and cost relationships existing in different countries.

(2) Design suitable mathematical models of study into time and cost relationships during post-contract.

(3) Identify the factors or causes of change in time and cost.

(4) Promote management understanding of various components of time-cost relationships.

(5) Establish some scientific basis for the effective control of time and cost resources available in the construction of housing projects in Nigeria.

(6) Recommend areas for further studies on time-cost relationships.

CHAPTER 2

LITERATURE REVIEW

2.1. INTRODUCTION

From the provisions in the JCT Form of Contract, the total cost of a project at the end of a contract is a summation of the following:- (i) Initial cost, (ii) Variation cost and, (iii) Fluctuation cost. The total time for the completion of a project is a summation of the initial time and extension of time. The following literature reviewed each resource component as well as some previous work undertaken on cost/time relationships.

2.2. INITIAL CONTRACT COST

Initial contract cost can be defined as the proposed cost to a client for executing a project within a given time and under certain technical and legal terms agreed to by parties to a contract.

Stone (1966) reviewed pricing theory in relation to bidding situations and stressed the fact that bid situations resemble bargaining situations in that the price is being fixed for a particular supplier - customer deal. The existence of an invitation provides the information that the buyer is unlikely to settle for the alternative of not making a deal. However, the seller also knows that the publication of the invitation to tender will bring other firms into the market. The seller is at a disadvantage in that he has no exact information about the prices quoted by competitors, but he does know exactly what has to be supplied in order to be

able to supply it. Stone (1966), further argued that unfortunately, this knowledge creates the opportunity for collusion. Quotes on particular bids may be arranged as part of a series of quotes designed to ensure that business is shared out in a particular way. If no conclusive arrangement is possible, then the individual firm may try to predict the bids of its competitors by relating bids to past bids in similar situation.

Broster (1968) noted that modern theories recognise that businessmen may not be interested in profit alone but also in the extent and growth of their sales, market share, inventory position, liquidity, prestige, and labour relations. Also, the customer's choice is influenced by a multiplicity of factors, including the social standing and the opinion of friends advertisement and shop displays. Not all management would wish to maximise profits by optimising among them for example, in state-owned industries, like the British Post Office, the object of pricing policy is not much to maximise profits but essentially to serve the best interest of the community. To ensure that, the pricing policies of the nationalised industries are subject to some measure of government control.

Samuelson (1970) explained the principles of supply and demand in relation to the initial cost of projects. He observed that when the price of a good is raised (at the same time that all other things are held constant), less of it is demanded. The demand schedule reflected market prices. He opined that there could be more flexible pricing in the building industry than in manufacturing. He also pointed out that uncertainty may enforce a lower level of investment than the volume of work actually available would warrant in a manufacturing kind of industry.

The discussions held by Stone (1966), Broster (1968) and Samuelson (1970) above, indicate that in arriving at the initial contract cost, some social and economic factors like supply and demand as well as the level of competition and social benefits are considered.

Southwell (1971) said that the "builder's price is the building owner's cost and that most of the data provided in cost analysis are based on the cost to the client in respect of projects.

Seeley (1972) argued that the process of arriving at the initial cost of a project is not only a personal process but it also reflects the varied approaches and policies of different organisations. He also pointed out that estimating and pricing may not always truly reflect the actual costs on a site.

According to Pilcher (1973), an investment can be constantly under risk in the more unstable overseas territories where large assets can virtually be stopped or shelved overnight because of political instability and nationalisation.

Neo (1974), held the view that apart from the fear of political uncertainties there is the likelihood of an outbreak of war, civil disturbances, insolvency or default by the employer, devaluation in currencies, exchange losses, inflation and fluctuating interest charges.

Landsell (1975) pointed out that the cost of a project may include professional fees, land acquisition expenses, payments to the contractor, furniture and equipment, commissioning and bringing into use and the interest charges for finance.

Goodacre (1976) explained that cost incurred by the client are not necessarily the same as those incurred by the contractor

executing the work. Initial contract cost comprises the summation of a contractor's cost of materials, labour, plant, finance, overhead and profit.

Mogbo (1978), noted that in arriving at the initial cost of a housing project, there are two principal technical problems that face the contractor, the client and the consultant. The technical problems are, (a) information and (b) risk assessment. There are two types of information necessary for assessing the initial cost of a house:- technical specifications and legal obligations. A major technical information is a quantified specification (often call bill of quantities). Sets of legal obligations are normally contained in any contract document. The type, quantity and quality of technical information are often in-exact because of the level of preparedness of design information. Also, the analysis of the rates to be applied to some work items may be difficult to assess because as discussed above, they may carry with them, some social economic and administrative factors which may be difficult to quantify. The assessment of the cost of carrying out some imposed legal obligation may as well not be quantifiable.

The discussions held by Southwell, Pilcher, Landsell, Goodacre and Mogbo (1978) point to the fact that the determination of an initial contract cost of a project is a personal process which may be linked also to the policies of different organisations.

The assessment of legal obligations as well as of risk due to political instability may have no basis for quantifiation.

Morrison (1980) pointed out that estimators tend to use historic costs from projects of which they have personal experience. This generally means that he data considered for

pricing a new project is very limited. Consequently, unrepresentative information is often used. Also, estimates are often produced in which a substantial proportion of the value lies in a very small percentage of the items priced. This tends to reduce the accuracy of the estimate as a whole to that of a few high value items.

Bennett (1983) pointed out that research findings undertaken at Reading University in the United Kingdom showed that accuracy of pricing data could be increased by isolating reasonably evenly-sized packages of work. About 100 such packages should be isolated for pricing.

Kolawole (1985) studied the pre-bid construction process in the light of venture profiles and suggested that the assessment of risk in construction contracts in developing countries can be successfully carried out using the method of utility theory, simulation, subjective probability and the use of microcomputers. He argued that the use of single value estimate of the various factors to assess risk which is highly stochastic in nature is grossly unsatisfactory. He showed that for a complete assessment of risk, it is necessary to perform sensitivity analysis so as to provide answers to certain naughty questions, improve the assessment and guide the management of risk. Thus, his findings are very important to the realisation of a realistic Initial contract cost.

Bennett (1986) suggested that each Q.S* Practice could build up its own data based on known projects and also prepare its own cost analysis. The two could be transmitted to the central data base which would match each new analysis with all the others. The centre would produce sets of unit rates in a form which makes it

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Q.S = Quantity Surveying

easy to choose the right one for any particular item on a new project. Unit rates would be transmitted back to individual Q.S. as needed. At each stage, data would be handled and calculations made by the computer. Bennett (1986) advised that statistical tests and wide range of estimating methods would enhance decisions.

Griffiths (1987) also provided explanations on the preparation and processing of data on construction costs in the U. K. Quantity Surveyors constantly need to refer to building price indices for a wide variety of purposes, and that one of those available for use in housing is the price index of public sector house building. The new index provides a measure of the change in tender prices for the construction of new public sector housing in England and Wales. The price data are extracted from the BQS of successful tenders for dwelling of traditional construction in blocks up to four storeys. Each item is selected to represent all the work in a particular work section or subsection, so that price movements of the other items in that work section are assumed to be broadly similar to those of the representative item. In order to provide anonymity, the returns do not include any means of identification to a particular contract. Weighted indices are later produced.

The discussions held by Morrison, Kolawole, Bennett and Griffiths postulate that the application of historic costs and weighted price indices have limited uses. The performance of sensitivity analysis is necessary for the assessment of various types of risk. Also, the carrying out of other various types of statistical tests would help in the determination of the initial contract cost.

The discussions held in this sub-section, show that the various Initial Contract Cost to be obtained on Nigerian

construction projects may show some marked differences because of (a) different pricing policies of various organisations,(b) the varied approaches used in the assessment of risks and,(c) the pricing techniques of estimators who may use different approaches.

2.3. VARIATION COSTS

The term 'Variation' as referred to in construction means sums of money added to or subtracted from an initial contract sum for adjusted physical works and/or adjusted compliance of some legal obligations in a contract.
Variation is always inevitable in most construction contract because of the ever-changing nature of the design and construction processes.

The Banwell report (1964) noted that it would be to the benefit of the whole industry if the impact of claims of variation were substantially reduced for it cannot be totally eliminated.

According to Wainwright (1968), the first of the special and difficult cases is for works of emergency of peculiar nature where a different procedure is used. The use of "day-work" rates are often applicable and it is based on published data (issued by the National Joint Industrial Council) or such other rates that may be agreed to by both parties. The second case is the determination of values not directly related to productivity but on time, like "extension of time claim". In such cases, values are obtained principally by examining various facets of the "preliminaries" affected by time and perhaps, relating them to some substantive work executed. The third case is the claims for "Legal Obligation"

like loss in turnover, penalty clause, liquidated and ascertained damage. The determination of loss in turnover is based on business consideration of profit, loss, changes in overhead and interest charges.

Emden et al. (1969), observed that the matters in building and engineering contracts which are most frequently changed are the making of additions, omissions and variations, the dispensing with or varying of stipulations as to the time for completion and as to the claim of ascertained and liquidated damages against contractor for delays. Building and engineering contracts usually contain provisions giving power to the employer or his architect or engineer in some specified manner to vary the works embraced by the contract.

Bromilow (1970) concluded from his studies that the client generated approximately half of the variations involved in the construction of Australian buildings based on competitive tenders. He suggested that the use of package deal of contracting may restrict clients' use of variations. It could well mean that competitively tendered projects are subject to a higher proportion of delays due to variations instigated by the client.

Lucas (1974) pointed out that probably the most abused device of all the contractual procedures is the variation order. In theory, it is simple enough and seems eminently practical. After contracts have been made, the architect may decide to change the design in some way - the intention is clearly to cover quite minor variations - and a procedure for modifying the contract sum accordingly is defined. However, some projects hardly pass without more variation orders, some of minor nature but some seeking to change large sections of the work. There is no doubt

that competitive tenders have been obtained against drawings, bills and specifications which it was known would bear little resemblance to the completed building. The cumulative effect of this large number of variations is that a considerable extra cost is incurred and also a considerable extra time is needed to execute the extra works.

The preparation and processing of data for variation are in almost all aspects the same with that of the initial contract sum. This is because additional or adjusted work are normally worked out on pro-rata the BQ rates.

Goodacre (1974) suggested that the volume of variations can be controlled if the client maintained a closer contact with operations on site and be aware of the problems both being encountered and foreseen and thus integrate his own cost control with the progress on site. Also, special attention should be paid to alteration contracts. As well, emphasis should be laid on forecasting interim payments, cost of anticipated variations and the final account. They are actions to be take before cost are actually incurred.

Thompson et al. (1977) explained that by their nature, construction projects are subject to variability and change. The changes might be unavoidable or due to deliberate management and economic policy.

Thompson, et al. (1977) also contended that one of the most significant effects of changes in construction was upon the pace of work. Variations can cause changes in the rate of work and also, may have a significant effect upon the cost. For example, a small change made to an earth dam during the earth - moving operations caused a 1% increase in cost. A cost model of

the contract would have made no significant difference to the cost. Barnes (1977) also noted that other effects of a change in the pace of work was upon cash-flow. He demonstrated that an increase in cost during period of construction of 5% could cause a three-fold increase in the capital employed although compensated for in the final account. The return on turn-over remained the same, but the return on capital employed, a better measure of profitability, was reduced to one third.

Carpenter et al. (1981), argued that a project is only a means to an end. The end may be a public service or a commercial market, but the predictions of either may change, perhaps, because of economic or administrative reasons and therefore, require changes to design or programme.

Barry (1984) explained the methodology for an effective control of the volume of variation in the construction of Heysham Power Station in the U.K. It followed the procedure of the Board. It was effected by the identification of all changes and potential changes at the drawing board stage. This allowed both the designers and the client the opportunity to consider alternative strategies. The key to this successful operation has been the location of a cost control surveyor in the design engineer's offices. He incorporates design changes when they occur and potential design changes as soon as they are identified.

The reviews held in this subsection pointed out that variation cost is always inevitable due to deliberate management and economic policies. The value of variations can also effectively affect the initial speed of work. It is therefore important that the relationship which exist between variation and final time be of interest in this study.

2.4. FLUCTUATION COST

"Fluctuation" cost refers to a sum of money paid by either party to a contract to compensate for the rising or falling in prices of some principal construction resources like labour, material, plant or overhead. Fluctuation cost is therefore a bye- product to inflation and deflation.

Furness (1975) observed that a developing country which is committed to rapid growth and which is still at an early stage of industrialisation inevitably has a rapidly growing demand for capital goods, specialised services, intermediate goods, raw materials and sophisticated consumer goods which cannot be produced domestically at an economic cost. The rise in import costs (implying a corresponding reduction in the real income of that country's residents) is liable to set in motion, cost inflation, particularly if the exchange depreciation is not accompanied by adequate deflation of internal demand. There are undoubtedly many dangers and problems in a regime of flexible or floating exchange rates. All too often, the benefits of exchange depreciation have proved to be temporary, the competitive advantage being eventually eroded by the spiral of demand and cost inflation.

Perry et al. (1977) stated that inflation has become an acceptable fact in the current commercial work and seems likely to remain so. It is hoped that such pessimism is unwarranted but nevertheless, it emphasizes the need for a serious reconsideration of financial and contractual management procedures. At a time of high and variable rates of inflation, it is expedient to review the implications for project and contract finance. The final contract sum is

affected by extra works and variations which are magnified in an inflationary situation.

Allen (1984) asserted that in recent years, inflation has had a major effect on the profitability of many long-term contracts. The risk involved with fixed-price contracts is greater than with inflation - adjustable contracts, given otherwise similar circumstances. The greater the period which the contract covers, the greater too will be the risk of variation in contract profitability due to inflation. But whether the price has been established as fixed (i.e. not price - adjusted for inflation) or has been adjustable (in line with pre-agreed formulae) inflation can significantly reduce contract profits if not handled carefully.

Perry et al. (1985) also noted that the "Baxter" formulae used in civil engineering work or other price adjustment formula are approximate - reimbursement is independent of actual cost escalation and there is no consideration for non-recoverables.

In the absence of price adjustment formulae, cost escalation is processed by scrutinising the various vouchers and claims submitted by contractors. This is a tedious operation and always involved disagreement between the contractor's and client's representatives. But it's inherent advantage is that it is not per se, the average claim but not the real claim. This is the method prevalent in Nigeria.

It stands to reason then that short term fluctuations on labour, materials and equipment can have a disastrous impact on the economic viability or delivery of a project. The stabilisation of some of these resources is difficult under the

present structure of the construction industry. Construction is a service industry which is geared to respond to cyclic fluctuations in the economy and which depends on a transient labour force. It also exerts little control over the production of materials and equipments.

Farrow et al. (1986) explained that a good method of controlling fluctuation cost was (a) to maintain a good and close monitoring system, and (b) the liberal use of cost studies, often in consultation with the contractor.

Revay (1985) pointed out that the cost due to fluctuation can be influenced by changes, late or inadequate supply of information, active interference on the part of the owner (or his agent), changed soil conditions, or acceleration and strikes, inclement weather, shortage of labour and material, or unavailability of construction equipment. Which of these factors are compensable by the owner would of course depend on the terms of the given contract. The costs flowing from those causes may be classified in two broad categories:- (a) time-related, and (b) productivity - related. Time-related costs are normally not compensated by the client while productivity related are usually, the risks assumed by the contractor.

Osemenam (1987), argued without any empirical evidence that in Nigeria, periods of contracting is extended because of technical problems associated with changes in the desires of the client, insufficient technical drawings and details at various stages of work, paucity of co-ordination of the works of various consultants delays in payments of certified valuations.

The reviews in this sub-section highlight the facts that, (a) inflation has a major effect on the profitability of a contract, (b) the payment of fluctuation claims has become inevitable due to inflation and the structure of the construction industry. Also, inflation has a major effect on the overall cost of a contract, (c) fluctuation can be influenced by the volume of variation as well as delays due to:- inclement weather and the unavailability of construction resources.

From the above inference, it is therefore expedient that in the study of cost-time relationships, appropriate investigations should be undertaken on the effects that: (a) final construction time has on the fluctuation cost, (b) delay time has on the fluctuation cost.

2.5. FINAL CONTRACT COST

"Final Contract Cost" is a summation of the values of the initial contract sum, variations, and fluctuation costs paid to a contractor by a client for work executed within a given time. Therefore, all the discussions held on initial contract cost, variation and fluctuation costs, in this chapter apply in all aspects to the "Final Contract sum". The completion of work in whole or in part gives rise to Final Contract Sum. It is always a welcome event to all parties when completion is achieved and Final Contract Sum is agreed to and honoured. It needs a lot of goodwill and determination from all parties to a contract.

Brett (1969) argued that the length of time allocated to the construction of a particular building can be

economically critical and discussed a logical method of arriving at an economically correct decision. He argued that conventional building methods may at first sight, appear to cost less than an alternative and faster non-traditional method. In fact, the industrialised method which would normally result in a shorter construction period and so incure less interest charges could be the most economical solution.

Morris (1977) stated that cash-flow is significant because of the usual delay between the time the contractor renders requests for payment and the time that he receives his reimbursement form the owner or financier. In addition, there is a customary retention of a portion of the funds by the owner to guarantee the work. This final payment is made after the last inspection, often several months after the completion of the project. Both the periodic reimbursement for extra times and retention of funds until project completion tend to burden the contractor with the finance charges or act as a drawdown on funds otherwise usable for investment purposes. As such, the cash-flow has direct effect on the recovery cost.

Moreledge (1978) stressed the importance of records of costs and expenditure. The contractor is required to keep records of certain costs in the form of labour and plant, time, and material costs. This requirement is either specifically required by the contract, or may be inferred from the document. Such records include daywork expenditure, costs related to claim situation and details of varied work. The failure to keep

accurate records of this type results in unnecessary argument as to the costs actually involved.

Brandon et al. (1985) opined that "political expediency" was responsible for the completion of Sydney Opera House. "The original estimate was £2.5m... the final cost was £56m largely paid for out of government lottery". The political will overshadowed all other problems including the astronomical cost and then produced a building of outstanding quality and profit to the community.

Moore (1987) illustrated the importance of data processing to final costs when he described the project management strategies adopted in the conversion of an unfinished hotel into prestige offices in the U.K. Full budget and cost control systems were used together with overall and short-term programmes, which allowed for continuous detailed monitoring of construction events and expenditure. PMI (Project Management International) summarised progress and events, and made analysis of the performance of the consultants in relation to their agreed design programmes and fee expenditure, in regular reports to the client. The main bottlenecks were highlighted ahead of requirements to ensure minimal adverse effects to the works on site.

The salient points raised in the discussions held in this sub-section on Final Cost can be summarised as follows:-
(a) the length of time allocated to a project can be economically critical, (b) retention money which is released at the end of a project can adversely affect the financial capability of the contractor as well as the contractors overall performance efficiency, (c) costs actually involved on a project can be

obtained by keeping the records of various resources and events.

From the above, it was necessary to examine the effect that the Final Time had on the Final Cost. The data for such studies could be obtained from recorded project information.

2.6. TIME

The time for the construction of a project is the period agreed to by parties to a contract within which a completion is to be achieved. Because of the complexity of building operations, the proposed time of construction is hardly-ever achieved. The construction time on any given housing project is therefore divided into two major parts: the initial time and the final time. Extra time is the difference between final and initial contract times.

Benwell's report (1964), pointed out clearly that insufficient regard is given to the importance or value of time and its proper use in all aspects of a project, from the client's original decision to build, through the design stages and up to final completion. Time well spent can mean time and money saved. It suggested that modern techniques of programming should be used to provide an overall discipline for all concerned.

Bromilow's (1970), research into contract time performance on some professionally designed Australian building

projects showed that on the average, the time for construction originally allowed in the contracts was only 68% of that actually taken (i.e. over-runs averaged 47%). He showed that this was mainly the result of over-optimisjm in stipulating the construction period in the contracts.

Lowe (1970) held the view that package deals are more often than not, chosen when time is short, and as is thought that the normal method of using consultants is too time-consuming.

Calvert (1970) said that the precise form in which a programme is set down on paper may depend to some extent on the type of work being undertaken. Graphs showing quantity against time are simple to understand, and may be inconvenient for individual operations such as concrete output. Complicated sequences like the finishing trades in multi-storey building can be explained by isometric drawing and other pictorial strategies may be devised for special occasions but the commonest and most satisfactory method is the Gantt or Bar Charts. Charts of this nature are very versatile. It is usual to list the items to work one below the other on left-hand side and show time horizontally. Bars may be suitably hatched or coloured to distinguish trades or left blank for the future recording of progress.

Saunders (1971) observed that the cost of building factories and plants is still plagued by massive over-runs and suggested the use of project management to accelerate the pace of work. He asserted that "Project Dynamics" stresses that engineers are often unaware of the financial implication of late completing and do not appreciate that the construction of a new production facility is not the final goal, but only the first

stage in a larger project.

Pilcher (1973) advised that it is an important function to balance the ideal requirements of the client against the cost curves of the contractor in order to produce an optimum project period the also pointed out that net work analysis covers a range of slightly varying techniques known by different names; the three most common in use are the Critical Path Method, PERT and Precedence Networks. All of the three use similar principles and similar approaches. Network of activities are drawn, a duration is then assigned to every activity. The length of all possible continuous paths through the network are added up to give the total duration for each path. The longest path through the network represents the minimum overall duration in which the work can be completed using the plan represented by the network and is known as the critical path. Network analysis methods when used for controlling projects may be said to have some of the following advantages:- (a) the systematic approach to planning encourages a logical discipline in the overall process, (b) it allows the practice of management by exception, inasmuch as it concentrates attention on critical activities rather than those which have an abundance of float.

Bromilow et al. (1974) contended that at the times of high inflation rates, the project time is more critical because of mounting construction costs. In a study of some Australian building projects, they showed that on the average, the lowest tender leads to the lowest contract sum, but additional costs brought about by delays in construction can be and often are in excess of the differences between the lowest and the next tenders. They argued that the lowest tender may not result in

the cheapest overall cost to a client unless considerable care is taken to include time performance and financial reliability of tenders.

Harris (1978) suggested that a prudent client will manipulate the costs and benefits associated with alternative time scales in order to produce the optimum project control. He pointed out that the important date to the client is the contract completion date, and an early start on the site, in some cases, have a negative effect in that a premature start together with a lack of pre-planning leads ultimately to delayed completion times and claims for extras.

Smith (1980) illustrated the processing of data for the construction of Canadian project. "The first task of the management team was to establish a schedule of anticipated construction activities and then relate those to the budget. This was done and 29 work sections were identified, later increased to 30 by the inclusion of commissioning. Monies were allocated to each of these work sections to form section budgets. This figures were extracted from the masterplan and adjusted where necessary to reflect the information current at the time. Timelines were then allocated to the activities and plotted on to a bar chart which, produced by a computer, was easily updated on a monthly basis. The original schedule for each activity was the lower bar. Progress was monitored continually and the project management team held meetings to assess design, construction and financial status.

Bennie (1980) reviewed the control procedure for development projects in the United Kingdom. He noted that this is a broad measure of agreement between architects, quantity surveyors, builders and clients that the main reasons for the delays and

excessive costs are:- (a) planning delays, (b) changes required by the client after the contract has commenced, (c) poor site management, (d) industrial disputes (e) delays in delivery of plant and materials. Also, he asserted that more responsibility for the problem of delay lies with the client than most would admit. He further suggested a management appraisal of the delay problem, an attempt at all times to anticipate problems and to be prepared for them, and, finally, a realisation by all senior partners of the professional team and by the executive of the client that only by total commitment at the top can all other personnel be motivated to succeed.

Whatley (1981) highlighted the factors that were successful in creating a balance between cost and time on a big London project which lasted seven years. (The refurbishment of London Chamber of Commerce and Industry buildings). The factors were:- (a) the budget cost was linked-up to the clients' decision to fund the work as far as possible, (b) track of records of costs were kept, (c) a very flexible system of cost reporting was developed, (d) phases were modified to produce "economic packages" of work for both the client and the contractor, (e) nominations of sub-contractors were avoided where necessary. On completion, the final result was not so very different from the original plans.

Piesold et al. (1984) reported of how a big dam project was executed in Kenya. They explained that the project was completed four months ahead of schedule and within seven years of the launching of the pre-feasibility studies. According to them, that was possible because the client quickly perceived the

rates, the project time is more critical because of mounting construction costs, (d) the time available for a project may have significant relationships with the cost.

The above suggest that in this study, the magnitudes of initial and final construction times should be determined and that there is a need to relate the cost to the construction time as well as investigate the effect of extra time on the cost of a project.

2.7. SPEED

The speed of construction is the rate at which work is performed. It can be represented by the value of work done/ Time taken. Studies undertaken on field productivity of work force on construction sites are in themselves studies of speed of construction. Such studies normally express the volume of work produced (which can be quantified in terms of money) and also construction time.

As speed is a ratio of cost/time, the various factors: social, economic, administrative and technical factors affecting cost and time components discussed in this chapter also can affect the speed of construction.

Parker et al. (1972) explained two important methods of measurement of construction speed: the "time lapse photography" and the "Standard Times". Time Lapse Photography" although expensive, the method provides complete permanent records which allow unlimited replays and detailed analysis of the work including the relationships of simultaneous activities and the cause and the effect of delays. "Standard Times" - consists of accurately recording the total man - hours per unit of work. The

units are chosen so that uniform standards can be established to permit comparison with similar structures previously built or with published values. This system is based on studying the work crew as a whole as opposed to examining the activities of individual tradesmen.

Selfert (1974) reviewed ways in which work could be speeded up and costs reduced on building sites. He explained that the principal feature in the prolongation of time periods has not been evolved from any arithmetical projection over the last forty years, but has expressed itself more in the form of a geometric projection of increasing construction time per job. Selfert (1974) further argued that the reasons which affect the time aspect of the industry are as follows:- (a) lack of incentives in a workman's job, (b) the shortage of craftsmen and skilled staff, (c) competitive tendering which is the basis of the construction industry is in some ways a cause of accelerating contracts sums. Keener building times will only be achieved by keener pricing, (d) there are pressures for additional time and cost increases on the basis that this is beyond the main contractor's responsibility.

In 1976, the Slough Estate Report of the U.K, was published giving the findings and recommendations arising from a study on the high cost and delays of development in the United Kingdom. Some of the conclusions arrived at were that: (a) development in Britain was too slow and too costly, (b) the large number of government regulations stemming from a variety of agencies has a harmful and slowing-down effect on the development process; they are too complex and often obsolete, (c) communication between client and designer and

co-ordination between designer and contractor were found to be poor, (d) clients were always changing their requirements.

Morriss (1977) reviewed the economic analysis of accelerated construction in the U.S.A. He pointed out that the potential economic benefits of increasing off-season construction activity are of such significance that the development of more thorough plan analysis of accelerated work techniques is warranted.

Laing (1979) briefly reviewed Britain's high cost and low speed buildings. He pointed out that some of the main causes of high cost and low speed in building operations in Britain were due to:- (a) planning controls were excessively slow and bureaucratic, (b) attitude to work was poor, (c) designs were often not simple but too detailed and complicated, (d) poor attitude of the trade unions, (e) workers are not well adequately rewarded or motivated.

Bowness (1979) discussed the logistic adopted to complete on time, one of U.Ks' biggest refurbishment projects. The principle of, project management approach was used. Project management, apart from representing the client from an authoritative position, acknowledges the need to weld together a variety of personalities and styles to create an atmosphere conducive to producing a performance higher than the norm. He notes that throughout the whole time span, communication was vital to the efficiency, accuracy and smooth functioning of the project. Close relationship between the project manager and other members of the design team obviated the need for lengthy referral systems and ensured a common

awareness of the state of play. To cope with this, a system of evaluation, agreement and authorisation was established and no works other than those contained in the pre-letting agreement, were accepted unless they, could be fitted into the contractor's programme. He concluded that the logistics of completing the building, precisely on the date agreed at the outset were akin to a military precision.

Wakefield (1981) compared the speed of construction in the U.K. and the U.S.A. - He emphasized that many papers had pointed out that the speed of construction in the U.S.A. was relatively more than that of the U.K. due to more efficient management adopted in the U.S.A.

An important method is the "Productivity Delay Model" recently devised by Adrian (1982) and it is similar to the time study technique in that it attempts to identify and optimise cycle times for repetitive construction activities. A key feature of this method is its emphasis on classifying and documenting delays to construction operations, and statistical analysis are utilised in interpreting filed data.

Thomas et al. (1984), noted that despite the recent growing interest in measuring labour productivity, no one method has become the standard in this field. The common techniques are classified as work study methods, and aim to provide a systematic approach to analysing labour productivity based on scientific principles, accurate observations and measurements and statistical methods. These methods were initially developed to assist the manufacturing and service industries but in recent years, have been applied to the construction industry.

Discussions held on the speed of construction pointed out that,(a) the development of an acceptable plan analysis for accelerated work techniques is essential, (b) attitude to work, complicated designs, trade union activities and bureaucratic controls can seriously affect the speed of work, (c) the adoption of a sound project management principle could accelerate work, (d) the use of work study techniques can assist in understanding how to improve the speed of construction.

The above suggest that this study of the cost-time relationship should, (a) endeavour to work out an acceptable model for accelerating work, and (b) investigate the effect on costs by delays due to bureaucratic controls, attitude to work and trade union activities.

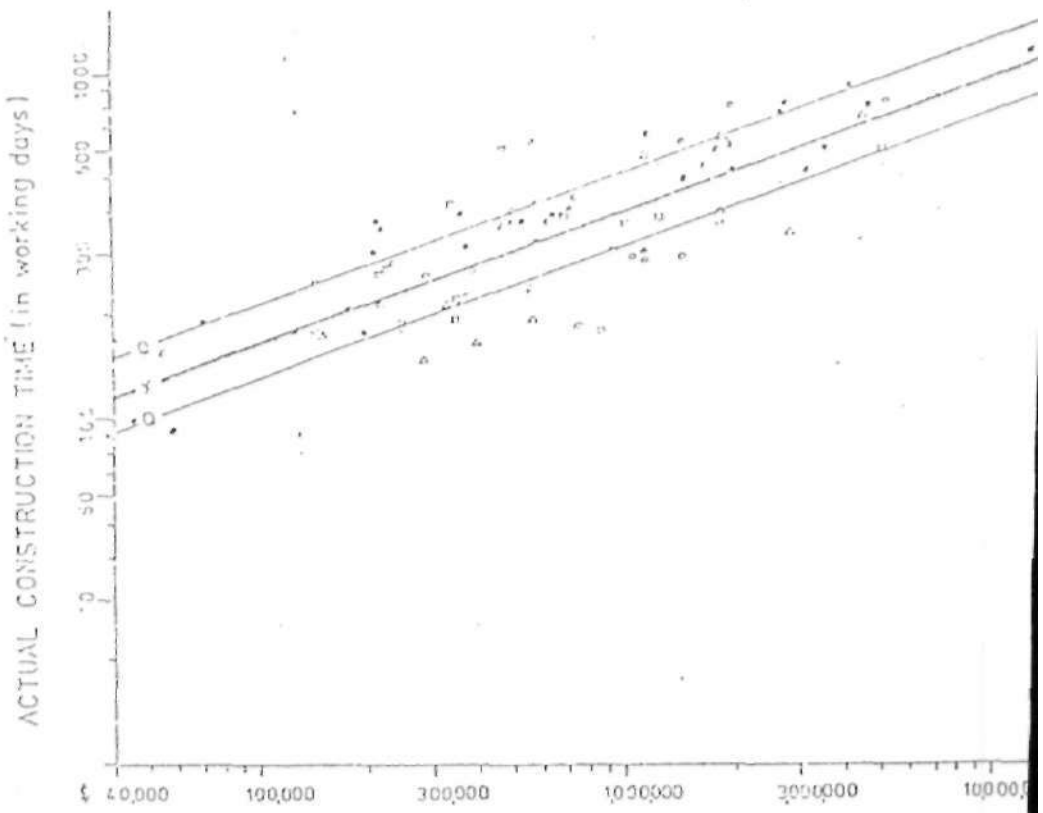
2.8. COST/TIME RELATIONSHIPS

Bromilow (1969) studied 329 contracts in Australia to ascertain the degree of contract time performance, its expectations and reality. The following were some outstanding points in his studies:- (a) for each contract, the ratio of the actual construction time divided by contract time has been calculated to provide a measure of time-performance ratio. The major factors affecting this ratio were the type of building and the mode of the selection of the builder, (b) average time performance ratios for various types of building regardless of the mode of contractor selection ranges from 1.00 for the four private schools to 2.12 for miscellaneous works, (c) the range of performance of individual projects is much larger than is commonly supposed. Experiments showed that the reality is general far from

ACTUAL CONSTRUCTION TIME AS A FUNCTION OF FINAL CONTRACT SUM

(from the start on site to the practical completion of the contractual work)

KEY	COMPETITION	NEGOTIATION	PACKAGES
PRIVATE SECTOR	o	Δ	□
PUBLIC SECTOR	o	Δ	N.A.
MAIN TREND	X——X	$Y = 28X^{0.38}$	
QUARTILE LINES	Q——Q	UPPER Q $Y = 36X^{0.38}$	
		LOWER Q $Y = 22X^{0.38}$	



(adjusted at midpoint to 30 September 1972 prices, using B.I.A.C. cost indices)

BASED ON 83 CONTRACTS

Source: Bromilow, F.J. (17).

expectations as defined by the original contract completion date. In any case, the completion dates written into contracts are often avoidably based on partial information, subsequently they are subject to a variety of unpredictable pressures which may affect the realisation of the original stipulation. It is therefore necessary to question if any general standards of performance are realisable in practice. Some light is thrown upon this by analysing the actual construction times in practice, to see if an explainable standard of performance can be identified, (d) the final cost of a project reflects the complexity and quality as well as physical size. For the large sample of building studied, the time actually taken to construct is highly correlated with the size as measured by cost over a range greater than a thousand- fold, (e) the most revealing way of plotting construction time against cost (size) is to use scales based on logarithms. This avoids a crowding of the relatively large number of 10,000 to 1,000,000 and shows the mean, trend line marked (xx) to have a simple cost-time relationship,

$$T = KC^{B},$$

Where T = Actual construction Time in working days

C = Final Cost of Building

K = Constant Characteristic of building time in Australia.

B = Constant indicative of the Sensitivity of time performance to cost level.

(Its value according to Fig. 1 is 0.30 when C = I

T = 350 so that K is in fact the average working time for such a project.

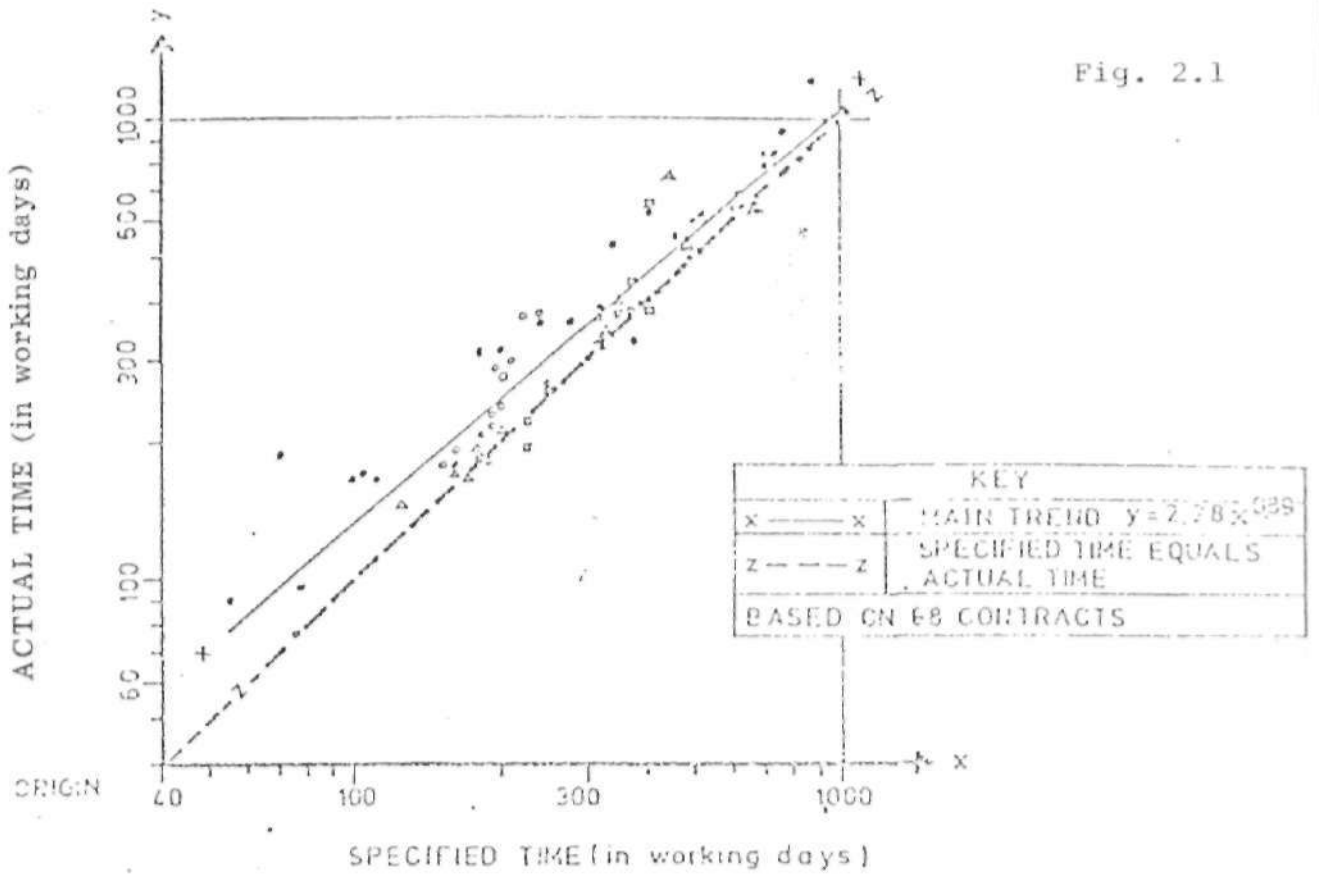


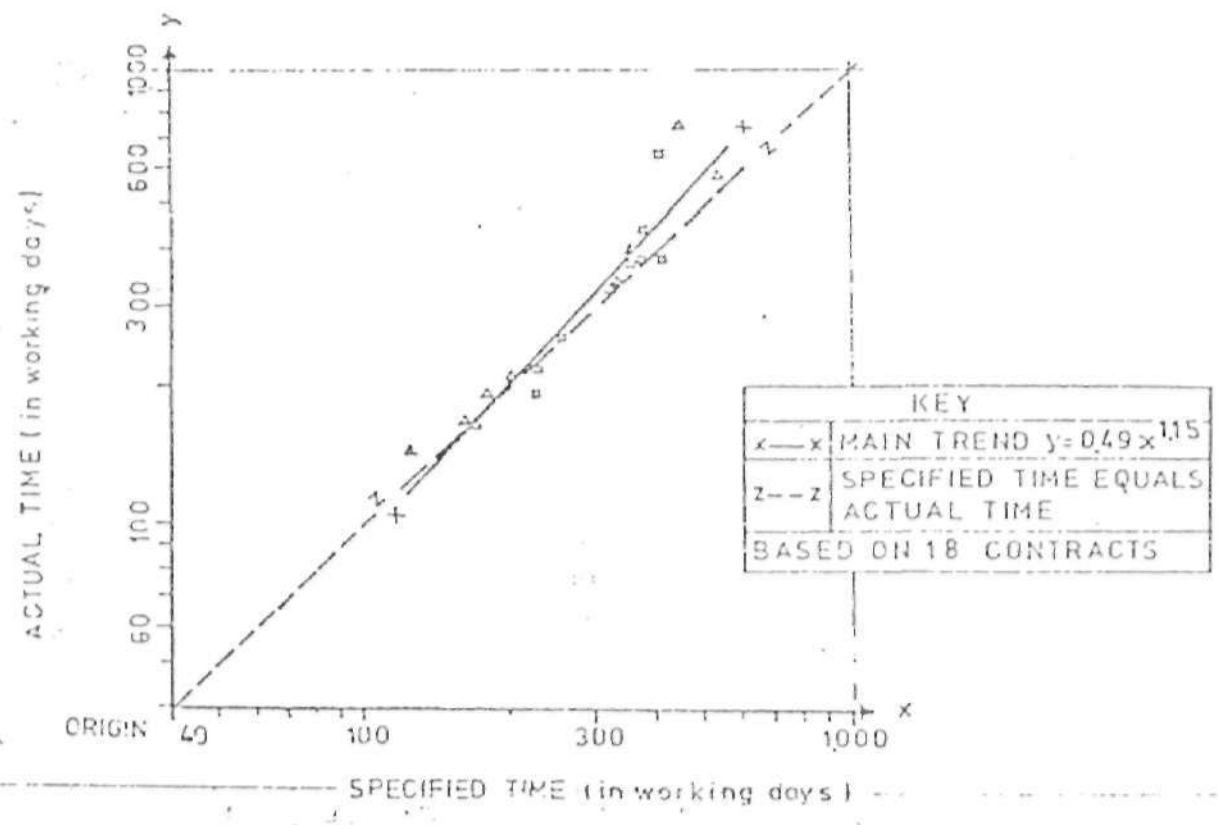
Fig. 2.1

Source: Soeterik, et al (100).

Fig. 2.2

ACTUAL & SPECIFIED TIMES

(ONLY PRIVATE SECTOR NEGOTIATIONS AND PACKAGES)

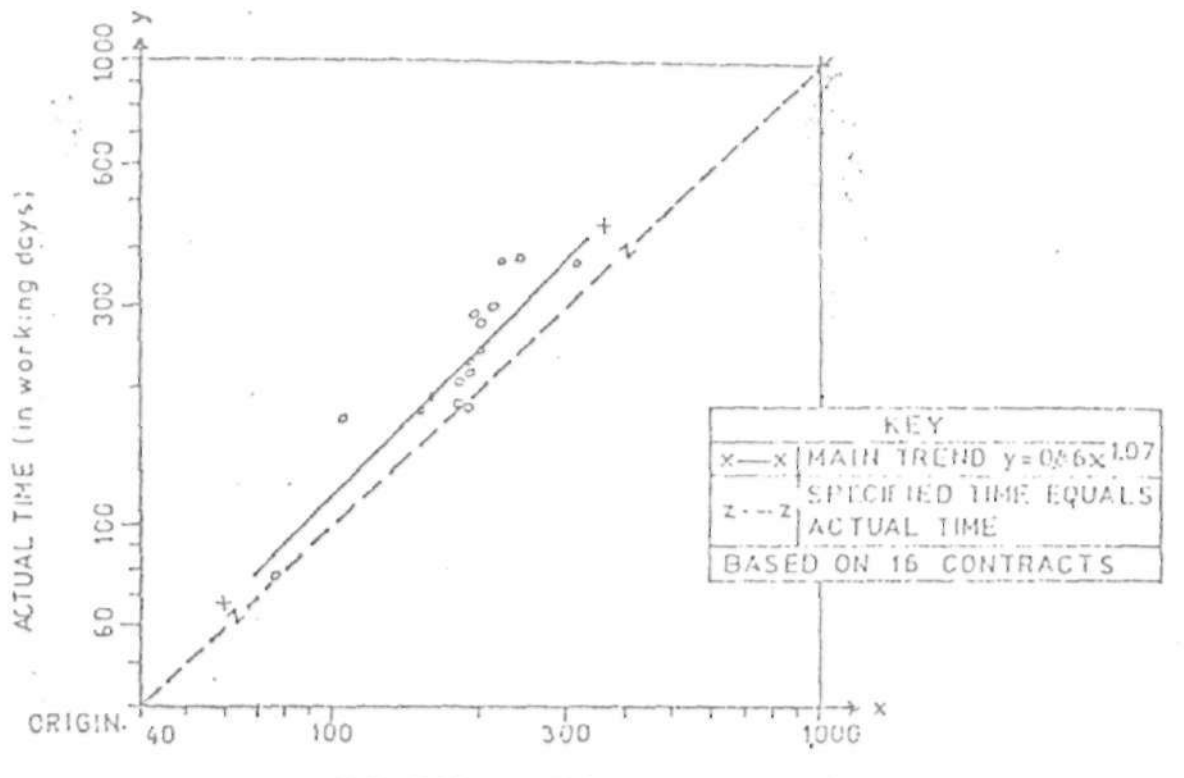


Source: Soeterik, et al (100).

ACTUAL & SPECIFIED TIMES

Fig. 2.3

(ONLY PRIVATE SECTOR COMPETITIVELY OBTAINED CONTRACTS)

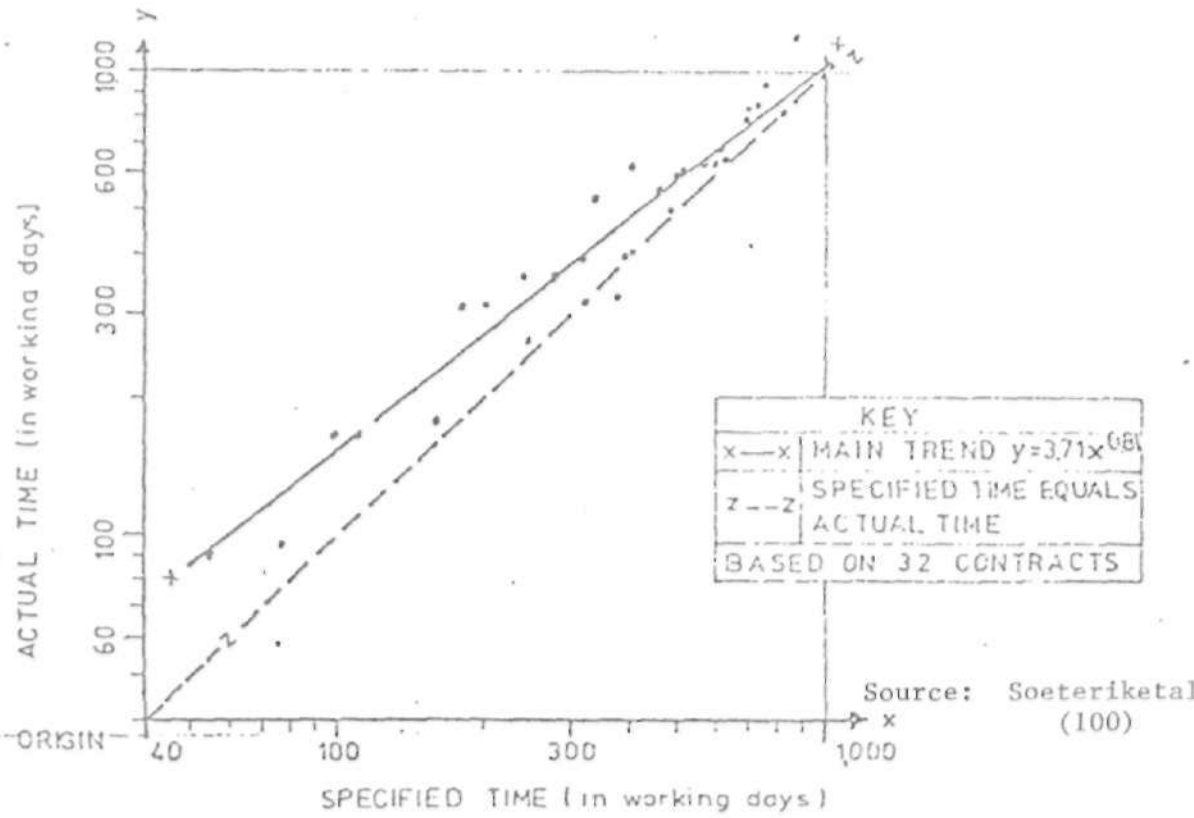


Source: Soeteriketal (100)

ACTUAL & SPECIFIED TIMES

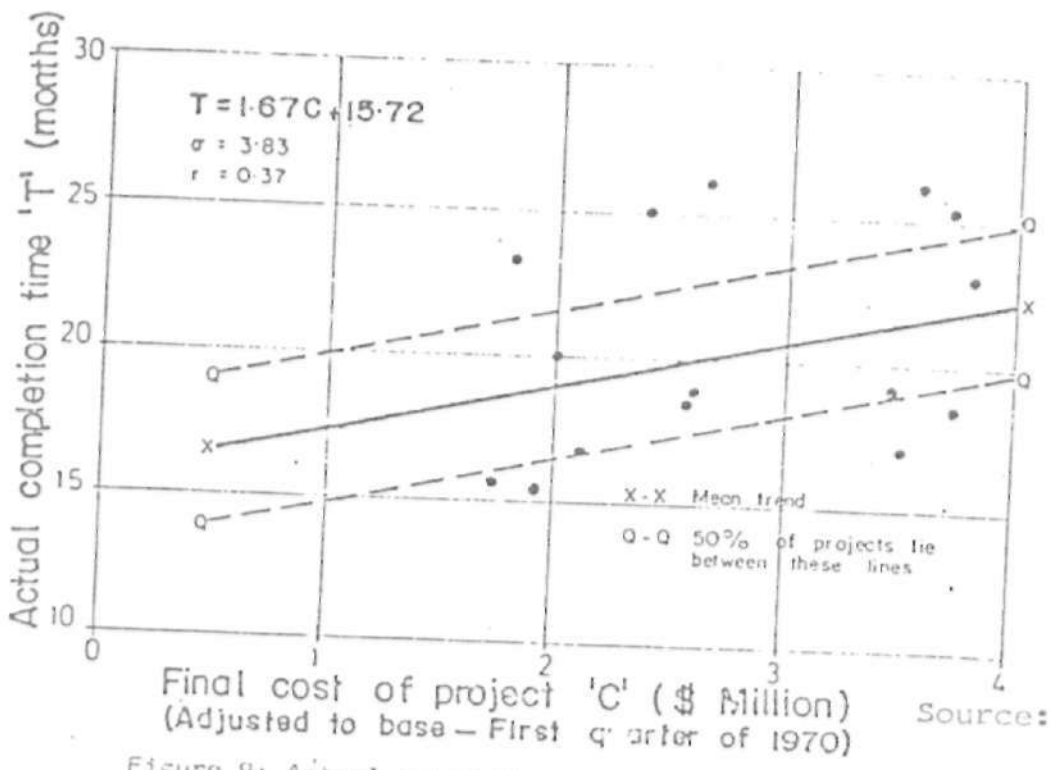
Fig. 2.4

(ONLY PUBLIC SECTOR COMPETITIVELY OBTAINED CONTRACTS)



Source: Soeteriketal (100)

Fig. 2.5



Source: Singh at al (95

Figure 9: Actual completion time as a function of final project cost (adjusted) - 14 storey construction

Fig. 2.6

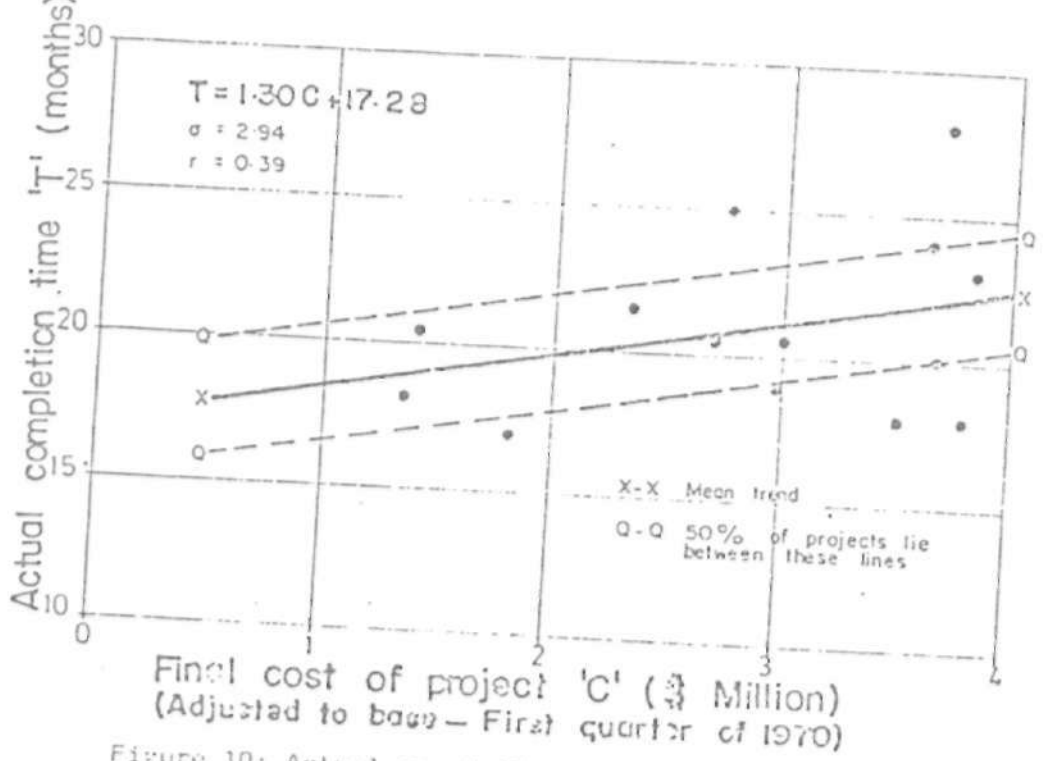
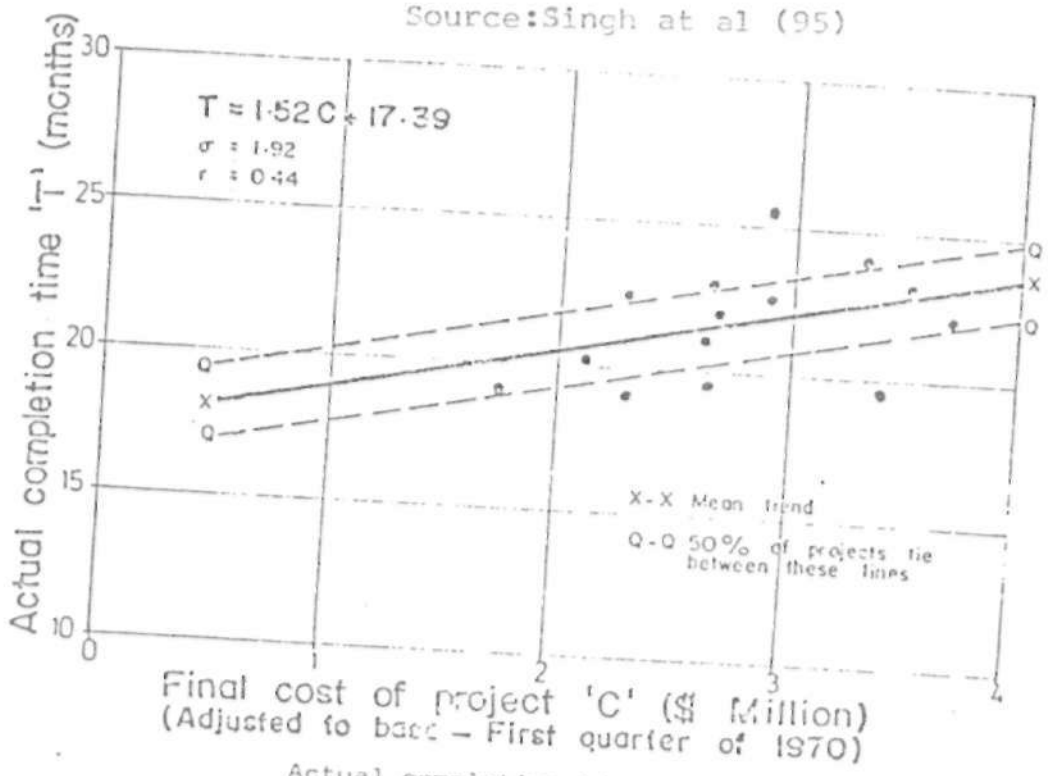


Figure 10: Actual completion time as a function of final project cost (adjusted) - 16 storey construction

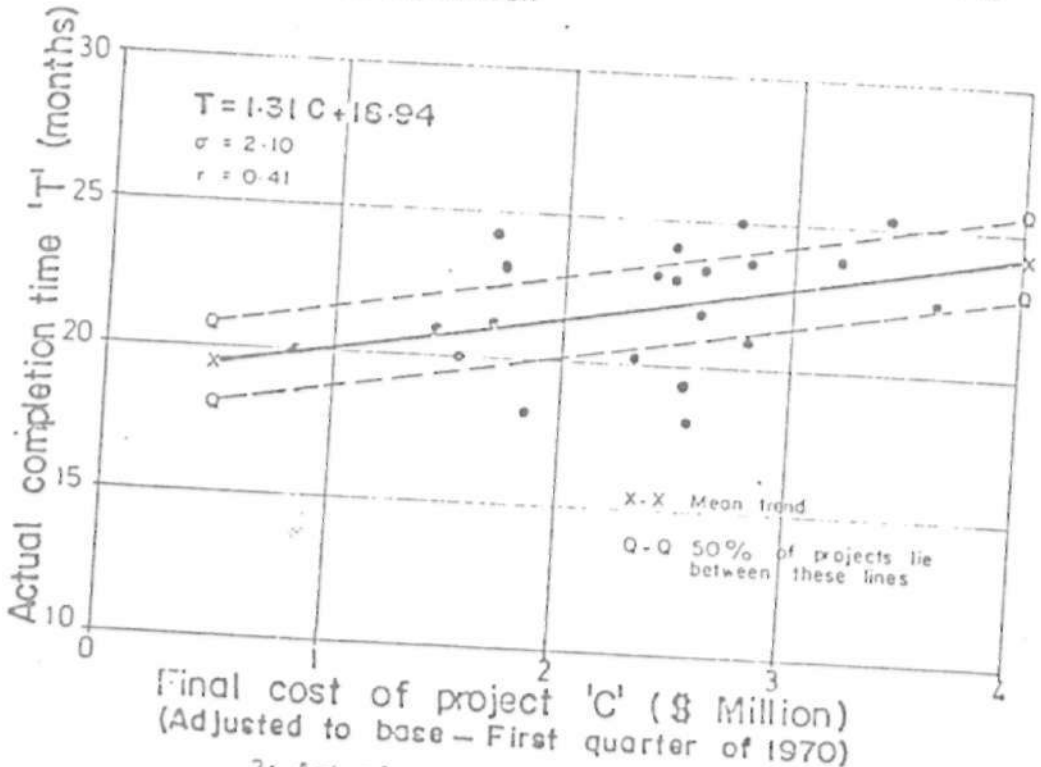
Source: Singh et al (95)

Fig. 2.7



Actual completion time as a function of final project cost (adjusted) - 20 storey construction

Fig. 2.8

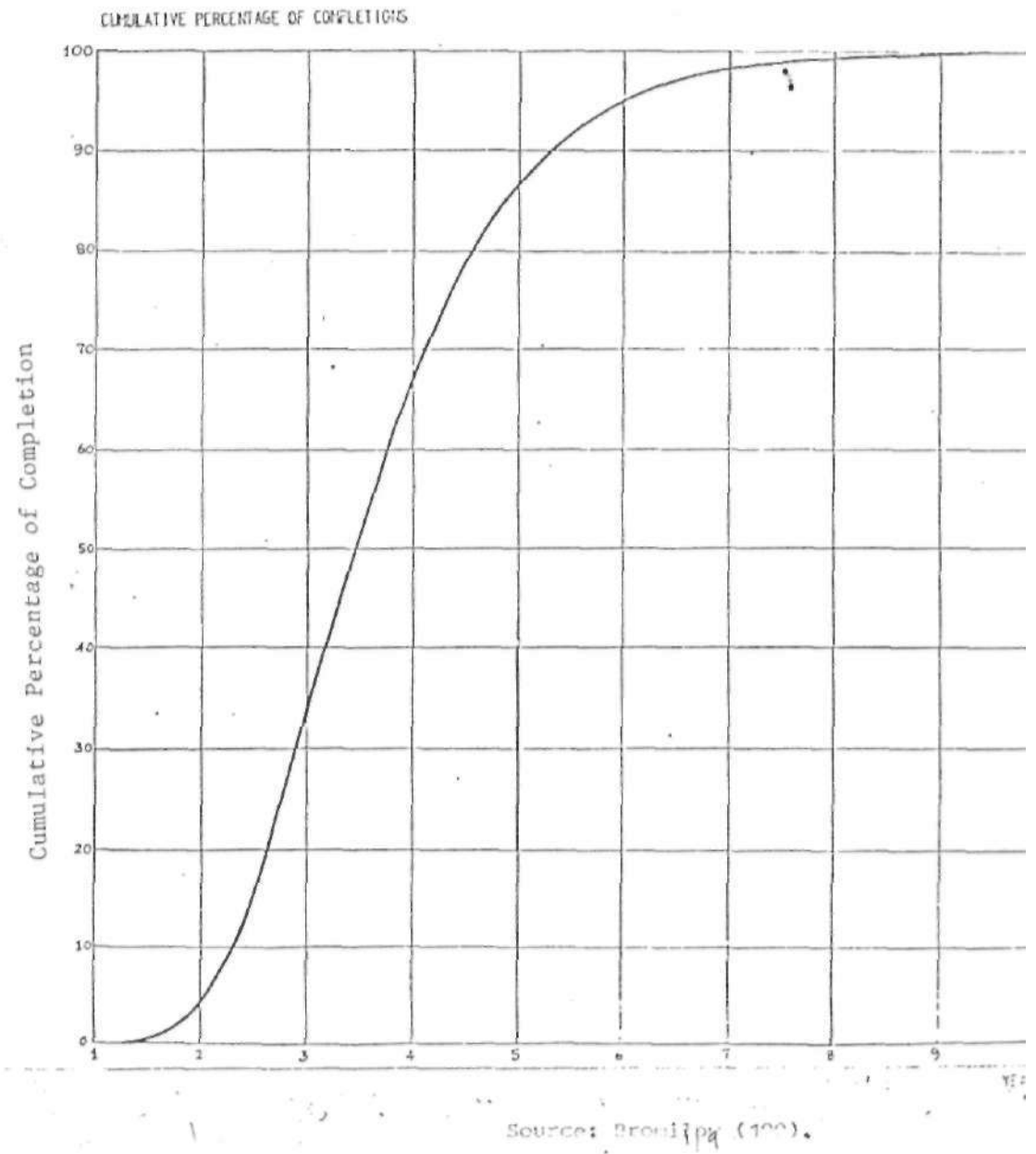


?: Actual completion time as a function of final project cost (adjusted) - 25 storey construction

rce:Singh at al (95)

Fig. 2.9

Distribution of completions



Source: Brouilpa (1[illegible]).

The equation shows that the rate of increase in time required for construction decreases as the project increase in size. The effect of this characteristic, the cost sensitivity constant is shown more clearly when the above relationship is plotted on linear scales as in Fig. 2), (f) the variability in the time performance ratios of the different types of buildings shown in table 4 may be seen as the result of varying but characteristic degree of optimism in fixing the expected construction times in the contract, it is not normally the result of characteristic differences in construction performance. For example, under open tender conditions, school construction and miscellaneous works demand time performance in which the reality is understated by 30%-50%.(g) also, results show that writing in construction times known to be inadequate in hopes of spurring the contractor to greater endeavours has little influence on the times that are actually taken in practice. On the other hand, there is yet, no clear evidence that writing in a long construction time will result in great improvement over one already conforming to reasonable standards unless at the same time control procedures are improved. Improvements in realism result when the contractor is selected on something more than the lower price.

Beru- Building Economics Research Unit, University College, London, (1974), reported on the investigation carried out on a study of the significance of duration of activities in the building process. Fig. (2) G1/1 shows a

typical relationship between the duration and cost of a set of schools and housing project. The average contract intensity is given by dividing the cost of the contract by its duration. The relationship is characterised by a relatively shallow slope. This means that smaller contracts proceed, on average at a lower intensity than larger contracts. In the light of these observations, rules of thumb governing maximum contract size in relation to firms' turnover should be expressed in terms of intensity rather than absolute size. This may seem to be basic common sense, but few contractors mention intensity as a limitation on the amount of work they take on. Indeed, many of the lists of pre-qualified building firms used as a guide by the Client department still classify firms by the maximum size of project they can cope with, but not how many jobs they can accommodate in a given period.

Another set of publication by BERU (1974) on the Public sector building time-table in the United Kingdom, outlined some important conclusions as follows:- (a) on the average, about half of the total time between commissioning an architect and taking possession of a new building is spent on construction itself, (b) durations of contracts are more predictable than pre-construction durations, (c) for similar types of building (e.g. schools, houses, and hospitals) of the same size, contract durations can vary in the ratio of about 1:4 (as compared to (1:10) for pre-construction work, (d) difficulties attributable to site management and shortages of labour and materials account for over a third of all delays, (e) in contrast only about one fifth of all delays are due to bad weather, (f) neither the type

and size of building nor the proportion of work sub-let have any significant effect on the incidence of delays, (g) the only contract characteristic which seems at all revelant is the type of tender used, (h) negotiated tenders result in fewer delays than any type of competitive tender.

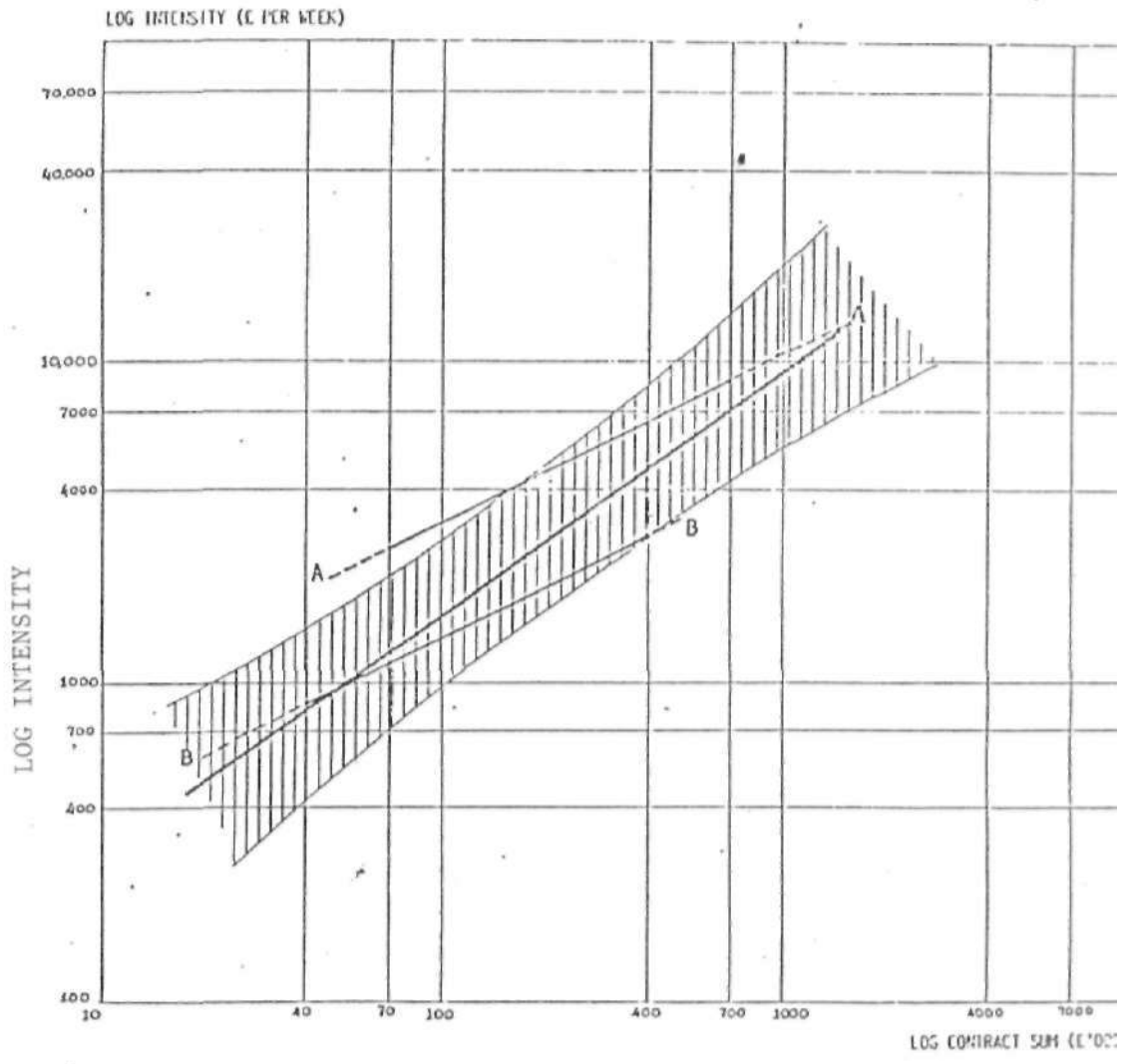
Fig. 2.10 shows the relationship between Intensity and Contract sum. Although individual data points have been suppressed for the sake of clarity, the relationship is typified by the best fitting regression line together with its 95% confidence limits. The relationship is of the form. Log intensity = (m log Cost + a) for schools and housing = 0.74. For intensity to be proportional to the square root of cost, m = 0.5. Within the scatter of intensities, for similar sized jobs taken on by different sized contractors, the larger contractors work at a faster pace. Other findings in the report were:- (a) durations increase with cost, (b) durations are not perfectly correlated with cost. In general, the distribution of building contracts by value is approximately log normal. This is true of national figures. From a cross-section nearly 4,500 projects comprising housing, schools, commercial and industrial buildings and for which information on total duration was available, it was concluded that in the late sixties, the median duration of a fairly typical selection of building projects (excluding civil engineering) was approximately 2.7 years and that over 2/3 of them took 1.8 and 4 years designing and building

Dallas (1974) studied the time/cost relationship through an experimental study with the use of regression analysis to determine whether or not a statistical relationship existed

Contract intensity vs contract sum

Fig. 2.10

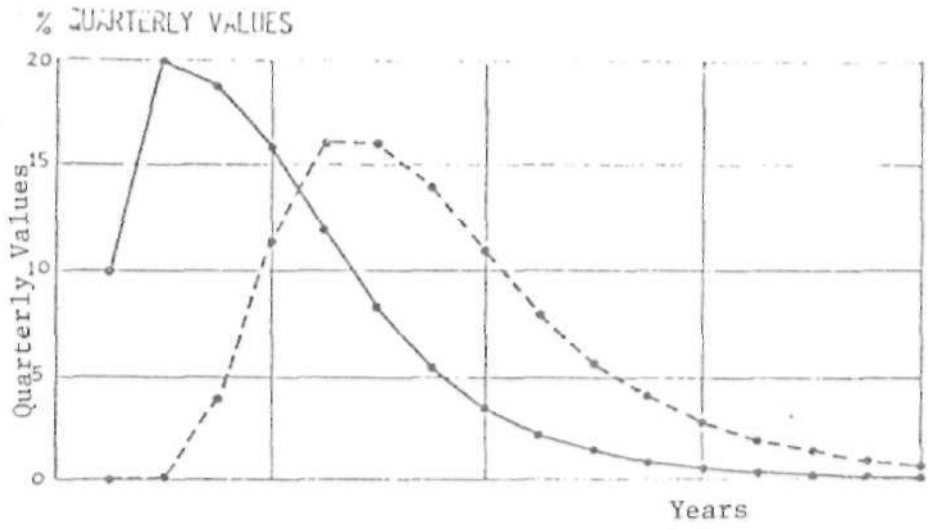
Schools and housing projects



Source: Building Econ Rsch Unit, London; (25)

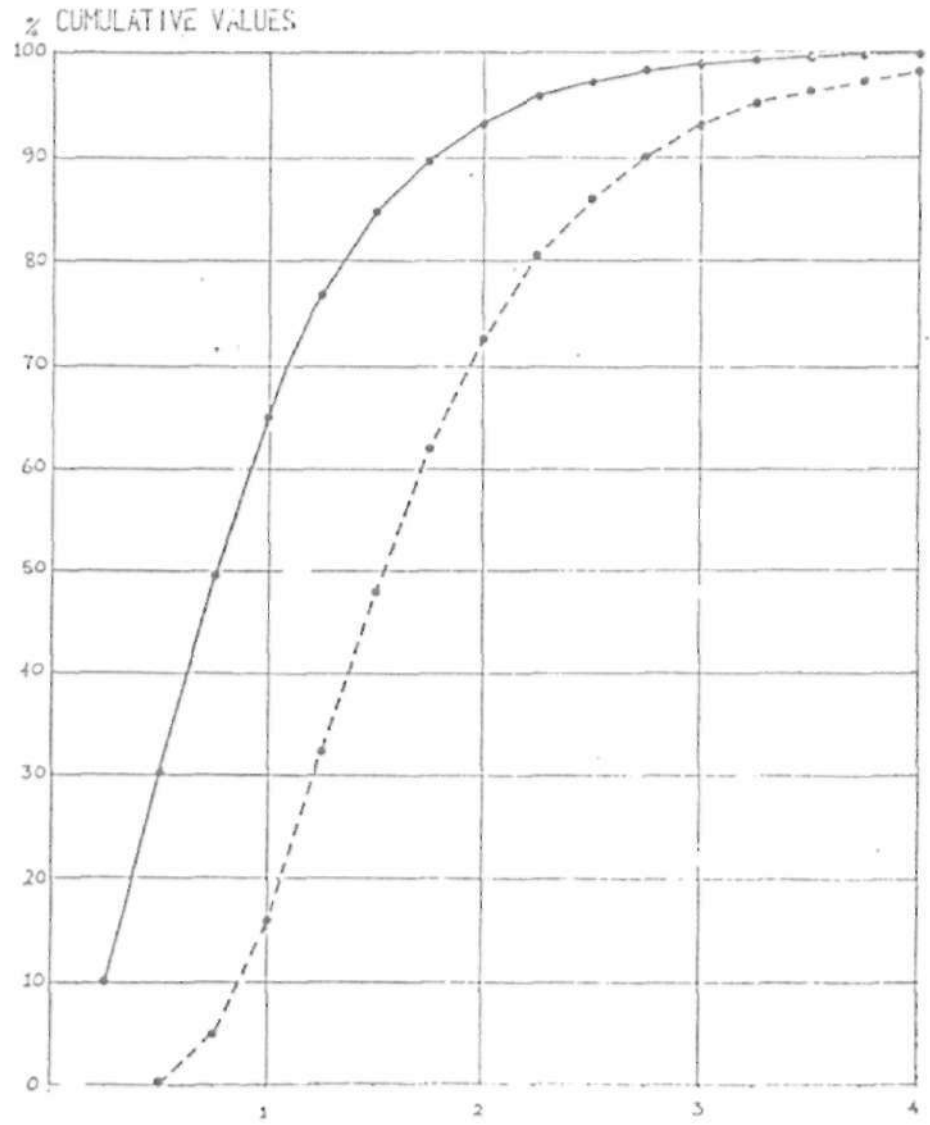
Fig. 2.11

Output and completions lag



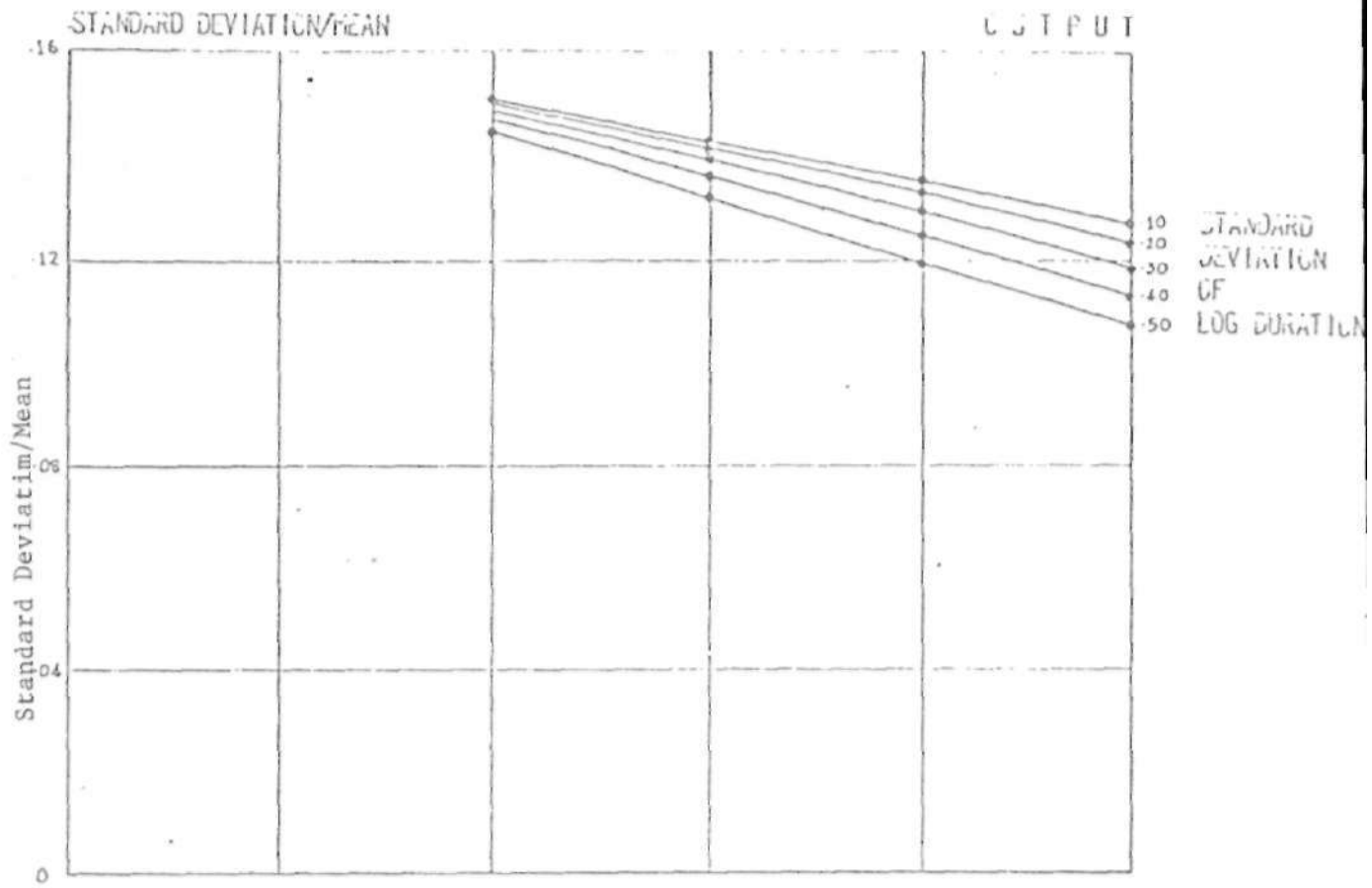
Source: Building Econ Rsch Unit, London, (25)

Fig. 2.12



Variability of output and completions

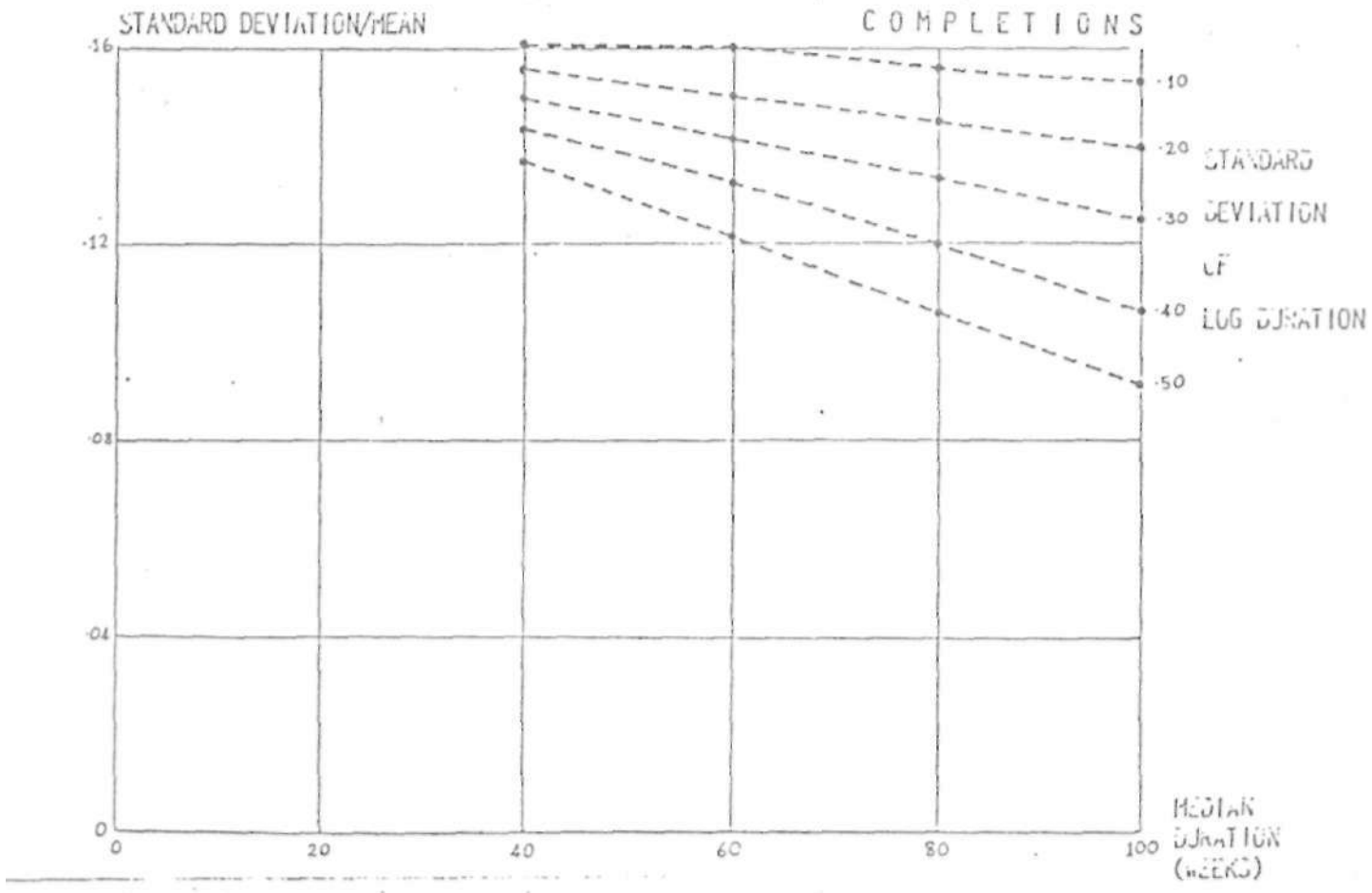
Fig. 2.13



Median Duration

Source: Building Econ Rsch Unit, London,(25)

Fig. 2.14



between time and cost at the pre-construction planning stages of major hospital building projects. The study was based on the master networks which had been prepared for a number of those projects. His conclusions were as follows:-

(a) good regression correlations had been recorded for the activities for which regression equations had been derived. It demonstrated excellently that for projects up to £7m, linear regression could provide equations which give accurate information.

(b) beyond that point, duration times can be derived from a different type of equation, i.e. one which is not linear. Experiments provided that those equations could be used over the whole range and not only the top and where linear regression had become less accurate for projects over £7m, particularly good result were obtained by using power equations:-

$$y = ax^b$$

(y = time, x = Cost, ab = Co-efficients calculated by regression co-efficients). Over the whole range of costs, this equation gave a regression co-efficient of 0.978 to 0.98m, (c) from the result which have been obtained, it was stated that accurate duration times can be calculated from regression equations provided that both in the projects used to establish the base data and the projects on which regression equations are being used to derive activity duration, - (i) the work content of activities is similar (ii) the projects, are using the same type of contractual procedure and (iii) if split activities occur on the critical path, the duration of the split sections are

aggregated, (d) finally, regression analysis can be used with confidence to establish activity durations from cost parameters.

Turney (1975) studied the time-lag from housing start to completion in the United Kingdom. From his studies he suggested that house building construction times were lengthening. At the beginning of 1974, the estimated time lag from start to completion was 21.3 months for public sector dwellings in Great Britain compared with 14.5 months in the equivalent period five years previous. The chart illustrates these trends and compares them with privates sector dwellings which although they take less time to build, have also suffered from increasing construction times. The longer time taken to complete public sector schemes is partly due to the greater number of flats built by Local Authorities which took about 24 months to complete compared with 18 months for houses. But part of the explanation is the fact that Local Authority schemes are built to higher standards at higher densities and tend to have more complex designs and a larger variety of housing types within a single scheme. To a large extent, the general increase in construction durations was a response to the excess demand placed on the industry's capacity. The threefold increase in house improvement work since 1970 resulted in acute labour and material shortages during 1973 in all house-building work particularly in the finishing trades. During that period, contractors were so heavily committed that many local authorities particularly in the London area had a great difficulty in obtaining tenders. As a result of the seriousness of the situation, an investigation was commissioned by the Department of the Environment to

ascertain the causes. It was found out that public authority work was less attractive because of the decline in the work load of the government.

Singh et al. (1975) reported on the investigations on some high rise residential buildings in Singapore based on the actual completion of past projects as well as their final costs. The following were outstanding points in their findings:- (a) for a given gross floor area, there is a significant increase in completion time with the increase in number of storeys. However, for a given number of storeys of construction, there is considerably less increase in completion time with the increase in gross floor area, (b) although the accuracy of the formula and charts developed in the paper was limited by the sizes of samples considered in the investigation, they give a better prediction of completion time than the optimistic evaluations being made presently, (c) the results of the investigation presented may not be applicable in every country but the methodology adopted can be applied in this research work to establish similar relationships.

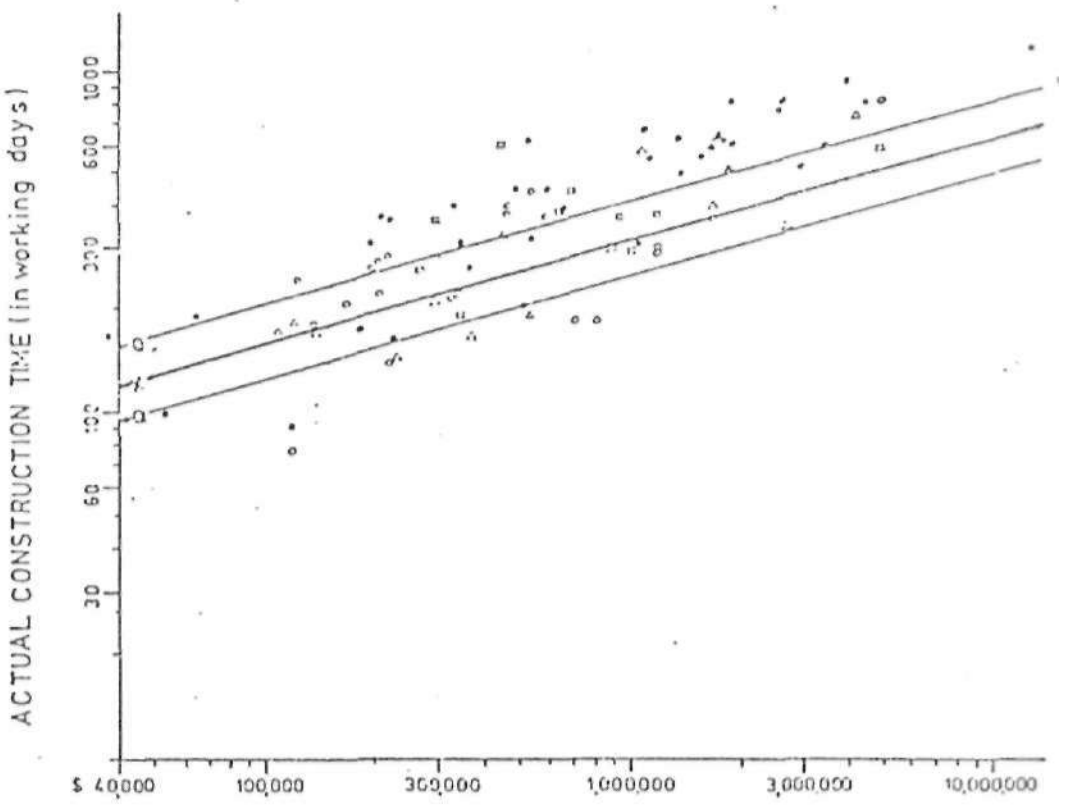
Soeterik et al. (1976) investigated the possible relationships between time and cost of New Zealand Commercial building contracts. The following were the main conclusions drawn from that research:-

Fig. 2.15

NEW ZEALAND ACTUAL CONSTRUCTION TIMES AND FINAL CONTRACT SUMS PROJECTED ON THE BROMILOW 1969 and 1971 REGRESSION LINE

(adjusted to Australian currency value as at 30 September 1972)

KEY:	COMPETITION	NEGOTIATION	PACKAGES
PRIVATE SECTOR	o	Δ	□
PUBLIC SECTOR	•	▲	N.A.
MAIN TREND	X—X	$Y = 39X^{0.3}$	
QUARTILE LINES	Q—Q	UPPER Q $Y = 51.X^{0.3}$	
		LOWER Q $Y = 31.X^{0.3}$	



BASED ON 83 CONTRACTS

Source: Seeterik et al (100)

(a) contract cost is a poor indicator of construction time compared with methods already in use. Although those methods may be subjective, they are more consistent, and had already taken into account, the effect of contract cost, (b) effects such as sector, contract type and building type are significant variables in determining construction time. The separate effects could not be isolated and estimated in the sample of contracts so far, (c) the time required for government projects as a whole averaged 22% longer and private projects averaged 10% longer, (d) values of "B" have not changed significantly indicating that the rate of change of time requirements as projects get bigger is still much the same as it was previously. The extent to which projects tend to vary above and below the trend lines has not changed significantly, (e) it is suggested that the industry should take note of the reported changes but the high degree of industrial instability over the observed period suggests that their practical use calls for some care in their interpretation, (f) most of the projects completed after January 1974 would have been caught up in the over-heated economy of 1973 with its shortages of materials, skilled labour and managerial expertise and its extensive delays arising from disputes on labour matters. The observed figures are consistent with this. In the late 1970s the extent of shortages and disputes on most work has lessened, and a new investigation would probably reveal a fall in the observed values of "K", (g) the constant quoted in the paper are in terms of June 79 prices. When using the figures, adjustments of contract sums from prices ruling at current dates to June 1979 prices using a recognised

---

"B" = constant indicative of the sensitivity of time performance to cost level.

"K" = constant characteristic of building time in Australia.

index is necessary, (h) further periodic surveys would provide a valuable service to the industry as a whole.

Grimm (1977) studied the method of estimating the time lapse for real estate development in the United States. He presented a mathematical model for preparing preliminary, deterministic, pre-design estimates of time lapse for real estate development activities. A computer programme was written to facilitate electronic calculation of development time lapse estimate by the method. Some important points in his studies are as follows:- construction some lapse for buildings may be accurately estimated given a complete set of construction documents. However, development time lapse may be estimated from some appropriate equations which are based on building cost versus construction time data on 4,080 projects in 37 states modified by building cost versus building area data and a climatic factor developed by Grimm (1977). The resulting building area versus construction time data compare favourably with that used by U.S. Corps of Engineers for predicting Military construction time as a function of building area. Accurate pre-design prediction of the time lapse for these activities are essential to the financial success of any project. Negotiated fast track construction contracts reduce development time by the time required to produce construction contracts.

A (1978) published study of the Orange County Housing Committee in the U.S. concluded that for every month that a residential project is delayed beyond its planned construction start date, the cost per dwelling unit increased by at least, 1.1% of the planned selling price. This is rather significant

for example, it was found that in 1975, it took an average of 2½ years to complete the planning, environmental review and permit process to build a particular house.

Bromilow et al. (1980) published the research findings of a study sponsored by the Australian Institute of Quantity Surveyors. It was to survey the building contract time performance of Australian contracts for building projects completed between 1970-1976. the following are the summaries of some of the findings:s (a) the equation of the general form, $T = KC^B$ identified previously by Bromilow (1980) as giving the relationship between construction time T and project cost C in the 1960s were still valid, (b) general levels of time required as measured by values of K have increased markedly from an average of 248 working days before 1969 to 288 during 1970-1976 where C is measured in millions of dollars at June 1979 prices.

The summaries of some previous work on time-cost relationships as discussed in this subsection can be stated as follows: (1) Time Performance can be affected by the type of building and the mode of contractor selection. Time Performance can always be more than unity (1.00), that is, Final Contract Time are always more than Initial Contract Time, (2) the final cost of a project reflects the complexity and quality as well as the physical size, (3) the rate of increase in time required for construction decreases as the project increase in size, (4) the determination of a Contract Intensity is the best way of expressing the contract size, (5) about one-third of all delays are attributable to deficiency in (i) site management, and (ii) shortages of labour and materials, (6) about one fifth of all

delays were due to bad weather, (7) good regression correlations had been recorded for the activities for which regression equations had been derived. Also, beyond certain points, duration times can be derived from a different type of equation which is not linear, (8) for a given gross floor area, there is a significant increase in completion time with the increase in number of storeys, (9) The constant "K" as contained in the equation $T = KC^B$ previously identified by Bromilow on Australian buildings, have been found to be subject of significant changes when:- (i) the period of that study was changed (ii) the country of study was changed from Australia to New Zealand, (10) the results of the investigations presented may not be applicable in every country but the methodology adopted can be applied on any research work to establish similar relationships, (11) effects such as sector, contract type and building type are significant variables in determining construction time.

The discussions held in this chapter on the various resource components can be summarised as follows:- (1) Initial Contract Cost and Initial Contract Time are always unreliable due to organisational problems, (2) Variation and fluctuation are always inevitable since there are changes in demands and tastes; also, prices are always rising and falling, (3) climatic, administrative and other factors affect the speed of construction. Therefore, it became relevant to measure the extra time due to:- (i) delayed payment, (ii) the execution of variation and (iii) delays due to climatic factors, (4) the cost and time of construction can be affected by the type of tender, the mode of selection, geographical location and type

of building. It was therefore relevant to bring the study to a common base in order to view the analysis as a homogeneous unit by assuming that the type of tender, the mode of contractor's selection, geographical location and type of building were the same.

The lessons drawn from the literature reviews of both the construction resources as well as of the previous research on time-cost relationship, were found to be useful in:- (i) formulating the hypothesis, (ii) the adopting of a suitable research methodology (iii) providing some guidelines for marshalling out the assumptions to be applied and the local factors to be considered in the Nigerian situation, and (iv) interpreting the results as well as in providing appropriate recommendations.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. METHOD STATEMENT

The following were the procedures taken to establish the research methodology:-

(1) The hypothesis was developed.

(2) Some pilot surveys were undertaken to determine the types and location of residential houses all over the state headquarters and the federal capital territory of Nigeria. The main purpose was to determine the suitable type and location of the samples that would be examined in the main research.

(3) For the pilot surveys the research obtained the following data which were collected (through questionnaires) on some completed buildings:- (floor area, Initial cost, final cost, Initial Time and Final Time) Relationships between areas and cost, areas and time, time and cost, Time performance, Cost performance and Cost Intensity were calculated and plotted on graphs in to order examine the graphical characteristics of various forms of the data.

(4) General Inferences were drawn up on studies enunciated above in (1), (2), and (3). From the inferences and other studies, simple Regression and correlation were considered to be on appropriate tool for analysis.

(5) The method of measurement was discussed showing the merits and demerits, general features, and interpretational methods as well as the methods of testing.

(6) The design of the questionnaire was explained based on the experience drawn up from the pilot surveys and of other researches on similar issues which were discussed in chapter 1.

(7) The data collected were presented and the composition and extent of the data were also discussed in chapter 4

3.2. THE HYPOTHESIS

In building contracts based on both the SMM of building works and the JCT Form of contract (1963 edition), the following assumption obtain:-

$$Fc = Ic + (Vc + FL) \quad \ldots\ldots\ldots\ldots\ldots (1)$$

$$Ft = It + Dt \quad \ldots\ldots\ldots\ldots\ldots (2)$$

$$Dt = dvt + dp + do \quad \ldots\ldots\ldots\ldots\ldots (3)$$

$$Ft = Ic + (dvt + dp + do) \quad \ldots\ldots\ldots (4)$$

where, Fc = Final cost, Ic = Initial cost.

Vc = Variation cost, FL = Fluctuation cost.

Dt = Overall Delay Time (Extension of Time)

dvt = Delay Due to execution of variation.

dp = Delay due to payment

do = Delay due to other factors (e.g. climatic and administrative).

Ft = Final Time, It = Initial Time.

From the above equations, the following hypothesis were developed by inspection:-

(A) When each of the following cost components, viz Final cost, Fc), Variation cost (Vc), fluctuation cost (FL) are correlated with the Final Time, (Ft).

(a) Fluctuation cost (FL) has the strongest significant

correlation co-efficient with the Final Time (Ft) than any of the other cost components have with the final time.

(B) When fluctuation cost (FL) is correlated with each of the time components in equation (4), then fluctuation cost (FL) has the strongest significant correlation co-efficient with payment delay time (dp) than with any of the other time components in equation (4).

(C) From A and B above, it can be argued that

(a) Fluctuation cost FL increases significantly when there is a significant delay in payment.

(D) Referring to equation (1),

If FL$\geq$Vc,

It was hypothesised that:- Fluctuation cost (which contributes significantly more than variation cost in the total increase in the Initial contract cost), increases significantly as the delay in payment is significantly increased.

It was appropriate to examine the fluctuation cost and also payment delays not only in relation with any of the cost or time components but also in relationship with "efficiency" parameters used in other studies.

"Efficiency" parameters can be defined as follows:-

$$\text{Time Efficiency} = \frac{\text{Final Time}}{\text{Initial Time}}$$

$$\text{Cost Performance} = \frac{\text{Final Cost}}{\text{Initial Cost}}$$

$$\text{Final Cost Intensity} = \frac{\text{Final Cost}}{\text{Final Time}}$$

$$\text{Initial Cost Intensity} = \frac{\text{Initial Cost}}{\text{Initial Time}}$$

$$\text{Relative Cost Intensity} = \frac{\text{Final Cost Intensity}}{\text{Initial Cost Intensity}}$$

The following had to be hypothesised in relation with fluctuation cost and payment delay time.

EFFICIENCY PARAMETERS

(1) Fluctuation cost (FL) has stronger relationship than variation costs (Vc) has with each of the following:-
"Time performance", "Cost performance" and "Cost Intensity".

(2) Fluctuation cost increases as the efficiency parameters also increased.

(3) Delay time due to non-payment to the main contractor (dp) has strong relationships with each of the following: "Time perfro-mance" and "Cost Intensity".

(4) Delay time due to other factors (e.g weather, and administra-tive) has no strong relationships with each of the following "Time performance", "Cost performance" and "Cost Intensity".

INFERENCE

To significantly curtail fluctuation cost, the following have to be significantly curtailed - (i) delay time due to non-payment to the main contractor (ii) Time performance, (iii) cost performance (iv) and Cost Intensity.

$\frac{\text{Final cost}}{\text{Initial Cost}}$ = Cost performance (CP)

$\frac{\text{Final Time}}{\text{Initial Time}}$ = Time performance (TP)

$\frac{\text{Final Cost}}{\text{Final Time}}$ = Final Cost Intensity. (FCI)

3.3 PILOT SURVEYS

Pilot surveys of houses chosen on a random basis were undertaken in all the state capitals and Abuja to study the pattern of house types constructed for the senior service cadre between 1970 and 1985. The results of the sampling are shown in table T2/1. For the Southern States, it was observed that bungalow house types constituted an average of 12.50%, two storey types, 45.13%, while three storey types were 42.38% of the total sample. For the Northern part of Nigeria bungalow house types constituted an average of 83.55%, two storey types 8.91% and three storey height 6.64% of the total sample. On the national level, it was found out that bungalow house types constituted 48.37%, two storey types 24.16%, and three storey types 21.68%. It was therefore decided to concentrate the main research on bungalow house types and to choose the Northern part of Nigeria as the area for the case study since about 88% of the bungalows sampled were from that part of the country.

Some preliminary studies were also undertaken on the relationship existing between cost and duration of project. Out of 100 questionnaire sent out for the ascertainment of project cost and time, only 15 were responded to. All the 15 were from Kano State Government projects. Information on:- areas, final cost, initial cost, initial time and final time were supplied while the data on variation and fluctuation costs were not supplied.

Based on the available data, the following relationships were studied by plotting graphs in order to visualise any trends:- (1) Area Vs Final Time, (2) Area Vs Delay Time (3)

Area Vs Initial Time, (4) Area Vs Final Cost, (5) Area Vs Initial Cost, (6) Area Vs Final Cost Intensity, (7) Final cost Vs Final Time, (8) Final Cost Vs Delays (9) Initial Time Vs Initial Cost, (10) Final Cost Vs Final Cost Intensity, (11) Final Cost/m Vs Final Time/m (12) Final Cost/m Vs Delay/m , (13) Initial Cost/m Vs Initial Time/m (14) Final Cost/m Vs Time Performance (15) Final Cost/m Vs Cost Performance, (16) Final cost/m Vs Final Cost Intensity.

Graphs No.Fig..3.1a.to.....Fig.3.15.....show the behaviour displayed on each study. Table.....3.3, 3.4.....summarise all the results obtained by visual inspection of the graphs.

The results are as follows:- (a) the size is directly proportional to the final time, the final cost and total delays, (b) the final cost is directly proportional to the final time, (c) the final cost/m^2 is directly proportional to the time performance, (d) no relationships existed between Initial cost and the Initial Time.

The following were the general summaries obtained from the entire pilot surveys:- (a) the sources of public finance for housing works was subjected to seasonal variations. There was no predictable relationship between finance and time. (see chapter 1) (b) on the national level bungalow residential unit types constituted 48.37%, two storey types 24.16% and three storey types 21.68% of the surveyed samples. They were found to be concentrated in the Northern States and the Federal Capital, territory Abuja. So, bungalow types in the Northern States were chosen for the main research, (c) in some cases, floor areas of

Table T3.1

SURVEY OF HOUSE TYPES BUILT WITHIN 1970-85 IN NIGERIA

	State	Bungalow	Two storey	Three storey
*	Lagos	16	44	40
*	Ogun	13	34	53
*	Oyo	10	43	47
*	Bendel	8	29	63
*	C. River	25	54	21
*	Rivers	12	47	41
*	Anambra	9	62	29
*	Imo	7	48	45
	Kwara	82	10	8
	Niger	90	7	3
	Kaduna	95	3	2
	Kano	85	4	11
	Sokoto	84	10	6
	Plateau	76	15	9
	Abuja	70	15	5
	Borno	80	8	12
	Bauchi	80	11	9
	Gongola	87	9	4
	Benue	90	6	4
*	S. States Av.	12.50	45.13	42.38
	N. States Av.	83.55	8.91	6.64
	National Av.	48.37	24.16	21.68

* Ondo State returns was not received.

Table 3.2

TYPE OF BUILDING : 1 STOREY BUNGALOW RESIDENTIAL

COMMISSIONED IN 1981 : KANO STATE
COST & TIME COMPONENTS

REF.	AREA m2	INITIAL COST	FINAL COST	INITIAL TIME (MONTHS)	FINAL TIME (MONTHS)	DELAYS (MONTHS
01	225	63,000	97,650	5.50	12.50	
02	315	70,875	152,381.25	4.75	16.50	11 3/4
03	408	016,080	233,376	6.25	18	11 3/4
04	286	71,500	228,800	4	28	24
05	275	82,500	371,250	4.25	36	11.75
06	313	109,550	230,055	6	24	18
07	384	130,650	417,792	3.50	32	28.50
08	362	104,980	398,924	3	45	42
09	287	63,140	107,338	11	17.50	6.50
10	269	91,729	20,272.09	9	25	16
11	417	158,460	499,149	10	31	21
12	408	89,760	376,992	4.25	42	37.50
13	390	76,050	205,335	5	25	20
14	285	62,700	94,050	4.25	9.50	5.25
15	186	64,356	70,791.60	6	9	

Fig. 3.1

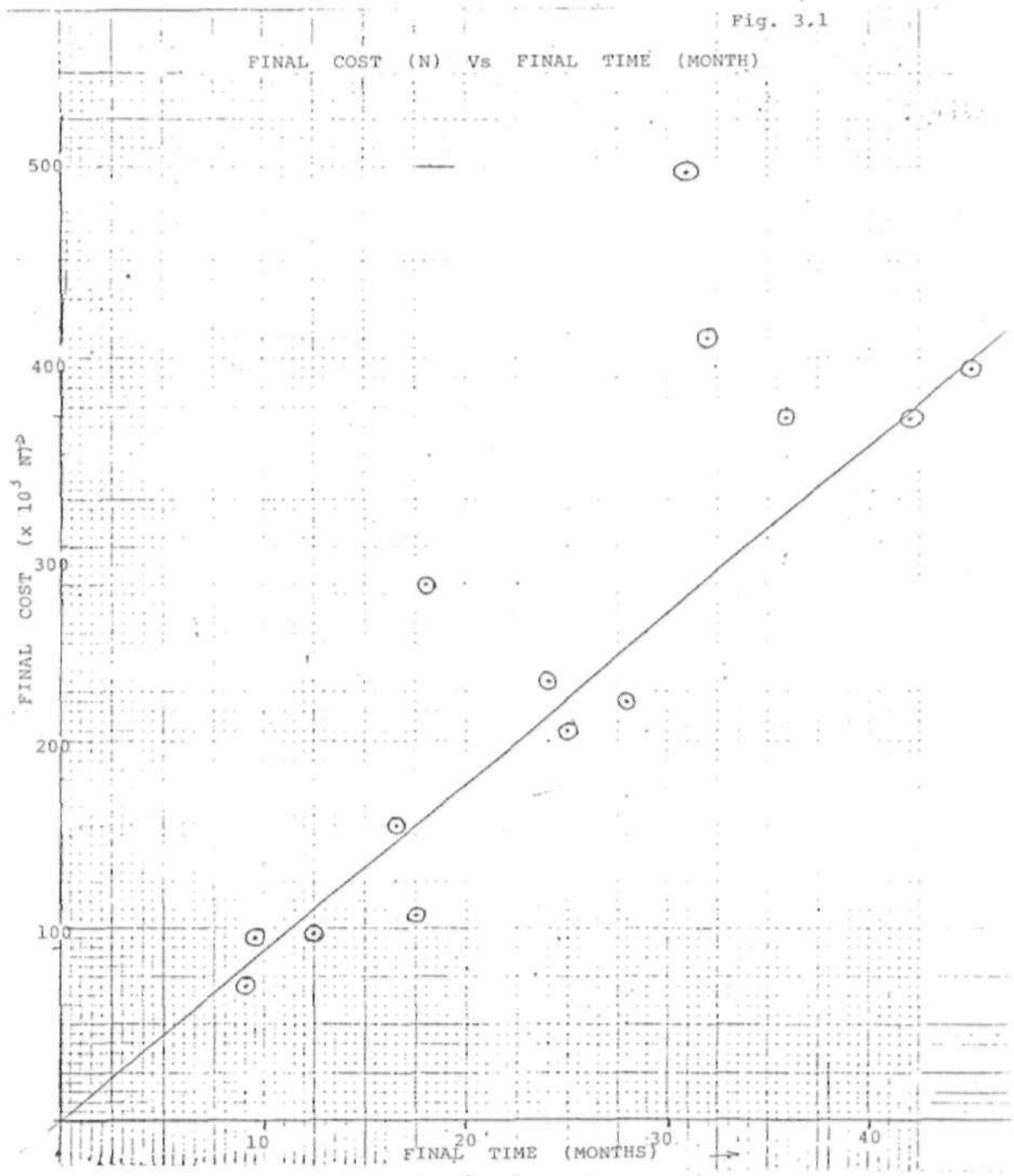

FINAL COST (N) Vs FINAL TIME (MONTH)
FINAL COST (x 10³ N)
500
400
300
200
100
10
20
30
40
FINAL TIME (MONTHS)

Fig. 3.2

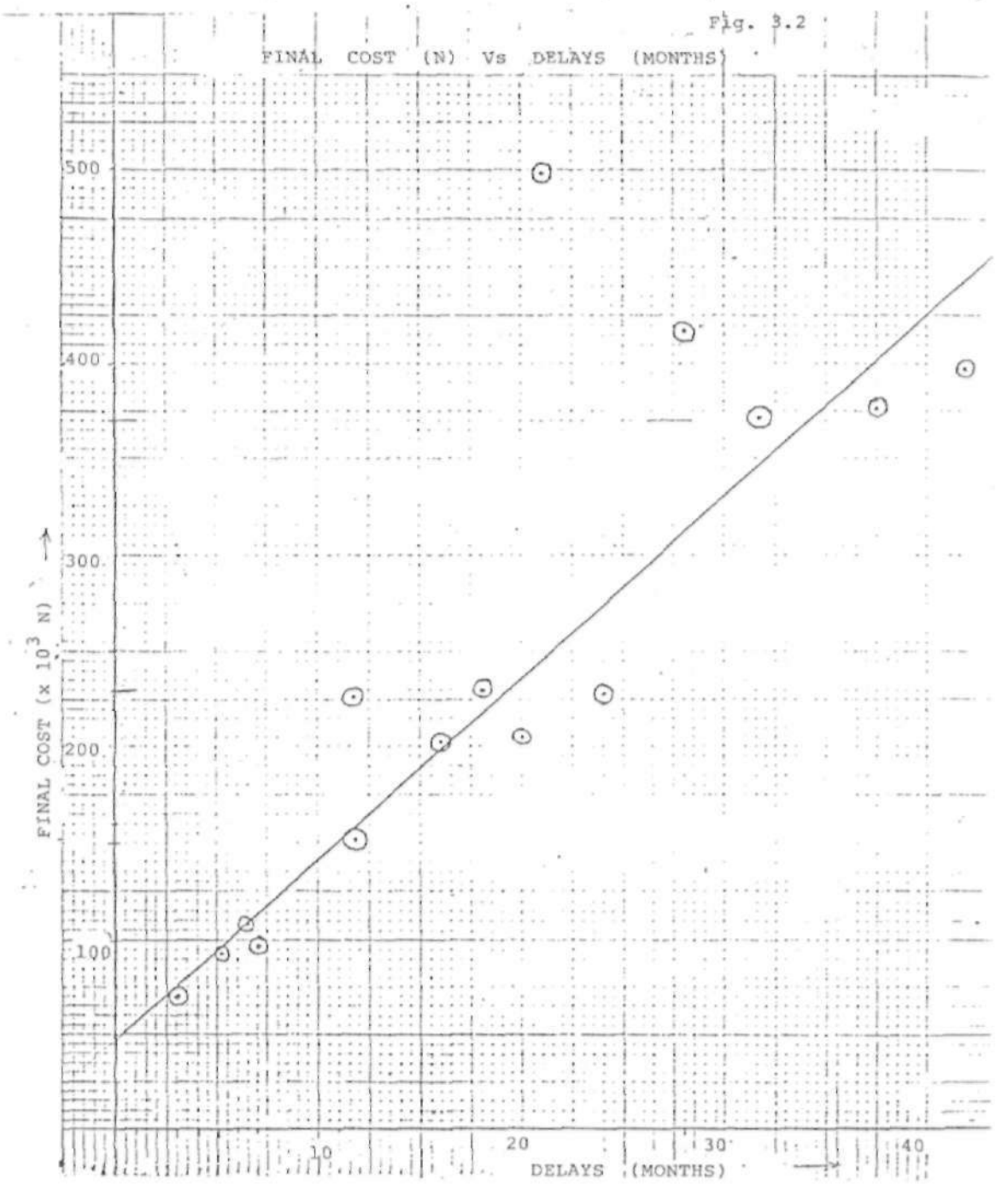

FINAL COST (N) Vs DELAYS (MONTHS)
500
400
300
200
100
FINAL COST (x 10³ N)
10
20
30
40
DELAYS (MONTHS)

Fig. 3.3

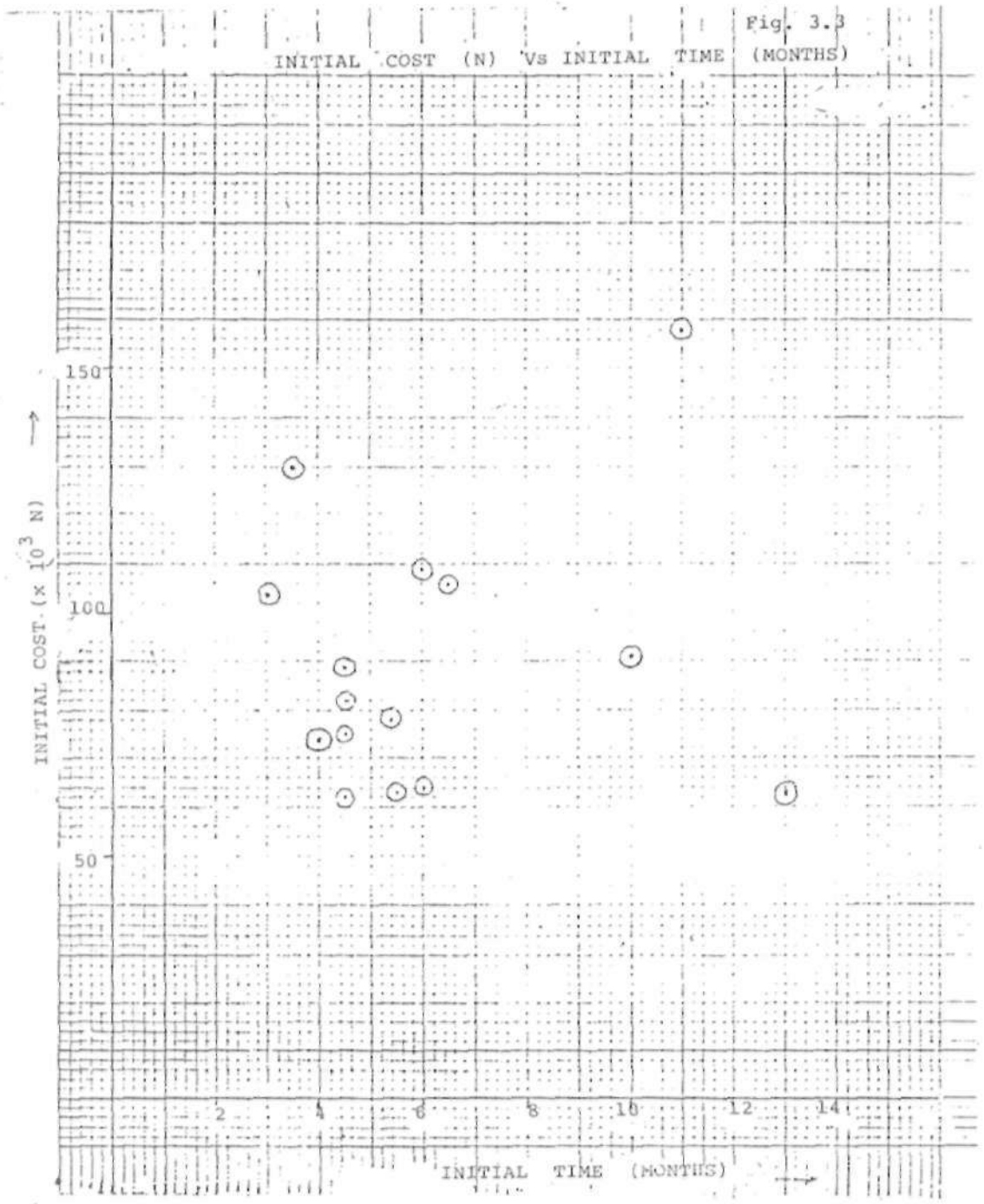
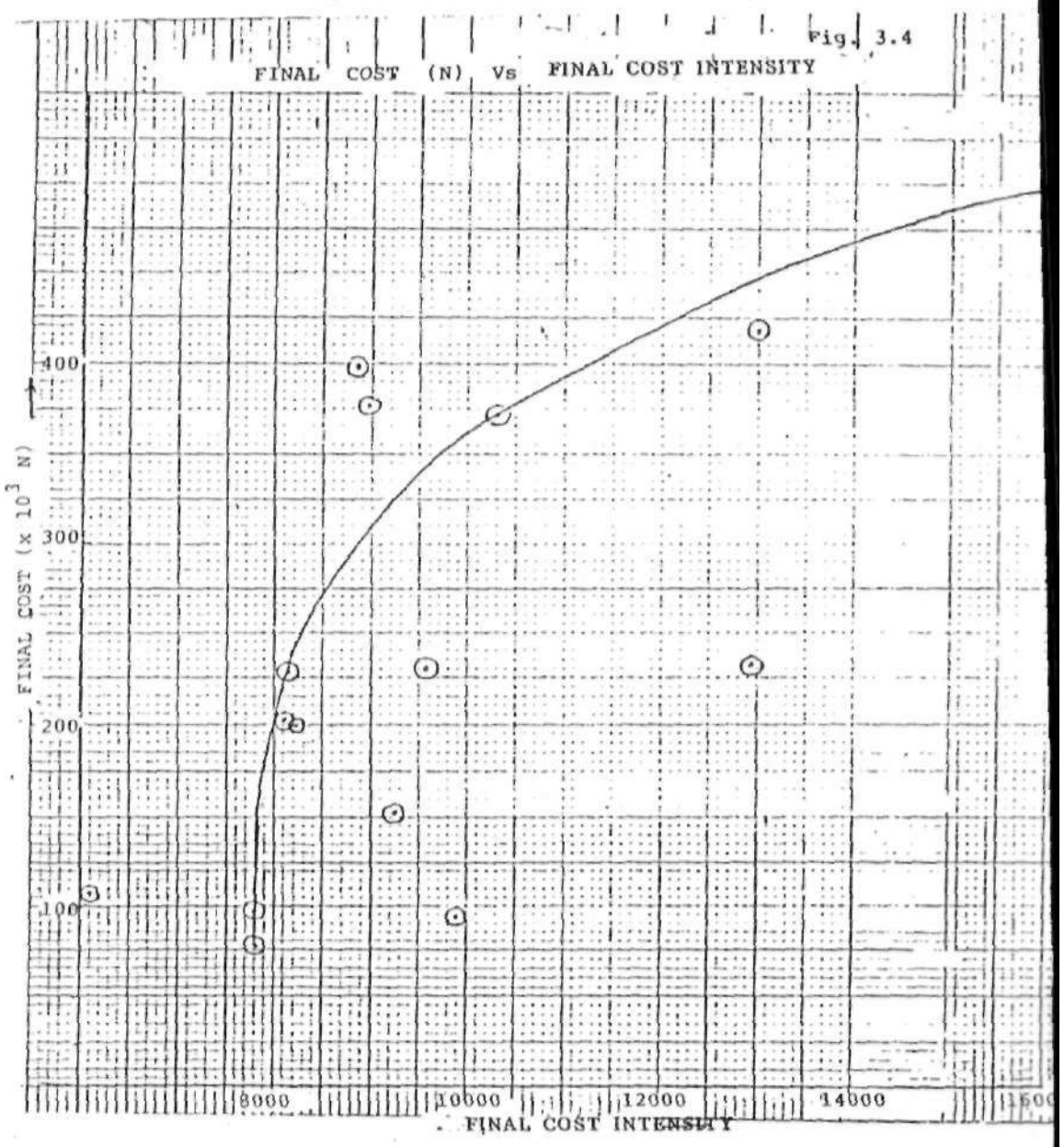
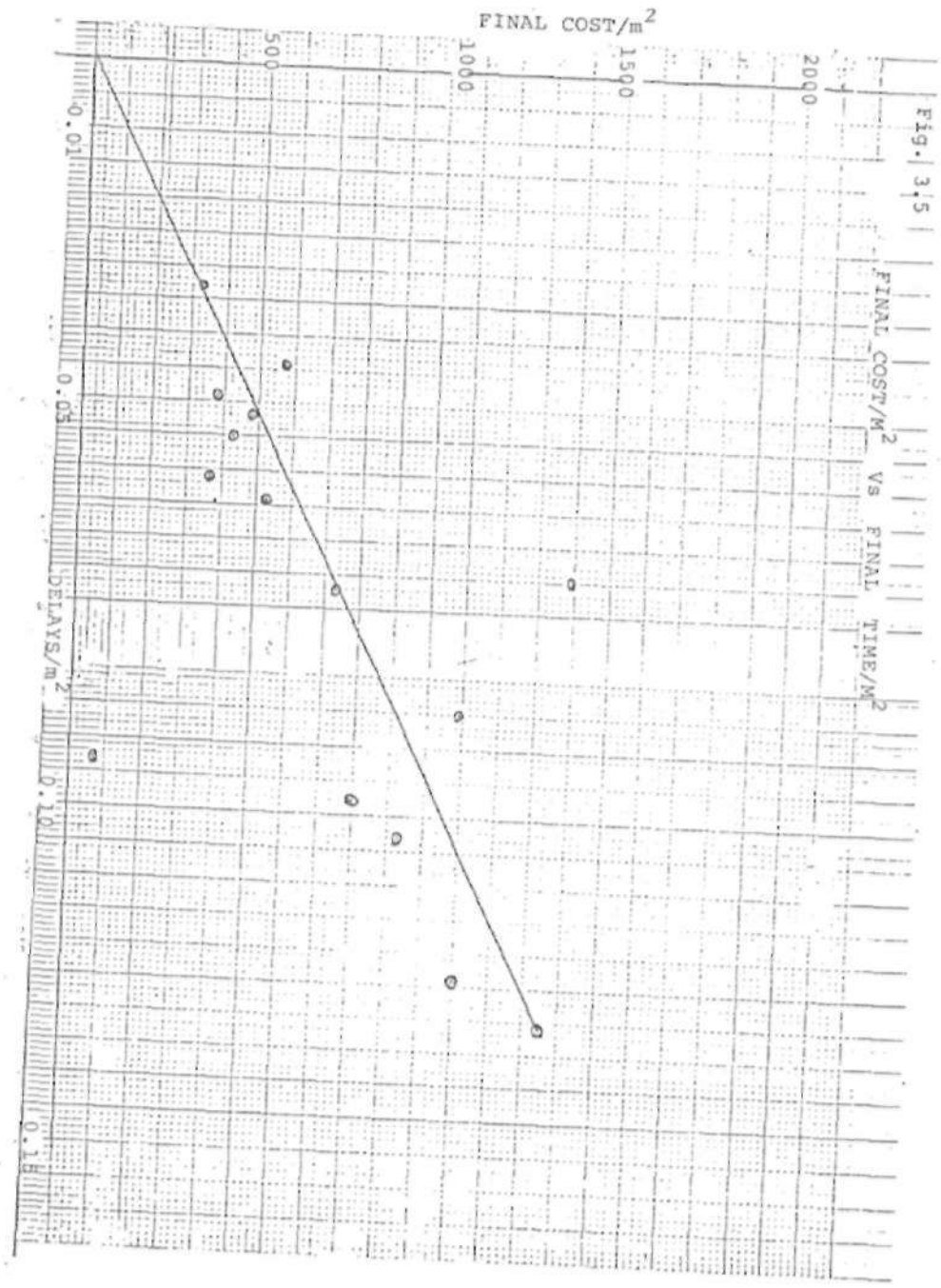

INITIAL COST (N) Vs INITIAL TIME (MONTHS)
INITIAL COST (× 10³ N)
150
100
50
2
4
6
8
10
12
14
INITIAL TIME (MONTHS)

Fig. 3.4


FINAL COST (N) Vs FINAL COST INTENSITY
FINAL COST (x 10³ N)
400
300
200
100
8000
10000
12000
14000
FINAL COST INTENSITY


FINAL COST/m2
500
1000
1500
2000
0.01
0.05
0.10
0.15
DELAYS/m2
Fig. 3.5
FINAL COST/M2 Vs FINAL TIME/M2

FINAL COST/M^2 Vs DELAYS/M^2 Fig. 3.6

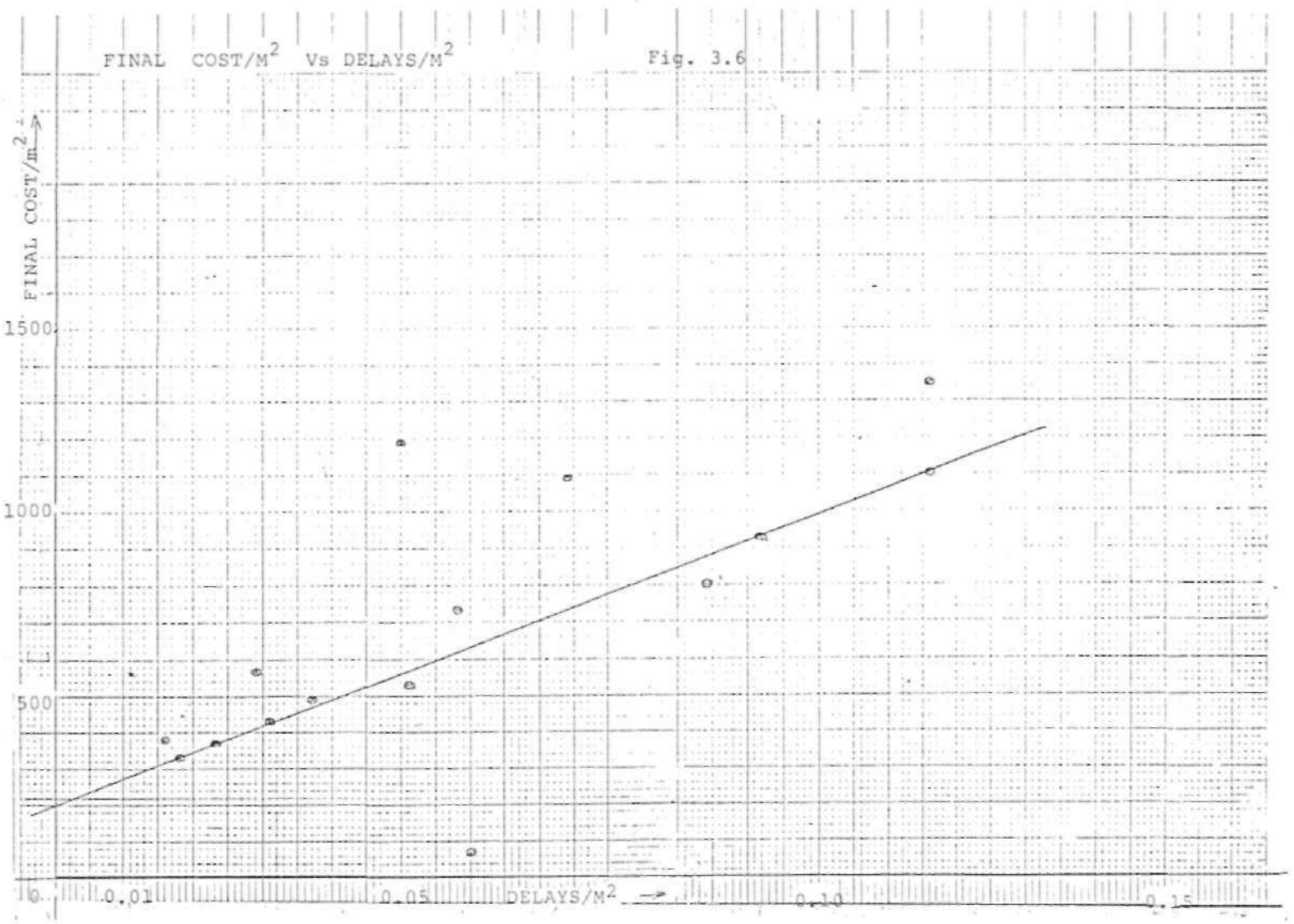
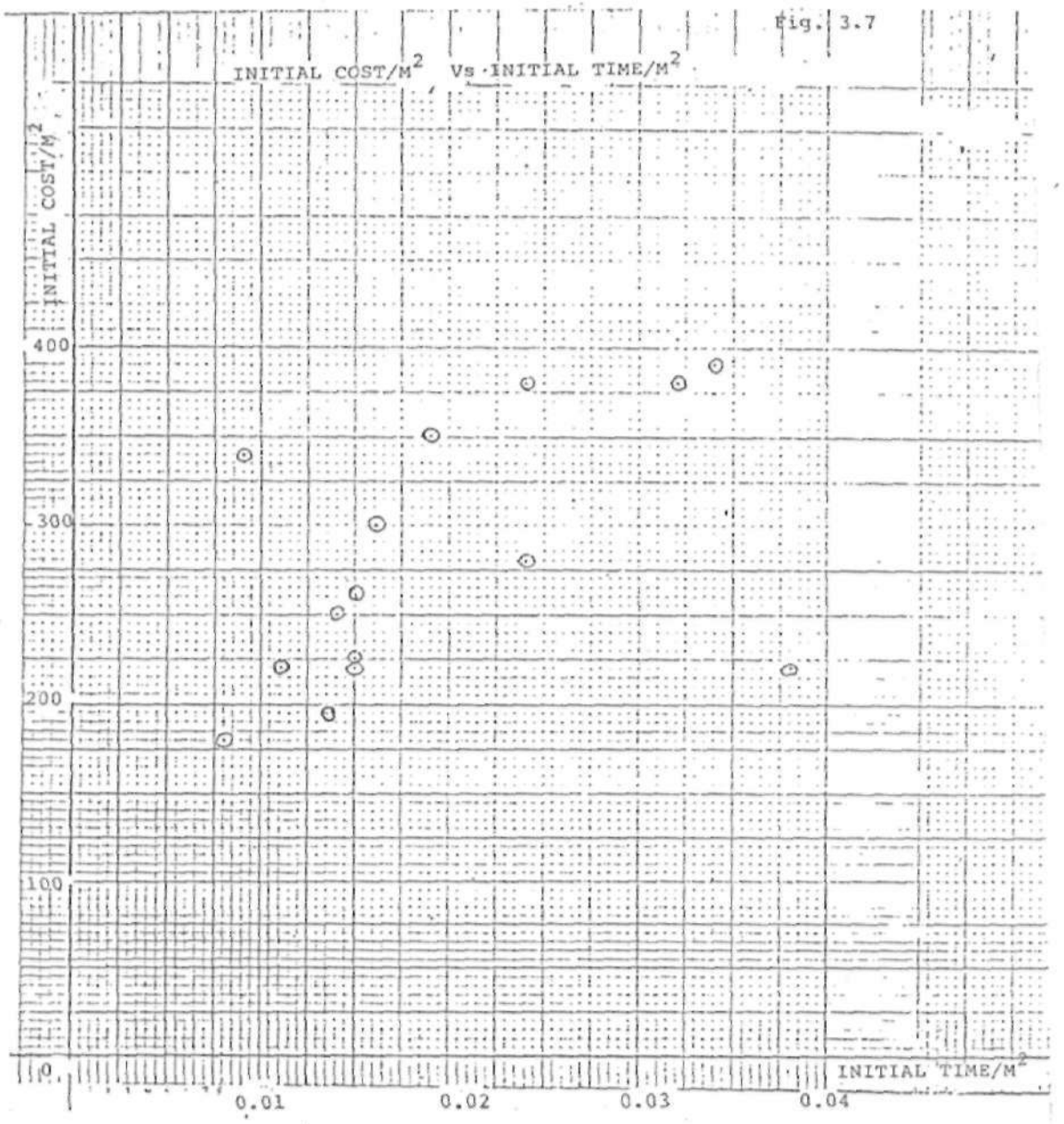


Fig. 3.7


INITIAL COST/M2 Vs INITIAL TIME/M2
INITIAL COST/M2
400
300
200
100
0
0.01
0.02
0.03
0.04
INITIAL TIME/M2

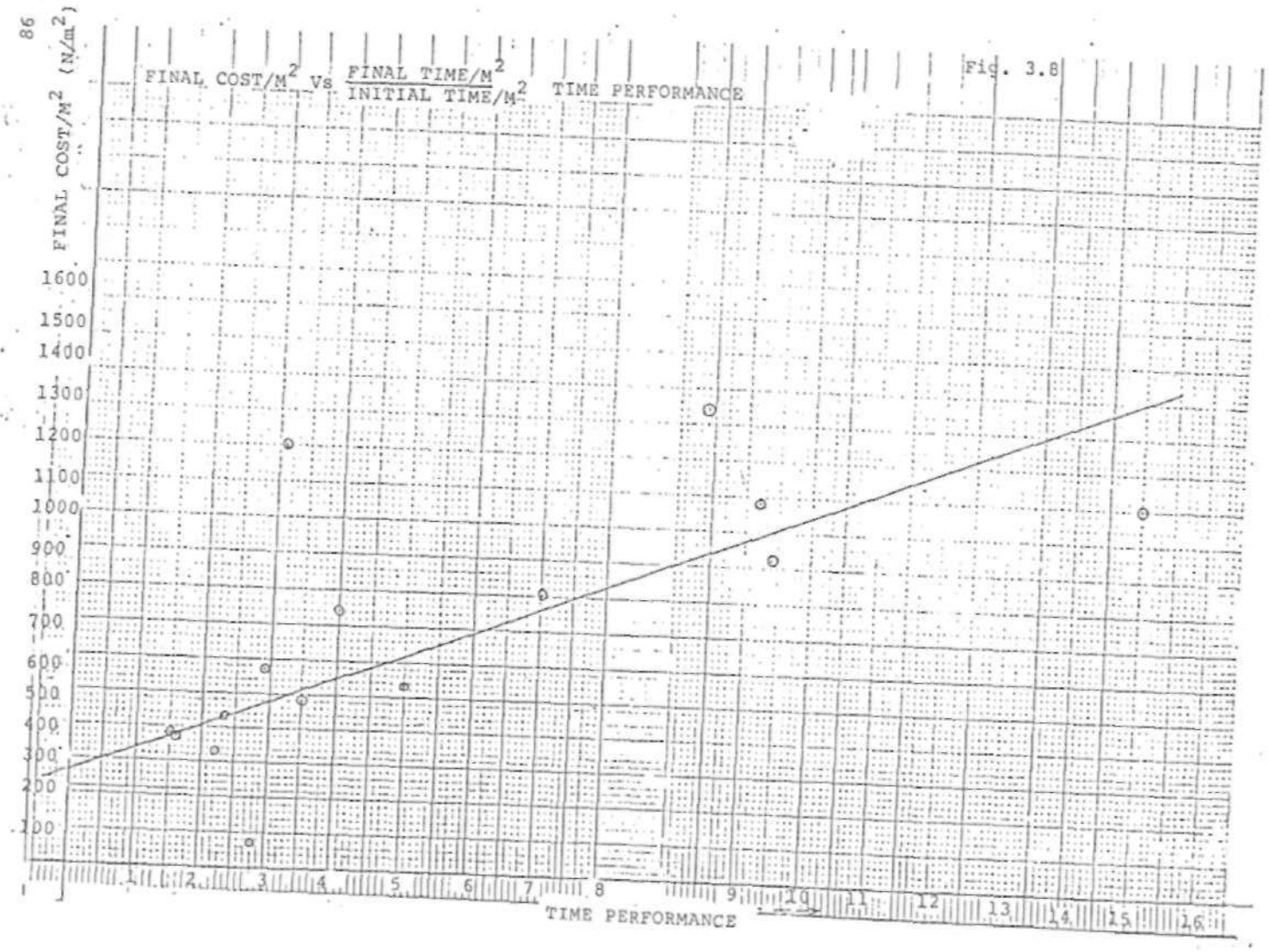
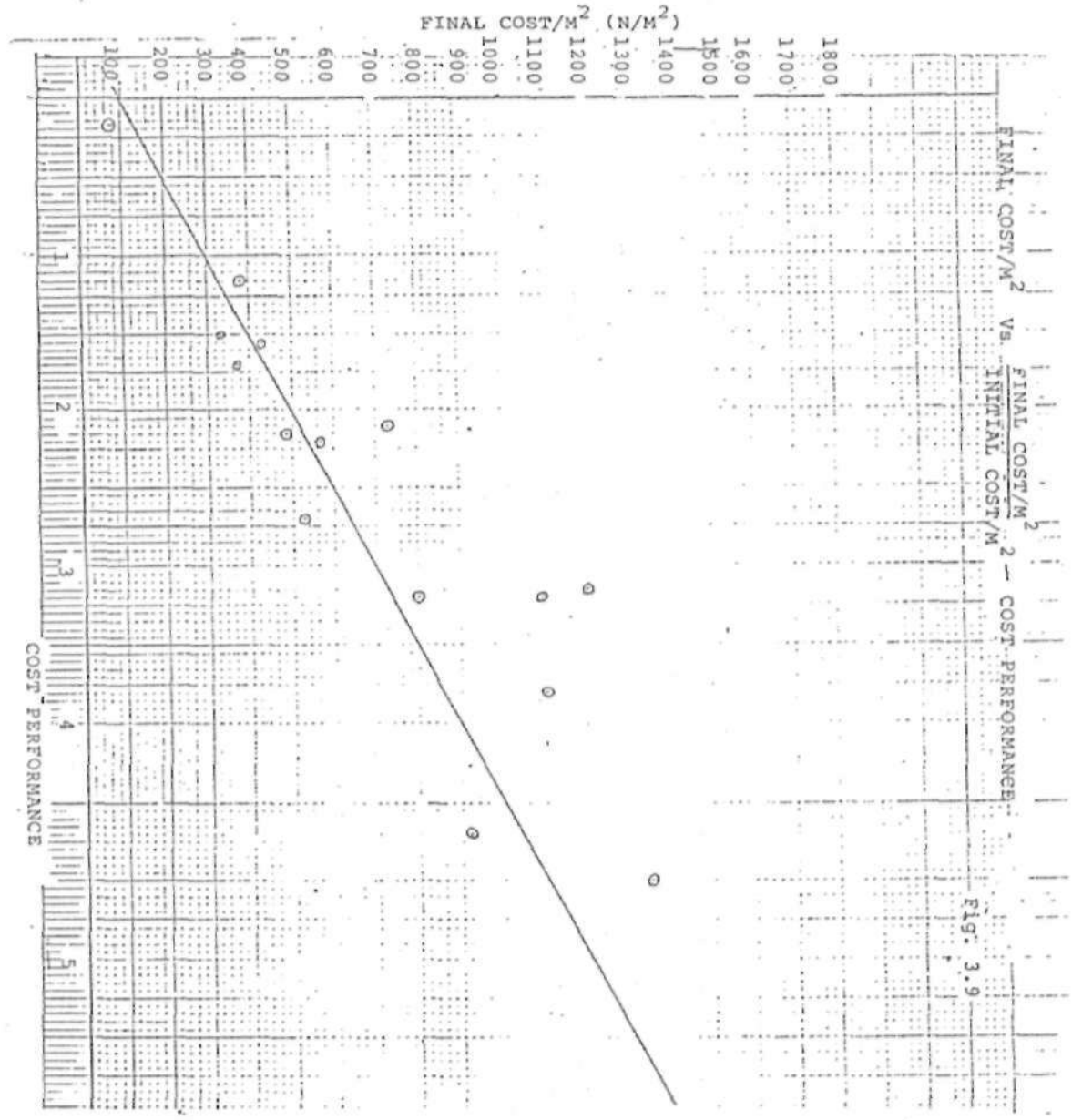
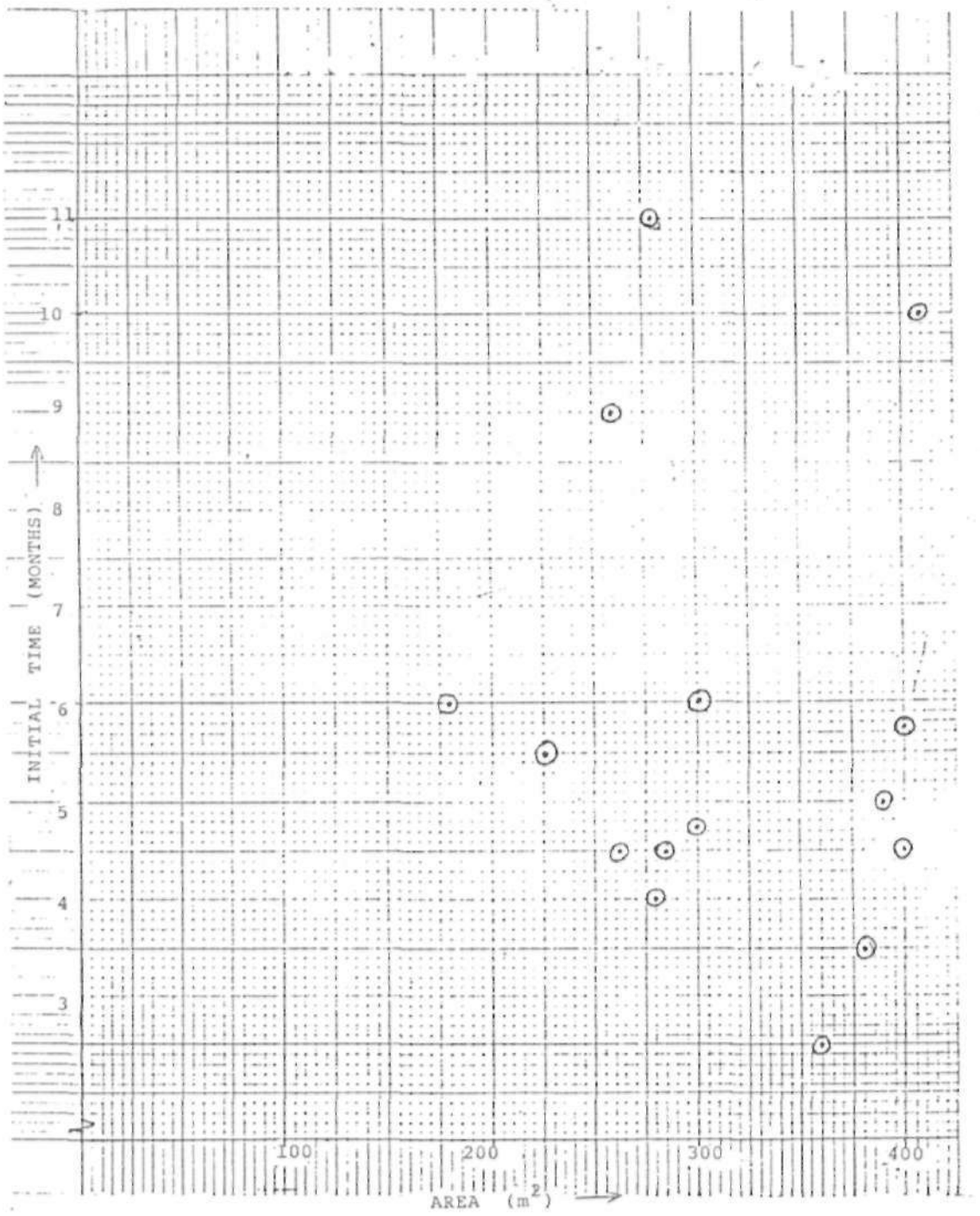

FINAL COST/M2 (N/m2)
FINAL COST/M2 Vs FINAL TIME/M2 / INITIAL TIME/M2 TIME PERFORMANCE
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
TIME PERFORMANCE

Fig. 3.8

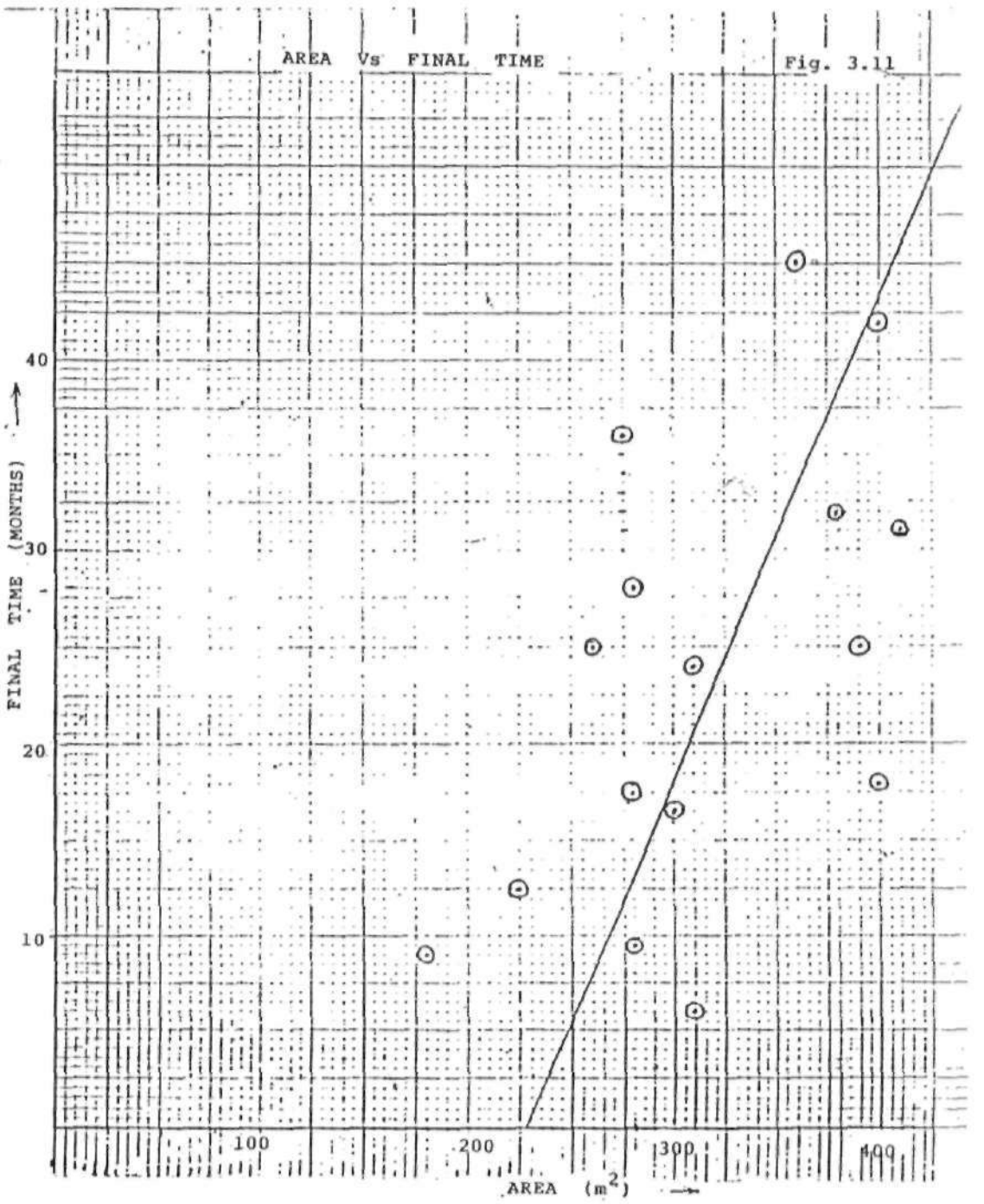


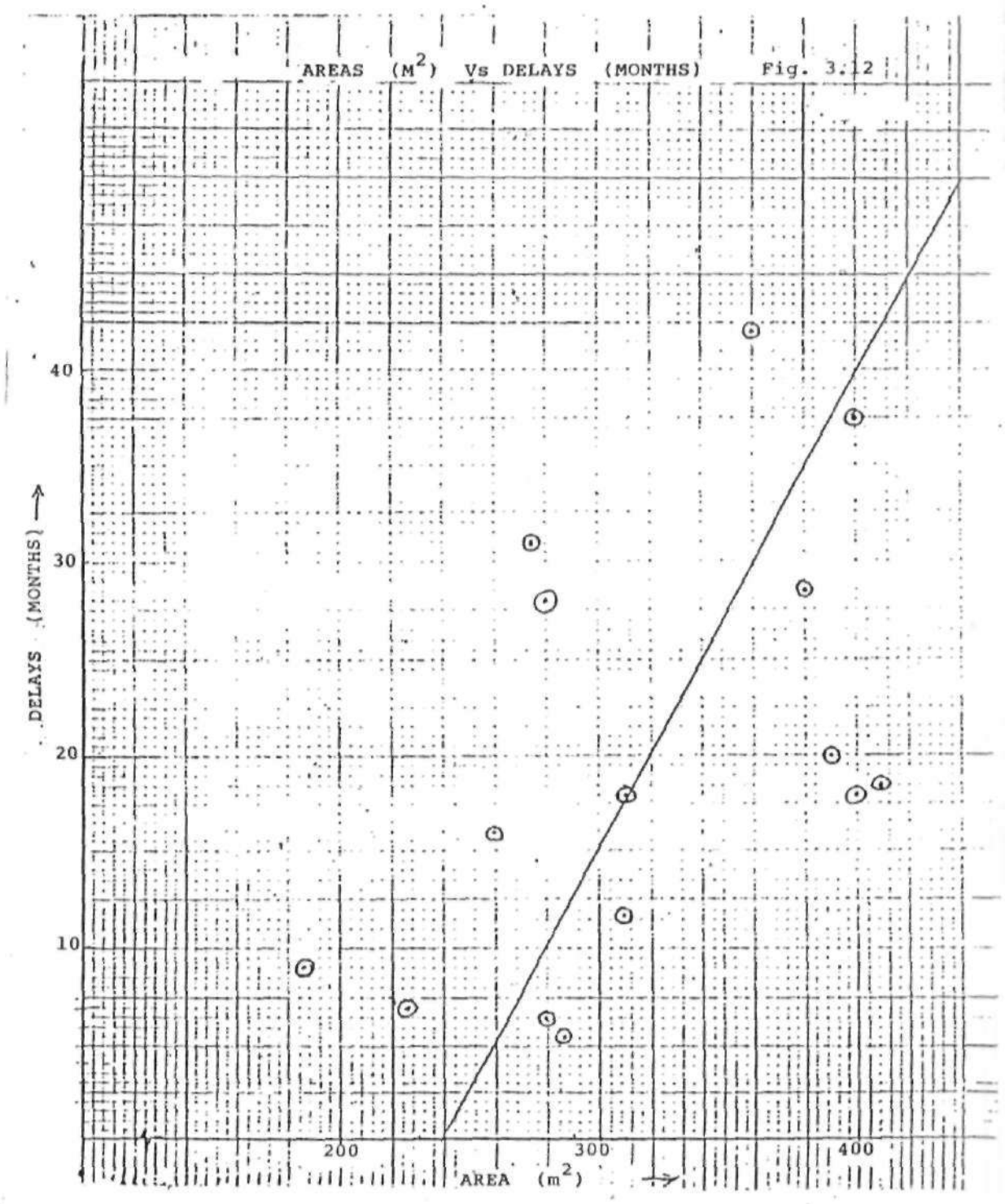
FINAL COST/M^2 Vs. INITIAL COST/M^2 — COST PERFORMANCE

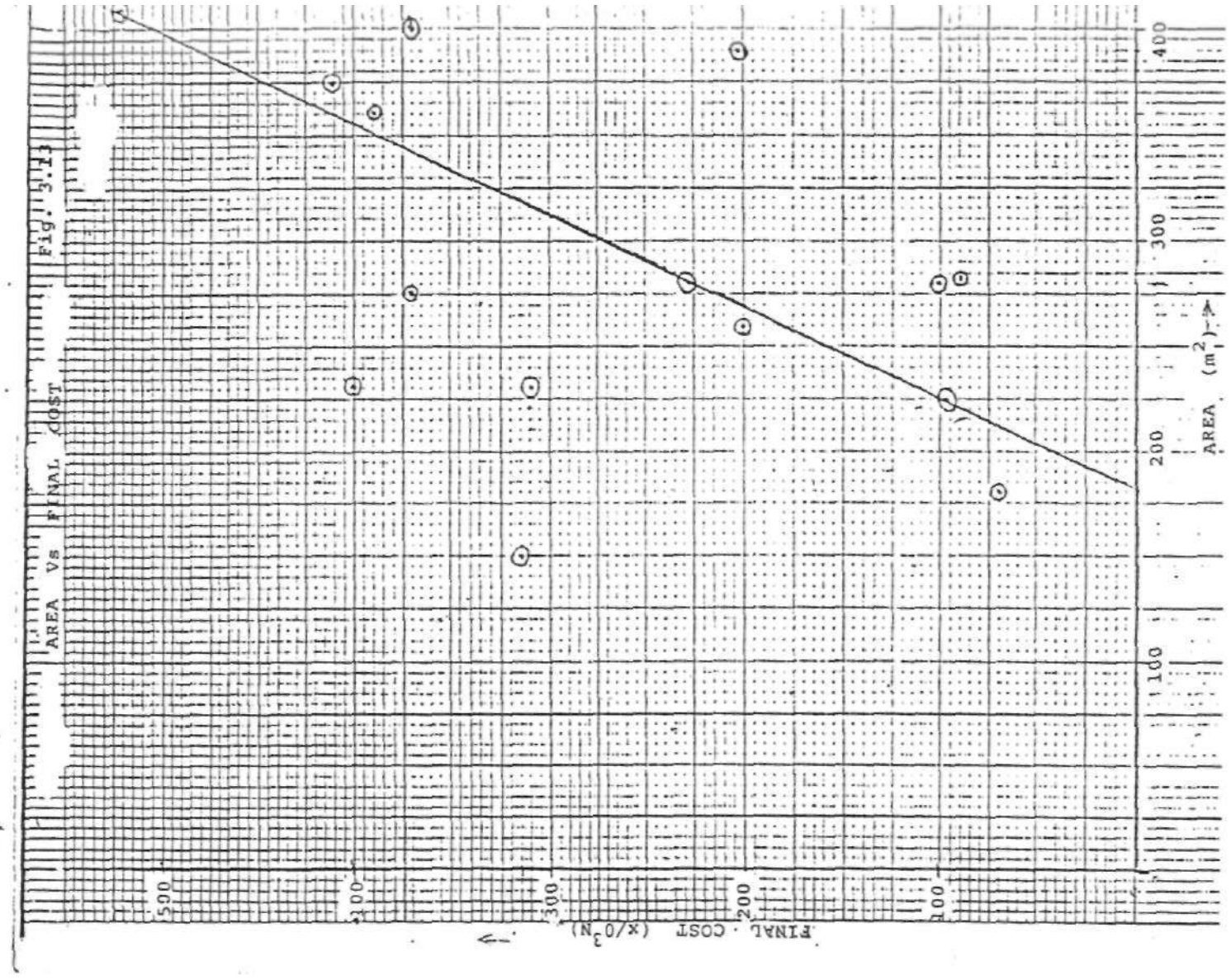
Fig. 3.9



AREA Vs INITIAL TIME Fig. 3.10


AREA Vs FINAL TIME
Fig. 3.11
FINAL TIME (MONTHS)
40
30
20
10
100
200
300
400
AREA (m²)


AREAS (M2) Vs DELAYS (MONTHS) Fig. 3.12
DELAYS (MONTHS)
40
30
20
10
200
300
400
AREA (m2)


Fig. 3.11
AREA Vs FINAL COST
AREA (m²)
FINAL COST (x/0³N)
100
200
300
400
500
600
700
800
900
1000
1100

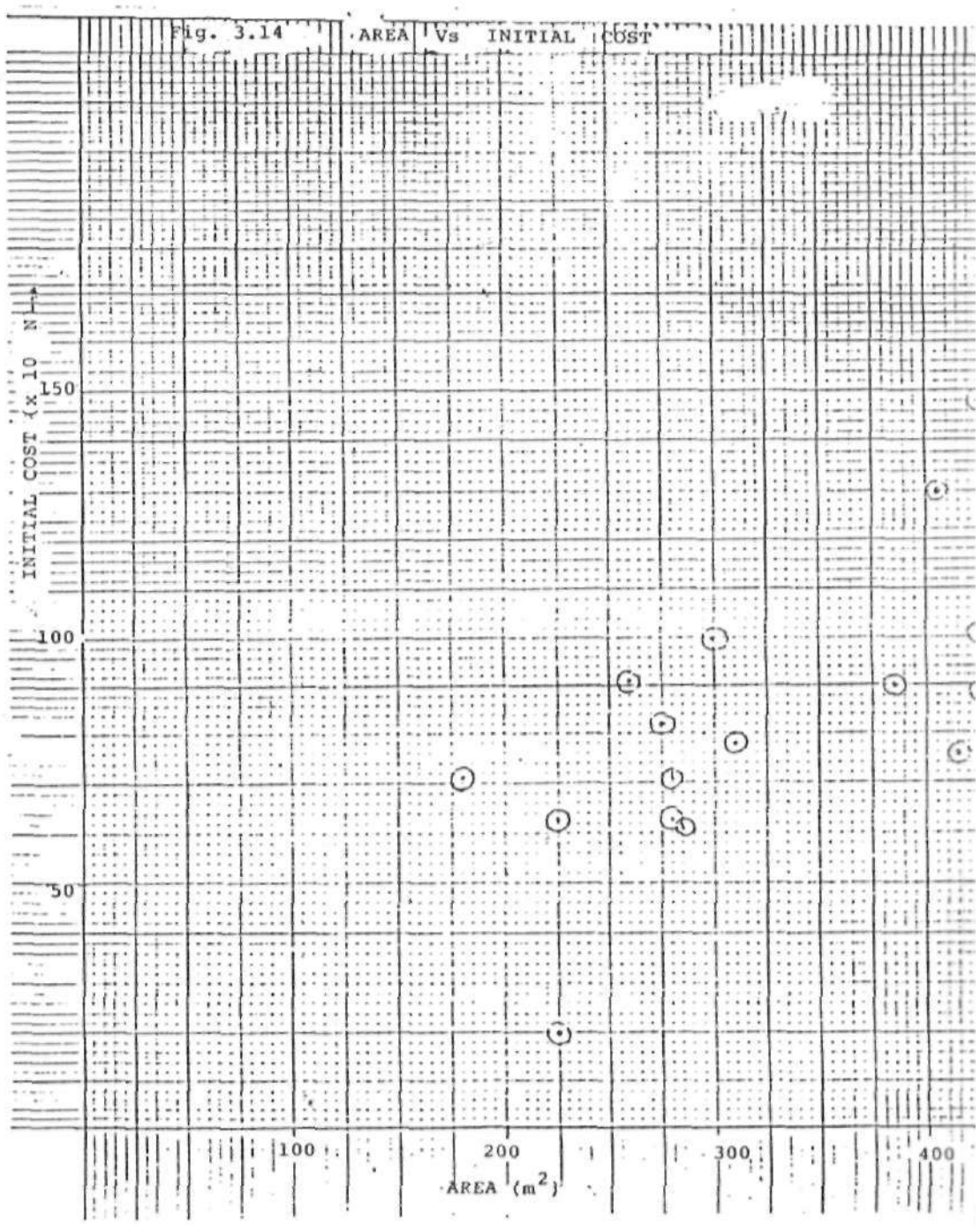


Fig. 3.14 AREA Vs INITIAL COST

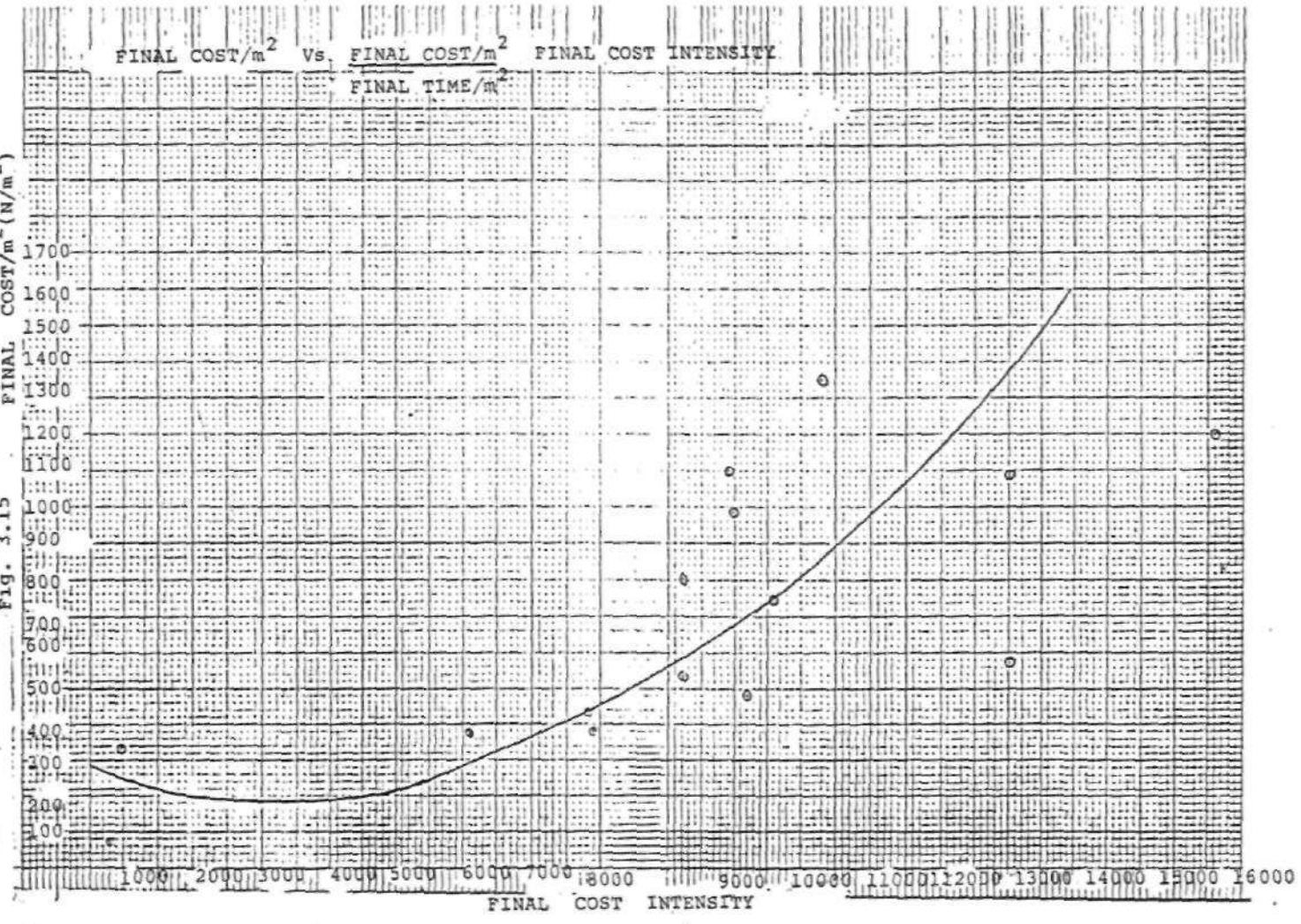

FINAL COST/m² Vs. FINAL COST/m² FINAL COST INTENSITY
FINAL TIME/m²
FINAL COST/m² (N/m²)
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 11000 12000 13000 14000 15000 16000
FINAL COST INTENSITY

Fig. 3.15

AREA (m^2) Vs SPEED (N/MONTH).

Fig. 3.15a

(FINAL COST INTENSITY)

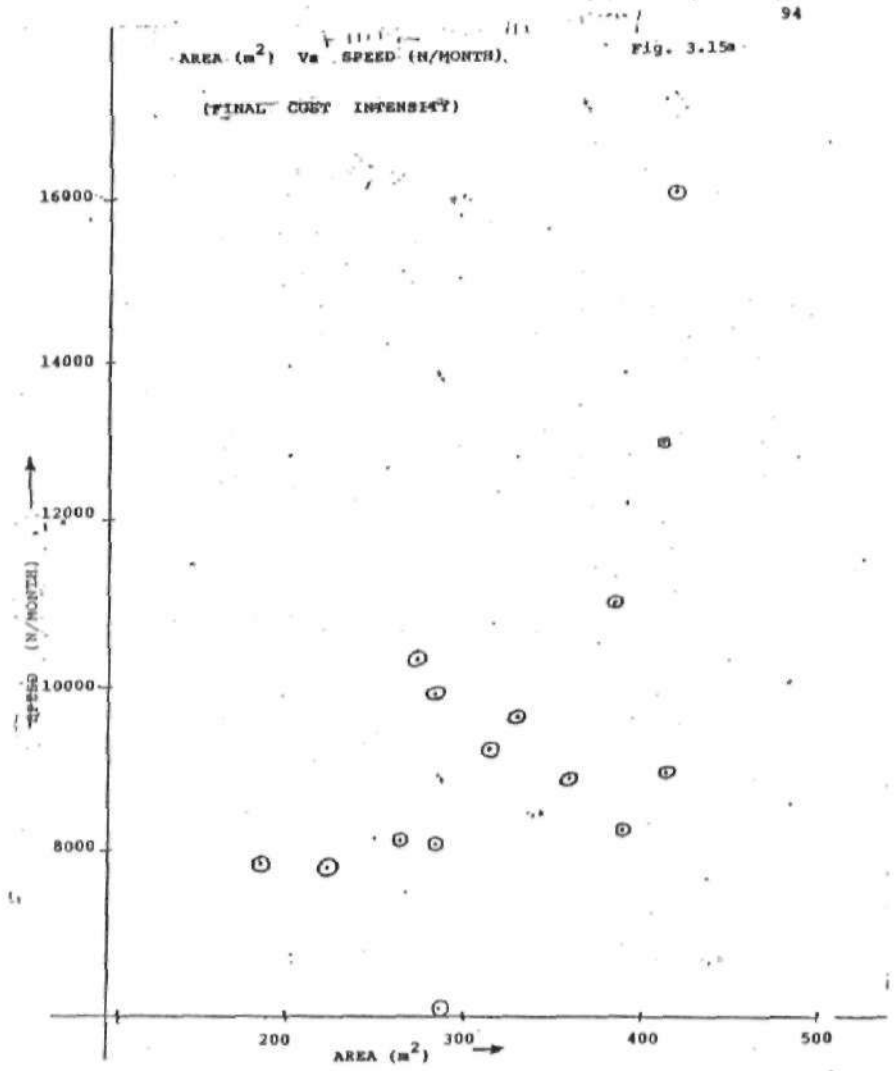


Table 3.3 EXPLORATORY STUDIES ON TIME COST RELATIONSHIP: SUMMARY

Figure Ref.	Relationship studies X Axis	Y Axis	Results &	Explanations
3.1	Final Cost	Final Time	Linear:-	As the Final Cost increased, the Time Increased also. Extra work and fluctuction cost are related to extra time.
3.2	Final Cost	Delays	Linear:-	As the Final Cost increased, the delays increased also. Delay is costly.
3.3	Initial Time	Initial Cost		No relationships. Both are unreliable
3.4	Final Cost	Final Cost Intensity		Curvelinear: Final Time may not be related to Final Cost.
3.5	Final Cost/m2	Final Time/m2	Linear:-	As the final cost/m2 increased, the Final Time/m2 also increased. Extra work and flucturtion cost are related to extra time.
3.6	Final Cost/m2	DElay/m2	Linear:-	As the Final Cost/m2 increased, the Delay Time/m2 also increased. Delay is costly.
3.7	Initial Cost/m2	Initial Time/m2		No relationship. Both initial cost and Initial Time are unreliable.
3.8	Final Cost/m2	Time Performance	Linear:-	As the Final Cost/m2 increased, the time performance also increased; Final time and Final Cost are reliable.
3.9	Final Cost/m2	Cost Performance	Linear:-	As the Final Cost/m2 increased, the cost performance also increased.

Table 3.3 EXPLORATORY STUDIES ON TIME COST RELATIONSHIPS: SUMMARY

Figure Ref.	Relationship studies X Axis	Y Axis	Results & Explanations
3.10	Area	Initial Time	No relationship; Initial time not reliable
3.11	Area	Final Time	Linear:- As the size increased, the final time also increased. Final Time - reliable.
3.12	Area	Delay Time	Linear:- As the size increased, the delays also increased. Extra work needs extra time.
3.13	Area	Final Cost	Linear:- As the size increased, the final costs also increased; size is an important factor.
3.14	Area	Initial Cost	No relationship - Initial Cost not reliable
3.15	Area	Final Cost Intensity	Curvelinear: Final time may not be related to Area.
3.15a	Area	Final Cost Intensity	Curvelinear.

building had some statistical relationships with time and cost components while in some it had none. It was therefore decided that in the main research, all inputs should be divided by floor area to reduce the effect of ambiguity and to assure homogenity. (d) because there was a poor response to the questionnaire which of course affected the number and quality of data, the questionnaire for the main research was re-designed and a new field strategy* was mapped out for collecting the relevant data for the main research.

During the pilot surveys, the following points were noted on the field data:- (a) lack of properly stored information of the type needed, (b) the reluctance of public servants and contracting firms to provide the required information, (c) lack of information on the summaries of some important events like delays and disruptions. The feedback on data matters are supported by the literature views of some scholars who had undertaken some researches on Nigeria's business sector.

Harris (1970) noted that the members of Nigeria's bureaucratic, political, business and professional elites were considered to be generally speaking, quite busy individuals who were always on the go and difficult to see. Harris (1970) assumed that even if an interviewer was fortunate enough to find them in their offices, he would be interrupted by the constant flow of telephone calls and personal visitations which these individuals daily endure. Under such circumstances, lengthy interviews were considered impossible, as were self administered questionnaires with open-ended questions requiring written answers. Therefore, it seemed necessary to select a survey instrument which could be easily and quickly

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* See Chapter 4.

The views of Harris and Akeredolu-Ale as well as the reports from the field suggest that a practical as well as a comprehensive system has to be adopted in obtaining the field data of the type required in this study.

3.4 THE DESIGN OF THE QUESTIONNAIRE FOR THE MAIN RESEARCH

It will be recalled that the information needed as contained in the hypothesis were as follows:-

(A) Cost Parameters:	(i)	Initial Contract Cost.
	(ii)	Variation Cost.
	(iii)	Fluctuation.
	(iv)	Final Contract Cost.
(B) Time Parameters:	(v)	Initial Contract Time.
	(vi)	Final Contract Time.
	(vii)	Year Project was Commissioned
	(viii)	Year Projected was completed
(C) Delay Parameters:	(ix)	Due to payment.
	(x)	Due to Variation Orders.
	(xi)	Due to other factors.
(D) Area	(xii)	Total floor Area.

Data on all the cost and time "parameters" stated above were extracted from final account certificates. However, the Delay "parameters could not easily be extracted from past project information. Total floor areas were extracted from drawings. During the summer vacation periods of 1987 and 1988 as well as the Christmas, **and Easte**r periods of 1987 and 1988, the assistance of practising quantity surveyors, as well as building, quantity surveying and estate management students were used in obtaining inform-

ation from public service representatives, consultant quantity surveyors and architects as well building contracting organisations.

Before the assistants were sent out to obtain data, they were properly briefed on the methods of collection and classification of data. They were divided into groups and each group was headed by a group leader who returned the forms to the researcher at Kaduna. Anonymity was promised to those who provided the relevant information from project files and also to those who responded to questions.

1650 questionnaires were sent out (i.e. 150 for each Northern States and Abuja). Each state had three assistants allocated to it with a maximum of fifty questionnaires per assistant. On a careful inspection, it was found out that 240 questionnaires were answered as required. On a further examination, it was found that the breakdown of the selected 240 projects were as follows:-

(a)	The Civil services	104	43.33%
(b)	Public Corporations	29	12.08%
(c)	Universities	31	12.92%
(d)	Other Higher Education	76	31.67%
		240	100.00%

*(Higher Education comprise : Polytechnics, Colleges of Education, Vocational Centres).

Table T3.7 (Completed Questionnaire Sectorial breakdown)

From Table T3.7 it appeared that civil service and Higher education projects were more than the public corporations and University Housing projects. Also from Table T3.9 the projects located in the new Abuja Federal Capital Territory scored the highest percentage of 40.4% followed by Gongola and Kaduna States

with 11.7 and 9.6 percent respectively. The differences in percentage distribution may be attributed to the number of projects executed, the availability of information, the skill, enthusiasm and efficiency with which the questionnaires were administered, of the questioners, and the eagerness of the respondent. The data were then classified into tables as shown in chapter 4.

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3.5 INSTRUMENTS FOR ANALYSIS AND INVESTIGATION

REGRESSION AND CORRELATION ANALYSIS

Freund et al. (1979) explained that the use of a linear regression model to analysis a set of data is subject to a number of assumptions and limitations. Failure of these assumptions and limitations may require the modification of the model or the placing of restrictions on the inference to be made by the analyses. Occasionally, it may even lead to the abandonment of a regression analysis. It is therefore appropriate to examine these assumptions and limitations before proceeding to the estimation and inference procedures:-

(1) The most important condition is of course, that the model has been correctly specified, i.e. the model adequately and correctly describes the behaviour of the data,

(2) The linear regression model must be linear in the parameters. However, the model may be non-linear in the independent variables and yet remain within the framework of linear regression.

(3) The model statement makes no mention of statistical properties of the independent variables. This is intentional since they are not random variables. They are specified to be

fixed, predetermined and/or chosen at will. No inferences are to be made about the independent variables and the independent variables are not influenced by the dependent variable. The focus of all inferences is on the dependent variable.

(4) The independent variables must be measured without error. If the independent variables are subject to error, the estimated regression co-efficients may be biased. This bias is a function of the ratio of the measurement error to the random error of the model; if this ratio is small, the bias is small.

(5) The stated purpose of the regression model and analysis per se, are to estimate Ux, the mean of the dependent variable for a specific set of values of the independent variables. Normally such estimation is performed within the range of the observed sample data and extrapolation is not encouraged.

(6) Another purpose for performing regression analysis is to study the partial regression co-efficients. Under certain conditions, the regression co-efficient estimates are quite unstable and not subject to meaningful interpretation.

(7) The fact that a regression relationship has been found to exist does not imply a cause-effect relationship, although it may exist.

(8) The data on which the regression analysis is performed is assumed to be a random sample. However, regression analysis is often used in situations where this is not strictly the case.

Weisberg (1980) opined that Regression is used to study relationships between measurable variables. Linear regression is used for special class of relationships, namely, those that can be described by straight lines, or by generalisations of straight lines to many dimensions.

- The most common reasons are description of a relationship and prediction of future values. To study a relationship between a number of variables, data are collected on each of a number of units or cases on these variables. A hypothesised model specifies, except for a number of unknown parameters, the behaviour of the response for given values of the predictors. The model generally will also specify some of the characteristics of the failure to provide exact fit, through hypothesised error terms. Then, the data are used to obtain estimates of unknown parameters. The next, and equally important, phase of a regression analysis is called "case analysis" in which the data are used to examine the suitability and usefulness of the fitted model for the relationship studies. The results of "case analysis" will often lead to modification of the original prescription for a fitted model, and cycling back to the aggregate analysis after modifying the data or assumptions is often necessary essentially, what are needed in regression and correlational analysis are the establishment of the equation of a straight line, the intercept, the standard error of regression. Three tests can be carried out: Analysis of Variance (ANOVA), the F Test for regression and the Co-efficient of Determination R^2. R^2 is easily computed from quantities that are available in the ANOVA tables. It is a scale-free one-number summary of the strength of the relationship between x, and y, in the data. It is very popular statistic since it generalises clearly to multiple regression, depends only on the sum of squares, and appears to be easy to interpret. Relationship to the correlation co-efficient and thus R^2 is the same as the square of the sample correlation between x and y.

Levin (1981) claimed that regression analysis tends to show the relationship between variables. He argued that Chi-Square tests determines whether a statistical relationship existed between two variables. The Chi-square test tells if there is such a relationship, but it does not tell what that relationship is. Regression and correlation analysis will show how to determine both the nature and the strength of a relationship between two variables. It is possible to predict with some accuracy, the value of an unknown variable based on past observations of that variable and others. The known variable is called the independent variable. The variable that is to be predicted is the dependent variable. Frequently, there is a causal relationships between variables, that is the independent variable "causes" the dependent variable to change. Essentially, the relationships found by regression are relationships of association but not necessarily of causes and effect. Unless there are specific reasons for believing that the values of the independent variable are caused by the values of the independent variable, it is not safe to infer causality from the relationships found by regression.

The first step in determining whether there is a relationship between two variables is to examine the graph or chart, called a scatter diagram. Visually, there can be patterns that indicate how the variable are related. Then, if the variables are related, the kind of line or estimating equation which describes this relationship can be formulated. The following are common:- Direct linear, Inverse linear, direct curvilinear, and inverse curvilinear. The next step is to measure the reliability of the

estimating equation by the "standard error of estimate" is symbolised by (Se) and is similar to the standard deviation; both are measures of dispersion. The standard error of estimate measures the variability or scatter of the observed values around the regression line. As in the case of the standard deviation, the larger the standard error of estimate, the greater the scattering of points around the regression line.

Conversely, if Se = 0, it is expected that the estimating equation is a "perfect" estimator of the dependent variable. In that case, all the data points should be directly on the regression line and no points would be scattered around it.

Correlation analysis is the statistical tool that can be used to describe the degree to which one variable is linearly related to one another.

Frequently, correlation analysis is used in conjunction with regression analysis to measure how well the regression line explains the variations of the dependent variable Y. Correlations can also be used by itself to measure the degree of association between two variables.

The general positive results of some of the essential tests to which the data were subjected signified a greater bias for the use of regression and correlation analysis. The analysis were carried out with aid of (SPSS package) on a mainframe computer.

3.6. SCOPE AND LIMITATIONS

MARK - UP - No measurement was undertaken of any possible mark-up due to corruption or shady deals. Increases in costs which were measured, were simply, certified payments on variations and fluctuations. The verification of such mark-ups is outside the scope of the study for it would be very difficult to obtain the relevant data and also to test such data due to the secrecy associated with them.

EXTENT OF FIELD DATA - Data were collected from the Northern parts of Nigeria. The Northern parts of Nigeria were chosen as an area of the field study because, (i) 88% of the bungalow units sampled in the pilot studies existed in that part of the country, (ii) as the contract practices in the Northern areas are of the same as in the south, the ensuing results and recommendations can be of general application to the whole of the Federation.

BUILDING TYPE - Three and four bedroom residential bungalow buildings constructed in the Northern parts of Nigeria were used for data collection and analysis. The quality of both the design and construction were not measured. They were assumed to be the same as government policy on senior staff were of general application to the senior cadre of public servants. The effects on cost and time of construction of the following factors:- (Shape, height, construction pattern, geographical location, type and size of

construction firms and sub-contracting) were not considered since they may likely involve various types of statistical modelling which is outside the scope of this study. The effect of area on the cost and time was eliminated by dividing all inputs by the floor area.

FINANCE - No updating of the Naira to any base datum. There was no available national price indices on which to refer. No interest was paid by the client for the money owed to a contractor, so interest was not calculated. The Final cost excludes the cost of furniture, equipment, professional fees, land cost, and commissioning. The Naira is the official currency.

TIME FRAME The number of working weeks measured included all normal working days, public holidays, Sunday, Saturdays, because a contractor's initial construction time is always assumed to include all such periods. The period of study covered was between 1975 and 1985. Care should be taken in applying the conclusions drawn from this study on other periods because of possible changes in economic, social, political and administrative factors.

INTERPRETATION This study does not cover other types and qualities of residential buildings. Therefore, care should be taken in applying the results and conclusions to other types of buildings. This study would however also provide some scientific guidelines for analysing and understanding the existing relationships between cost and time of other construction projects.

CHAPTER 4

DATA, ANALYSIS & DISCUSSIONS

4.1. DATA: COLLECTION & CHARACTERISTICS

Fig. T2/8 tabulated information on the sectorial and geographical distribution of the field questionnaire, on (a) the states that were selected for the study (b) the sample distribution, (c) the response, (d) the selection pattern and (e) the sectorial classifications. The highlight from Fig. T2/8 were as follows:-

A total of 1650 questionnaire were sent out for the main study. 370 (representing 22.42% of the total questionnaire were responded to and returned. Abuja FCT had the highest of the respondents (141 - which represented 38.10% of the total respondents), while Plateau State had 13 (which represented 3.5% of the total respondents).

The returned questionnaire were closely scrutinised as to the degree of completion of the required information. Those that were not fully completed were found to be adequately completed. FCT Abuja had the highest number (97 - which represented 40.42% of the total 240 selected questionnaire), while Plateau State had the lowest number (8 which represent 3.3% of the 240 selected questionnaire).

Sectorialy, there 104 selected Civil Service projects (which represented 43.3% of the 240 selected units) while the public corporations had the minimum (constituted 12.08% of 240 selected units).

240 housing units were therefore used for the main study. The recorded poor response in the main study were due to the reasons already provided the poor response in the pilot surveys which were reported in chapter 3. However, there was a higher degree of

SECTORAL AND GEOGRAPHICAL DISTRIBUTION OF THE FIELD QUESTIONNAIRE

TABLE T2/8

REF.	STATE	TOTAL NO. SAMPPLED	TOTAL NO. RESPONDED	TOTAL NO. SELECTED	% SELECTED	Sectors Breakdown in 1975 - 85			
						CS	PC	UN	HE
1.	ABUJA (FCT)	150	141	97	40.4%	73	6	-	18
2.	Bauchi	150	30	13	5.4%	4	1	2	6
3.	Benue	150	16	9	3.8%	3	4	-	2
4.	Borno	150	25	15	6.3%	4	2	3	6
5.	Gongola	150	36	28	11.7%	11	3	2	12
6.	Kaduna	150	33	23	9.6%	-	-	14	9
7.	Kano	150	17	11	4.6%	-	2	5	4
8.	Kwara	150	23	14	5.7%	2	4	3	5
9.	Niger	150	21	12	5.0%	3	4	-	5
10.	Plateau	150	13	8	3.3%	2	2	1	5
11.	Sokoto	150	15	10	5.2%	2	1	1	4
	TOTAL	1,650	370	240	100%	104	29	31	76

Key - CS = Civil Service, PC = Public Corporations, UN = Universities, HE = Higher Education.

response in the main study than in the pilot surveys. The highest percentage of selected project use at the FCT Abuja. That could be due to the fact that the FCT was a new area for development. Sectorialy, the civil service had more selected projects than the other sectors. That may suggest that more emphasis was given to the construction of housing units for that part of the public sector.

4.2 DATA: PRESENTATION

Fig T4.2 ..to.. T4.3 showed samples of the information on the 240 selected projects. They were serialy numbered for easy identification and all the inputs were properly checked. (3 Tables are included as samples in this chapter, all others are shown in the appendix).

The inputs were were then divided by the floor area and then recorded in Fig. No..... which is a sample. (The remainder are contained in the appendix).

4.3 ANALYSIS

About 40 experiments were undertaken in order to (a) prove or disprove the hypothesis, (b) show why the data had some characteristics.

The first phase was to inspect and describe the graphs obtained when any two selected resource components are both correlated. Information recorded and reviewed were: the correlation factor, R, the standard error, the shape of the graph, the intercept, and the level of significance.

After reviewing the whole experiments undertaken, the summaries of the results were provided and discussions were held. The benefits relationships and non-relationships obtained were explained in the discussions.

4.2 The Data

PROJ NO	FLOOR AREA (M^2) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) Ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dt	DELAY BREAK DOWN: PAYMENT TIME (WKS) dp	DELAY BREAK DOWN: VAR. TIME (WKS) dvt	DELAY BREAK DOWN: OTHER do	YEAR: INITIAL Iy	YEAR: FINAL Fy
001	135	89,173	10,247	35,640	135,060	045	10	035	019	101	066	85	85
002	135	88,155	09,256	41,433	138,844	038	12	026	016	006	004	85	85
003	135	93,983	08,222	32,886	135,091	043	15	028	012	004	012	85	85
004	135	84,375	09,914	37,125	131,414	050	18	032	023	010	017	84	85
005	140	78,418	09,408	50,176	138,002	117	20	097	057	022	018	83	85
006	140	79,800	11,571	37,506	128,877	136	25	111	058	012	041	83	85
007	140	80,519	13,283	34,615	128,398	084	15	069	042	012	015	83	85
008	140	72,100	11,176	62,727	146,003	154	16	138	100	018	020	82	85
009	147	79,380	11,510	50,009	140,899	117	10	107	052	027	028	82	84
010	147	70,560	07,762	54,331	132,653	100	15	085	045	025	015	81	83

.4.3 - The Data

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dc	DELAY BREAK DOWN PAYMENT TIME (WKS) dp	DELAY BREAK DOWN VAR. TIME (WKS) dvt	DELAY BREAK DOWN OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
011	147	64,680	07,762	32,340	104,782	085	15	070	049	011	010	80	81
012	142	61,770	09,883	46,328	117,981	076	16	060	035	017	008	80	82
013	142	60,350	10,561	52,505	123,416	143	18	125	056	044	025	80	83
014	142	61,060	8,243	54,954	124,257	194	25	169	101	026	042	80	82
015	120	27,000	3,105	12,150	042,255	065	15	050	026	010	014	76	77
016	120	27,000	3,375	9,450	039,825	048	20	028	013	008	007	76	76
017	120	31,800	3,498	12,720	048,018	040	25	015	010	002	003	77	77
018	120	31,200	4,212	13,104	048,516	050	14	036	018	008	010	77	78
019	125	36,250	3,263	17,400	056,913	063	16	047	018	012	017	77	78
020	125	43,125	2,803	32,344	078,272	116	15	101	075	015	011	78	81

4.4 - The Data

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dc	DELAY BREAK DOWN PAYMENT TIME (WKS) dp	DELAY BREAK DOWN VAR. TIME (WKS) dvt	DELAY BREAK DOWN OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
021	125	42,500	2,019	38,675	083,194	120	14	106	068	027	011	78	81
022	125	40,625	2,234	34,938	077,797	136	14	122	073	023	026	78	81
023	135	32,400	3,240	25,920	061,560	140	20	120	054	024	042	76	81
024	135	35,100	2,808	28,782	066,690	153	21	132	077	039	016	77	80
025	135	37,125	3,248	29,329	069,702	185	17	168	105	051	012	77	80
026	135	37,125	2,784	33,413	073,322	180	19	161	093	061	007	77	80
027	135	37,125	05,198	39,724	082,047	221	21	200	094	030	076	76	80
028	135	35,100	03,335	43,173	081,608	160	16	144	060	015	069	76	80
029	135	35,100	02,720	34,749	072,569	150	15	135	045	023	058	77	80
030	125	40,625	04,367	16,250	061,242	040	14	026	015	007	004	78	78

223

720 BYTES HAVE ALREADY BEEN ACQUIRED.
448 BYTES REMAIN TO BE ACQUIRED.

AT/1

112 DEC 89 Quantity Survey
11:13:52 Mogbo

NO	I	V.	FL	FC	FT	IT
1	660.54	75.90	264.00	1000.44	.33	.07
2	653.00	69.56	306.91	1022.47	.23	.09
3	696.17	60.90	243.60	1000.67	.32	.11
4	625.00	73.44	275.00	973.44	.37	.13
5	560.13	67.20	358.40	985.73	.34	.14
6	570.00	82.65	267.90	920.55	.97	.18
7	575.14	94.83	247.25	917.13	.60	.11
8	515.00	79.83	448.05	1042.88	1.10	.11
9	540.00	72.30	340.20	952.50	.80	.07
10	480.00	52.80	369.60	902.40	.68	.10
11	440.00	52.80	220.00	712.80	.52	.10
12	433.00	69.60	326.25	830.95	.54	.11
13	425.00	74.37	369.75	869.13	1.01	.13
14	430.00	53.05	387.00	875.05	1.37	.13
15	225.00	25.88	101.25	352.13	.54	.13
16	225.00	23.13	78.75	331.88	.40	.17
17	265.00	29.15	106.00	400.15	.33	.21
18	260.00	35.10	109.20	404.30	.42	.12
19	290.00	26.10	139.20	455.30	.50	.15
20	345.00	22.42	258.75	626.18	.93	.12
21	340.00	16.15	309.40	665.55	.96	.11
22	325.00	17.97	279.50	622.33	1.09	.11
23	240.00	24.00	192.00	456.00	1.04	.16
24	260.00	20.90	213.20	494.00	1.13	.16
25	275.00	24.06	217.25	516.31	1.37	.13
26	275.00	20.62	247.50	543.13	1.33	.14
27	275.00	38.50	294.25	607.75	1.64	.16
28	260.00	24.70	319.80	604.50	1.19	.12
29	260.00	20.15	257.40	537.55	1.11	.11
30	325.00	34.94	130.00	489.94	.32	.11
31	345.00	23.29	162.15	530.44	.38	.16
32	335.00	23.45	150.75	509.20	.48	.13
33	320.00	28.00	179.20	527.20	.62	.12
34	340.00	25.50	408.00	773.50	1.50	.19
35	330.00	34.20	418.00	832.20	1.62	.23
36	335.00	44.23	250.25	679.53	1.08	.22
37	376.00	36.66	413.60	826.26	1.73	.12
38	220.00	14.30	266.20	530.50	1.65	.12
39	240.00	31.20	93.60	364.80	.45	.10
40	245.00	453.07	154.35	423.85	.61	.14
41	448.00	67.20	174.72	689.92	.46	.18
42	415.00	47.53	186.75	645.33	.55	.13
43	425.00	61.63	267.75	754.38	.58	.11
44	430.00	51.60	202.10	683.70	.43	.14
45	441.00	46.10	175.18	682.28	.48	.10
46	480.00	45.60	288.00	813.60	.47	.12
47	490.00	42.88	230.30	763.17	.65	.17
48	495.00	43.32	297.00	835.32	1.04	.25
49	560.00	50.40	257.60	868.00	.67	.26
50	553.00	32.95	315.21	951.16	1.00	.23
51	590.00	59.00	295.00	944.00	.93	.16

T.4.5 The Data Divided by area

4.4 DISCUSSIONS

Graphs G5/3, G5/5 and G5/6 all indicated that the Initial Cost, the fluctuation cost and the Final Cost significantly increased as the years increased. However, fluctuation cost had stronger relationships with the growth of the years than Initial Cost and Final Cost.

(i) Fluctuation Coeff = .9895 G5/3

(ii) Final Cost Coeff = .9876 G5/5

(iii) Initial Cost Coeff = .9766 G5/6

Graphs G5/7 showed that as the Increase in Initial Cost (Variation + Fluctuation Costs) VcFc Significantly increased, cost performance also significantly increased.

Graph G5/8 showed that as the Time Performance Significantly increased, the cost performance also significantly increased.

Initial Time has no significant relationship with Cost Performance (.052). Also Initial Cost Intensity has no significant relationship with cost Performance (.132) as shown in co-relation co-efficients between Time Y(Axis) and Cost Performance X(Axis) Reference Table T5/4.

However, the following have significant relationships with cost Performance.

Total Delay Time	.830
Payment Delay Time	.776
Variation Delay Time	.512
Other Delay Time	.499
Final Time	.737
Time Performance	.639
Final Cost Intensity	.412
Relative cost Intensity	.429

The mean cost Intensity (Cost/Week) were as follows:-

3503.83 for the Initial Cost Intensity

i.e $\frac{\text{Initial Cost}}{\text{Initial Time}}$

1387.41 for the Final Cost Intensity

i.e $\frac{\text{Final Cost}}{\text{Final Time}}$

0.42 for the Relative Cost Intensity

i.e $\frac{\text{Final Cost Intensity}}{\text{Initial Cost Intensity}}$

From Graphs AG/33, AG/34, AG/35, it was shown that when Fluctuation Cost was correlated with delay parameters, the following were the results:-

A Axis	Y Axis	R
Fluctuation Cost	Payment Delay	.5950
"	Variation Delay	.363
"	Other Delays	.269

The above showed that Payment Delay period was more significant with fluctuation cost than Variation Delays and Other delays. It is also important to note that variation delays and other delays had significant relationships with fluctuation cost.

The above was supported by the results provided in Table T5.4 which showed that when Cost Performance was corrected with Time parameters, the following were the results:-

X Axis	Y Axis	R
$\frac{\text{Final Cost}}{\text{Initial Cost}}$	Initial Time	.052
	Total Delay	.830
	Payment Delay	.776
	Variation Delay	.512
	Other Delay	.499
	Time Performance	.639
	Final Cost intensity	.412
	Initial Cost Intensity	.132
	Relative Cost Intensity	.429

From the above, it was clear that Initial Time and Initial Cost Intensity were unreliable and had no significant relationship with the Cost Performance.

Inspecting Table T5/8, it was found out that Relative Cost Intensity had significant with Inital Time, Final Time, Total Delay Time, Payment Delay Time, Variation Delay Time and Other Delay Time.

Also, from Table T5/8, it was found out that the Final Cost Intensity had no significant relations with the Initial Time but it had significant relations with the Final Time Total Delay Time, Payment Delay Time, Variation Delay Time and Other Delay Time.

Table T5/8, also showed that the Initial cost had no significant relationships with: Initial Time, Final Time, Total Delay Time, Payment Delay Time, Variation Delay Time and Other Delay Time.

On inspecting Table T5/8, it was observed that when the various delays parameters were correlated with the various efficiency parameters, that Payment Delay Time co-efficients were always higher than the various co-efficients of Variation Delay and Other Delay.

INCREASE IN INITIAL CONTRACT COST (VCFC) (X AXIS) Vs COST PERFORMANCE Y (AXIS)

REF. FIG. 4/1

EXPERIMENT NO. 1

The following were the results obtained after plotting 240 values:-

(1) There was a high correlation (0.56909)

(2) The standard error of the estimate was (0.19743)

(3) The slope was 0.0013

(4) The intercept was 1.37637

(5) The level of significance was zero.

(6) Some co-efficients could not be computed.

(7) Graphical characteristics - The points were scattered approximately equal on top and bottom of the line.

(8) Inference - As the error was small, and R is significant, it can be concluded that the cost performance increased as the Increase in Initial Contract Cost increased.

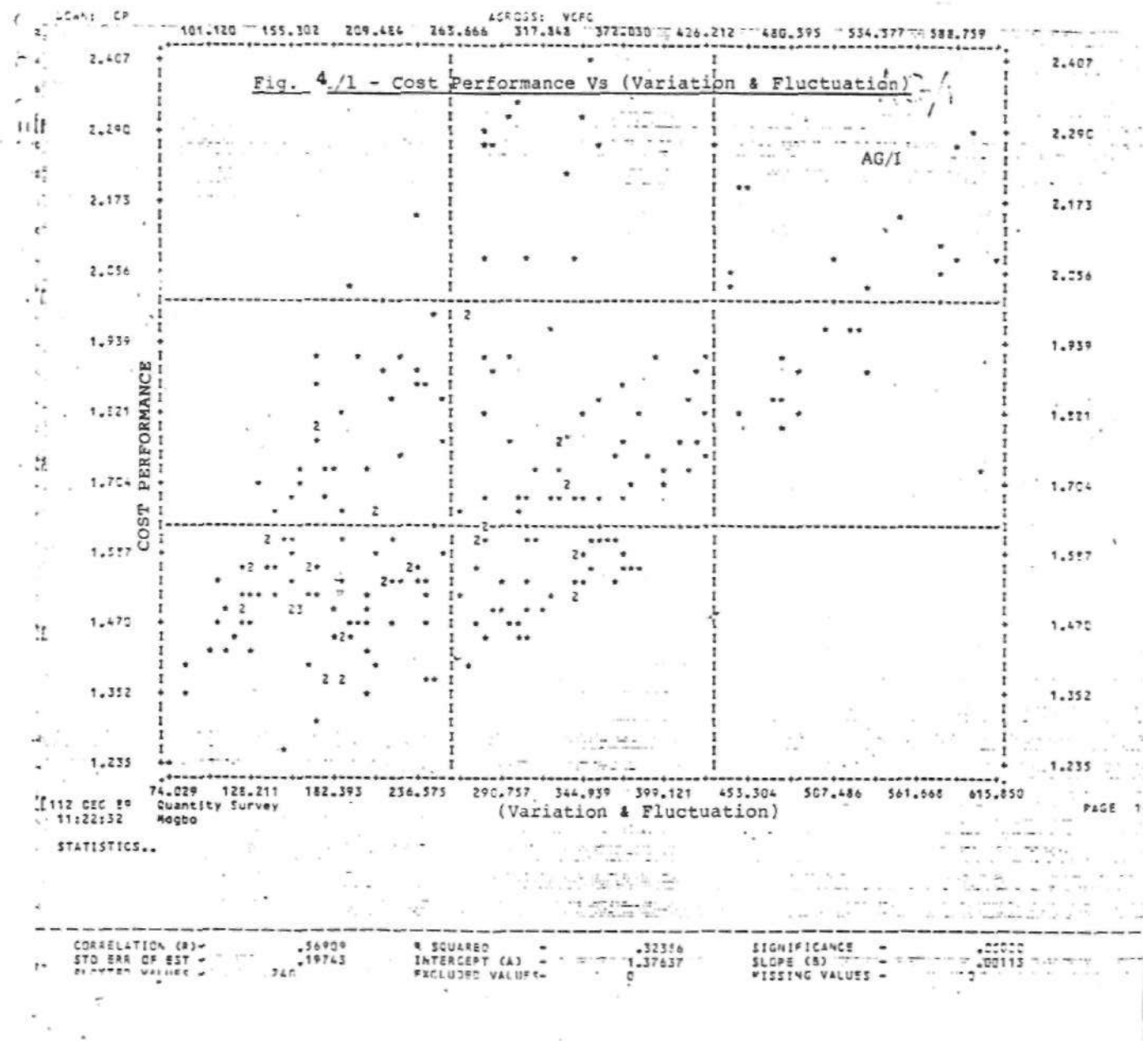


Fig. 4./1 - Cost Performance Vs (Variation & Fluctuation)

INCREASE IN INITIAL CONTRACT COST (VCFC) X AXIS Vs TIME

PERFORMANCE Y AXIS

REF. FIG. 4/2

EXPERIMENT NO. 2

The following were the results obtained after plotting 240 values:-

(1) There was a high correlation (0.37967)

(2) The standard error was 3.27458

(3) The slope was 0.01114

(4) The intercept was 2.49885

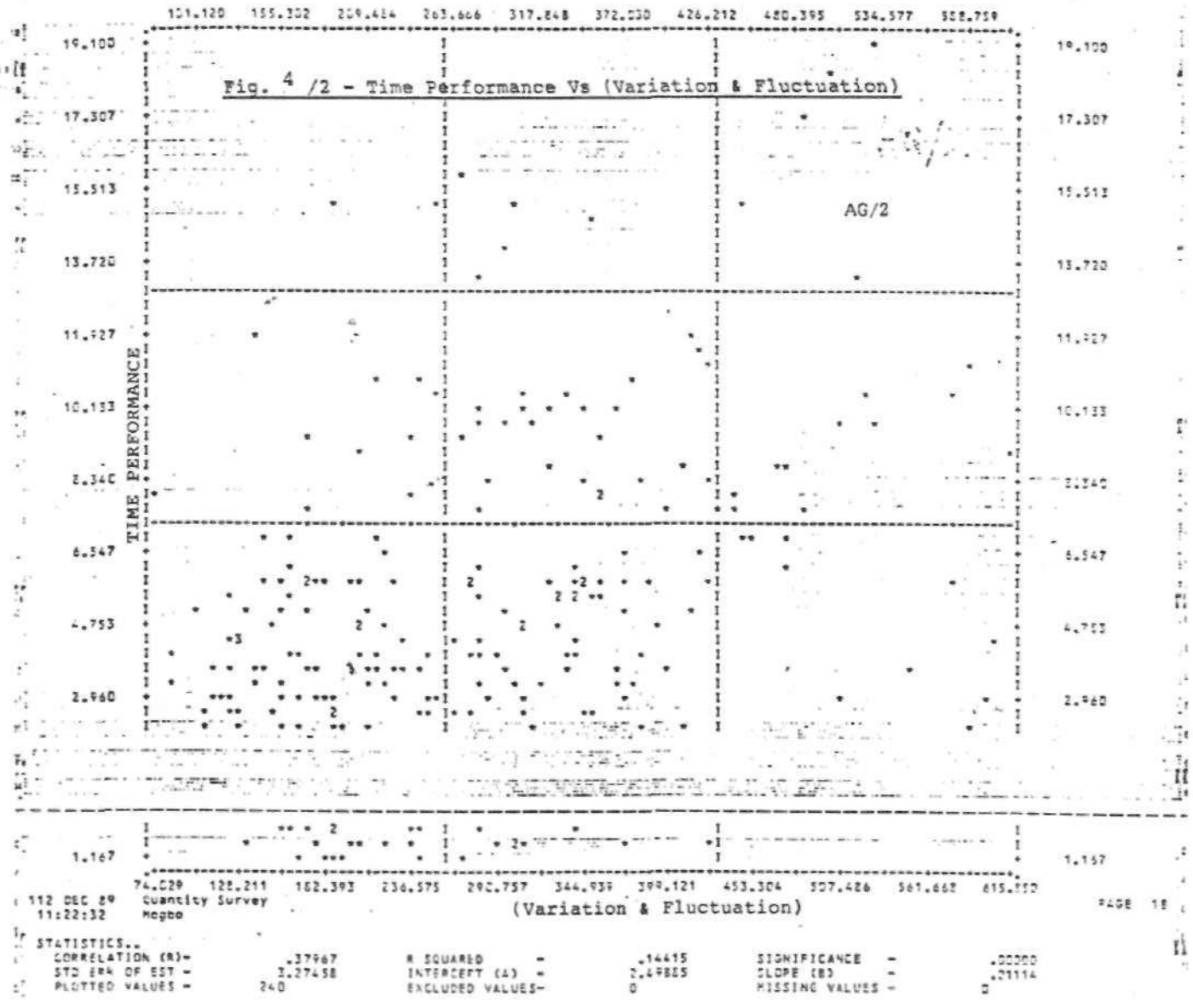
(5) The level of significance was zero

(6) Some co-efficients could not be computed.

(7) Graphical characteristics - points were scattered almost throughout the graph.

(8) Inference - as the error was large, and the points scattered almost throughout the graph, it can be concluded that although R is significant, the relationships are doubtful because of possible errors in Initial Times.

Fig. 4 /2 - Time Performance Vs (Variation & Fluctuation)



INCREASER IN INITIAL CONTRACT COST (VCFC) X AXIS Vs

FINAL COST INTENSITY Y AXIS

REF. FIG. 4/3

EXPERIMENT NO. 3

The following were the results obtained after plotting 240 values:-

(1) There was a low correlation (0.10526)

(2) The standard error was 935.19271

(3) The slope was 0.82022

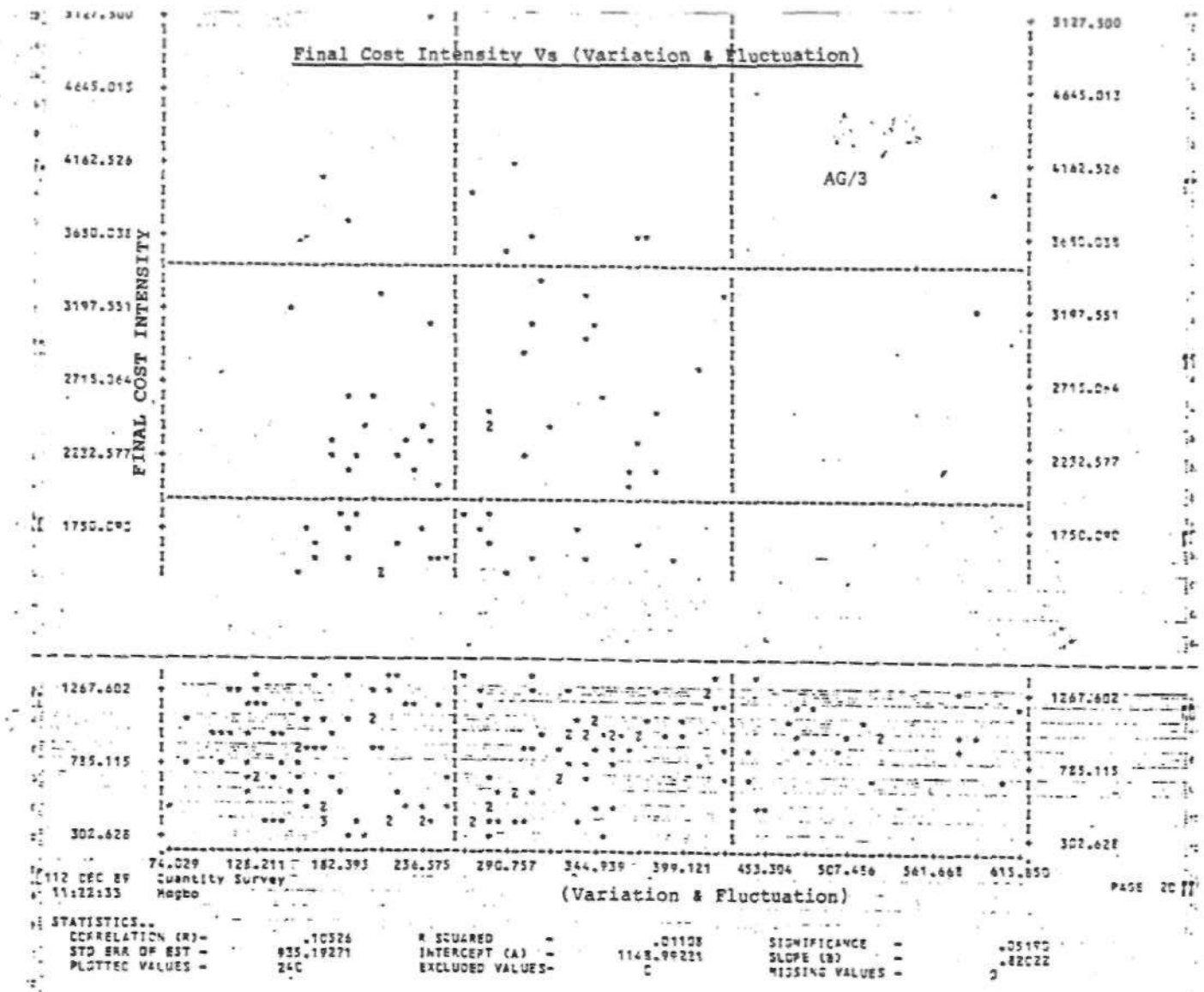
(4) The intercept was 1148.99221

(5) The level of significance was 0.05190

(6) Some co-efficients could not be computed.

(7) Graphical statistics - points were scattered round the graph indicating no defined character.

(8) Inference - As the error was large and R is not significant, it can inferred that the Increase in Initial Contract Cost has no relationships with the Final Cost Intensity.


Final Cost Intensity Vs (Variation & Fluctuation)
FINAL COST INTENSITY
AG/3
4645.012
4162.526
3680.039
3197.551
2715.064
2232.577
1750.090
1267.602
785.115
302.628
74.029
128.211
182.393
236.575
290.757
344.939
399.121
453.304
507.486
561.668
615.850
12 DEC 89
11:22:33
Quantity Survey
Hagbo
PAGE 20
(Variation & Fluctuation)
STATISTICS..
CORRELATION (R)= .10326
STD ERR OF EST = 935.19271
PLOTTED VALUES = 240
R SQUARED = .01108
INTERCEPT (A) = 1148.99221
EXCLUDED VALUES= 0
SIGNIFICANCE = .05190
SLOPE (B) = -.82022
MISSING VALUES = 0

INCREASE IN INITIAL CONTRACT COST VCFC (X AXIS Vs

INITIAL COST INTENSITY (ICI)

REF. FIG. 4/4

EXPERIMENT NO. 4

The following were the results obtained after plotting 240 values:-

(1) There was a high correlation 0.43877

(2) The standard error of the estimate was 1547.754

(3) The slope was 6.262

(4) The intercept was 1729.444

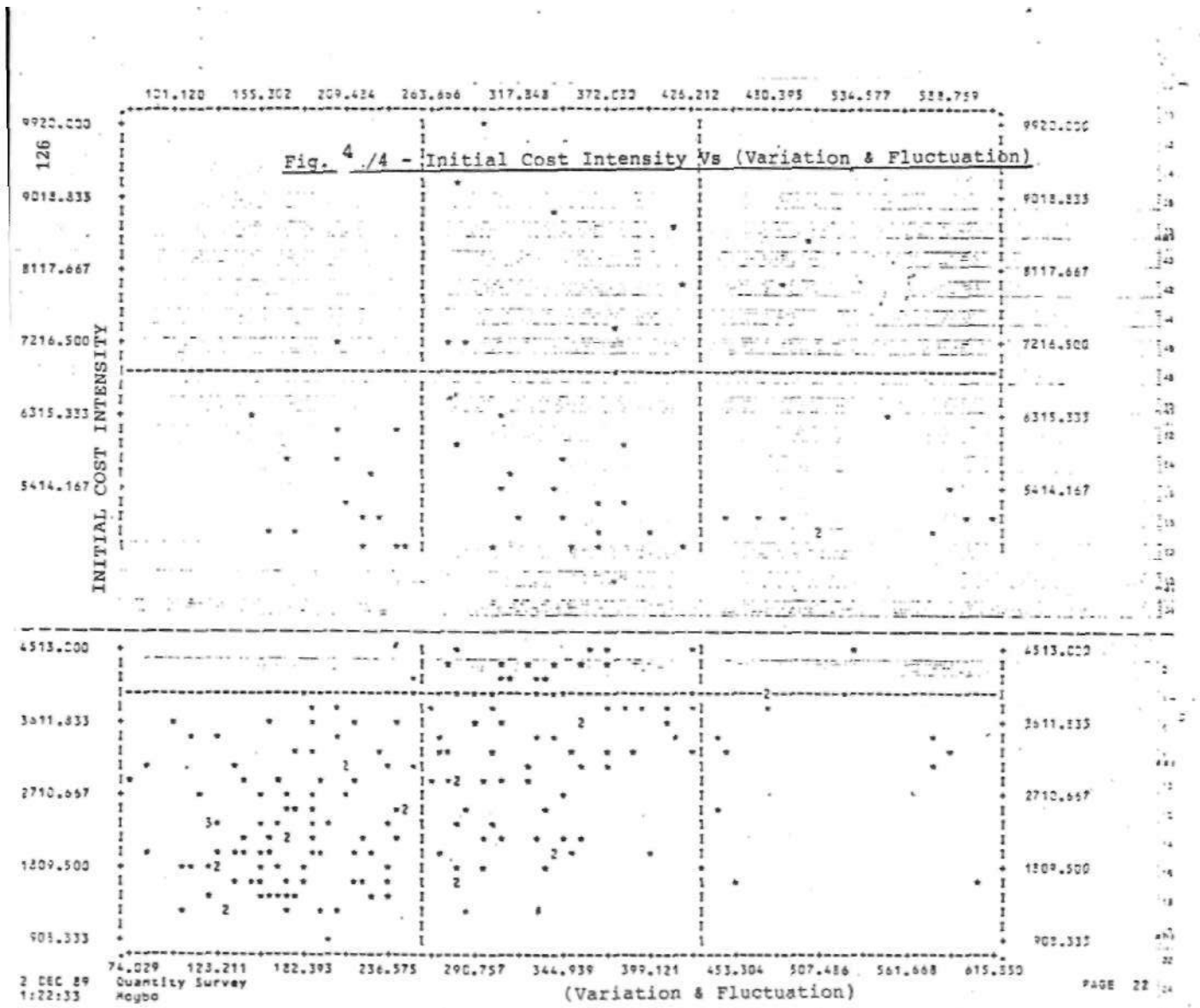
(5) The level of significance was zero

(6) Some co-efficients could not be computed.

(7) Graphical characteristics - The upper part of the graph shows a different character from the downward part of the graph.

(8) Inference - The error was large and the correlation co-efficient was high. The graph displayed no defined character. It may be inferred that due to possible errors in Initial Cost or Initial Time, there is no relationships existing between Increase in Initial Contract Cost and the Initial Cost Intensity.

Fig. 4 ./4 - Initial Cost Intensity Vs (Variation & Fluctuation)



TATISTICS..

CORRELATION (R)-	.43877	R SQUARED -	.19252	SIGNIFICANCE -	.00000
ERR OF EST -	1547.75364	INTERCEPT (A) -	1729.44366	SLOPE (B) -	8.26204
PLOTTED VALUES -	240	EXCLUDED VALUES-	0	MISSING VALUES -	0

INCREASE IN INITIAL CONTRACT COST VCFC (X AXIS) Vs

RELATIVE COST INTENSITY Y AXIS

REF. FIG. 4/5

EXPERIMENT NO. 5

The following were the results obtained after plotting 240 values:-

(1) There was a low and negative correlation - .20484

(2) The standard error of the estimate was .24152

(3) The slope was - .00042

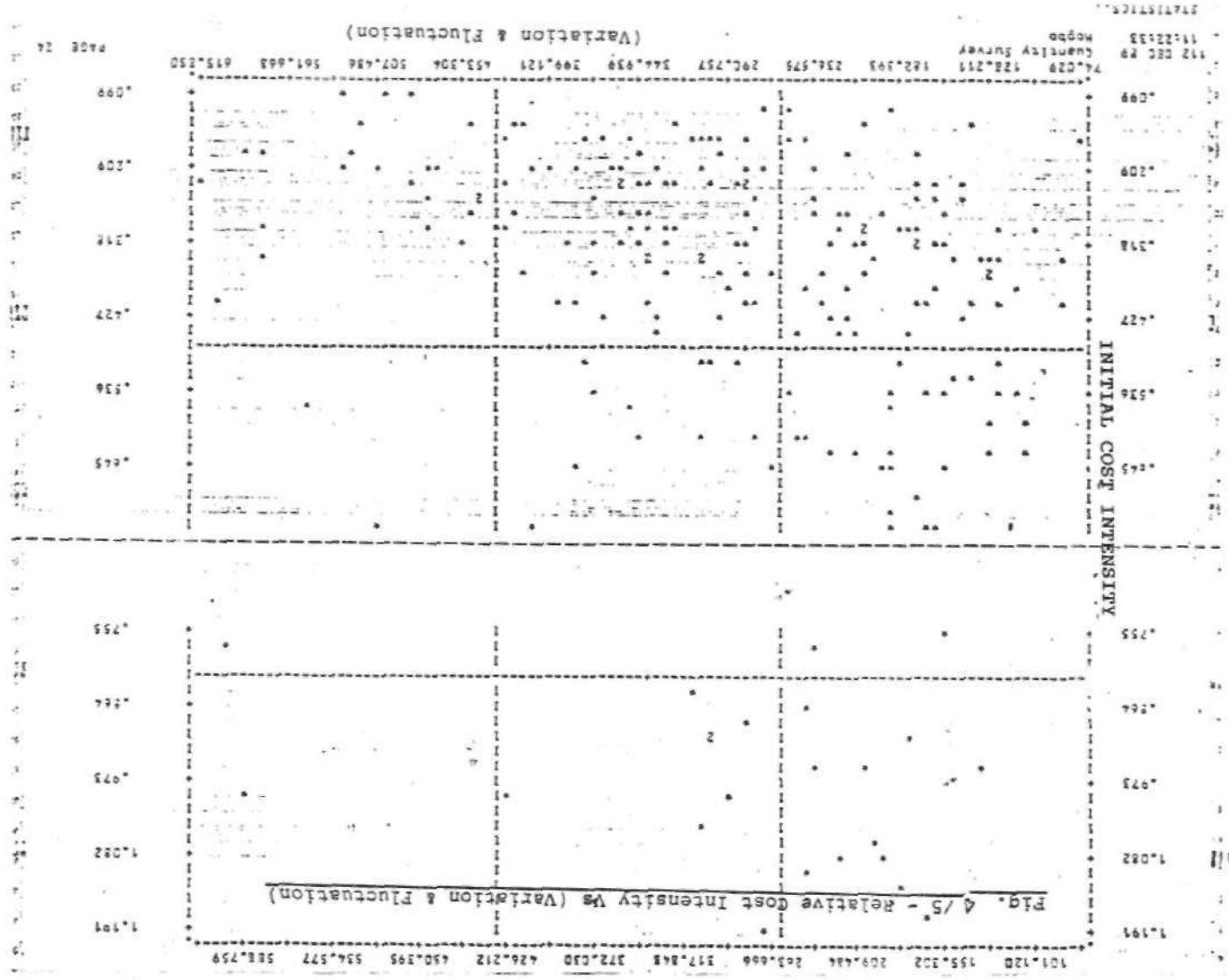
(4) The intercept was 0.53686

(5) The level of significance was .00071

(6) Some co-efficients could not be computed

(7) Graphical characteristics - the points were scattered but portrayed a curvlinear characteristics.

(8) Inference - Increase is Initial Contract Cost has no direct relationship with the Relative Cost Intensity.


INITIAL COST INTENSITY
(Variation & Fluctuation)
Fig. 4/5 - Relative Cost Intensity Vs (Variation & Fluctuation)

INCREASE IN INITIAL CONTRACT COST VCFL (X AXIS) Vs

VARIATION COST Y AXIS

REF. FIG. 4/6

EXPERIMENT NO. 6

The following were the results obtained after plotting 240 values:-

(1) There was a high correlation .46233

(2) The standard error of the estimate was 30.77449

(3) The slope was 0.13295

(4) The intercept was 11.673

(5) Many co-efficients could not be computed.

(6) Graphical characteristics - the points appeared to be spread out evenly along the graph.

(7) Inference - As the error was large, it may not be reliable to infer that there is a direct relationship between the two components although the R is significant and the graph showed a defined character.

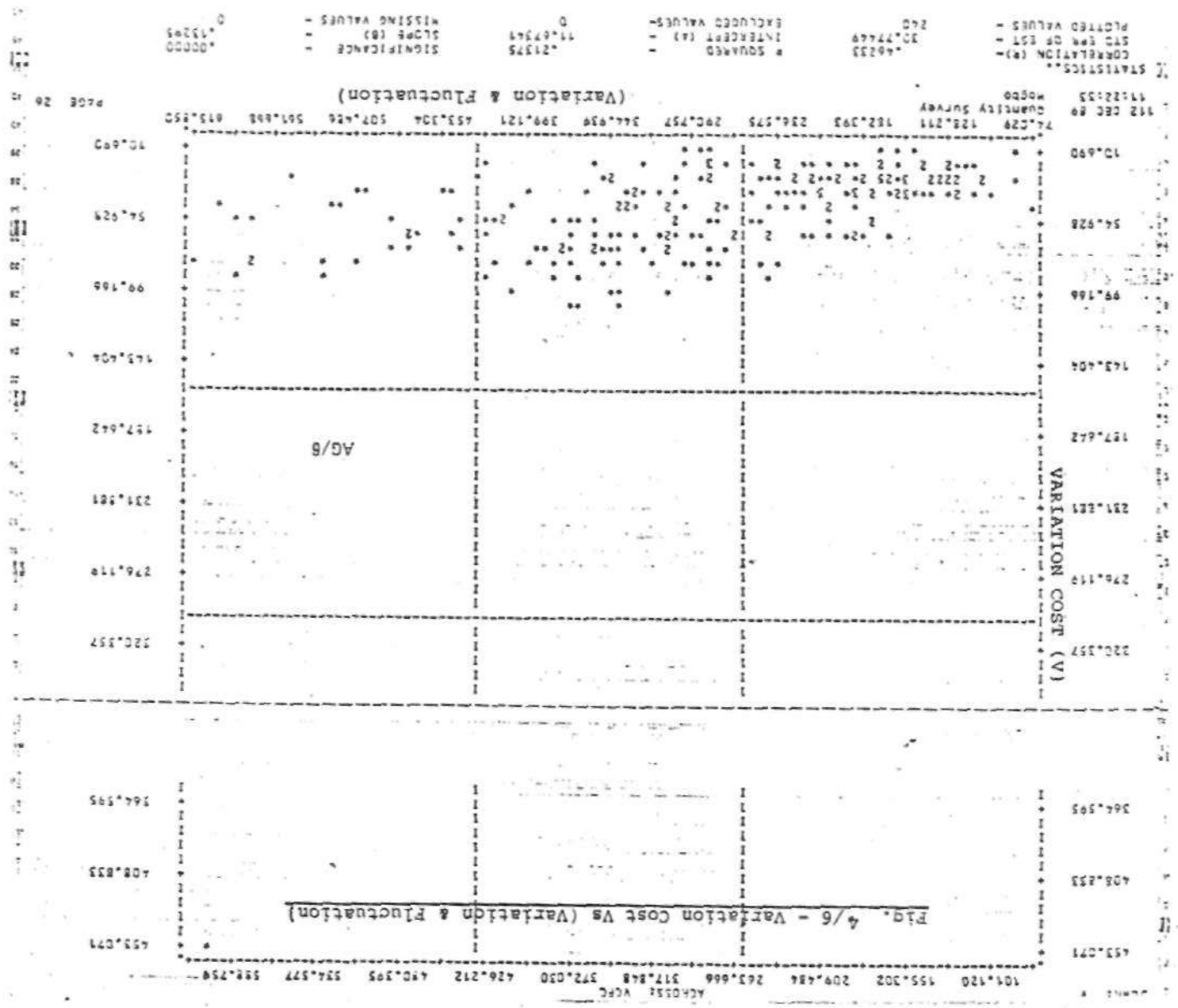


Fig. 4/6 - Variation Cost Vs (Variation & Fluctuation)

INCREASE IN INITIAL CONTRACT COST VCFL (X AXIS) Vs

FLUCTUATION COST Y AXIS

REF. FIG. 4/7

EXPERIMENT NO. 7

The following were the results obtained after plotting 240 values:-

(1) There was a very high correlation 0.95937

(2) The standard error of the estimate was 30.77449

(3) The slope was 0.86705

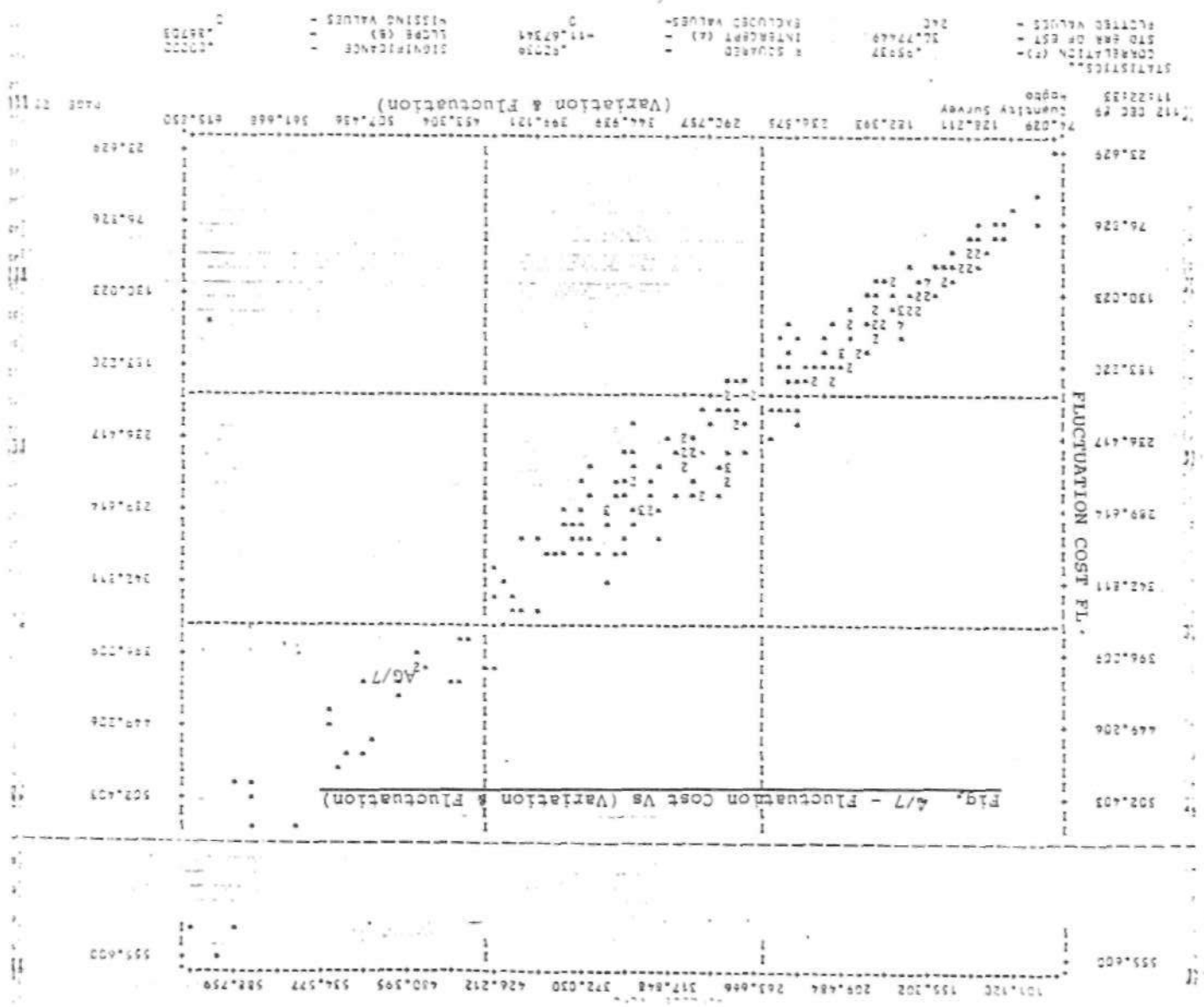
(4) The intercept was 11.67341

(5) The level of significance was zero.

(6) Some co-efficients could not be computed.

(7) Graphical characteristics - the points were arranged almost in a defined straight line.

(8) Inference - Despite the large errors which were caused possibly the inclusion of the variation cost, there is a direct relationship between the fluctuation cost and the increase in the initial contract cost.


(Variation & Fluctuation)
FLUCTUATION COST FL
Fig. 4/7 - Fluctuation Cost Vs (Variation & Fluctuation)

INCREASE IN INITIAL CONTRACT COST VCFL (X AXIS) Vs

FINAL CONTRACT COST Y AXIS

REF. FIG. 4/8

EXPERIMENT NO. 8

The following were the results obtained after plotting 240 values:-

(1) There was a high correlation (0.85021)

(2) The standard error of the estimate was 123.792

(3) The slope was 1.657

(4) The intercept was 227.252

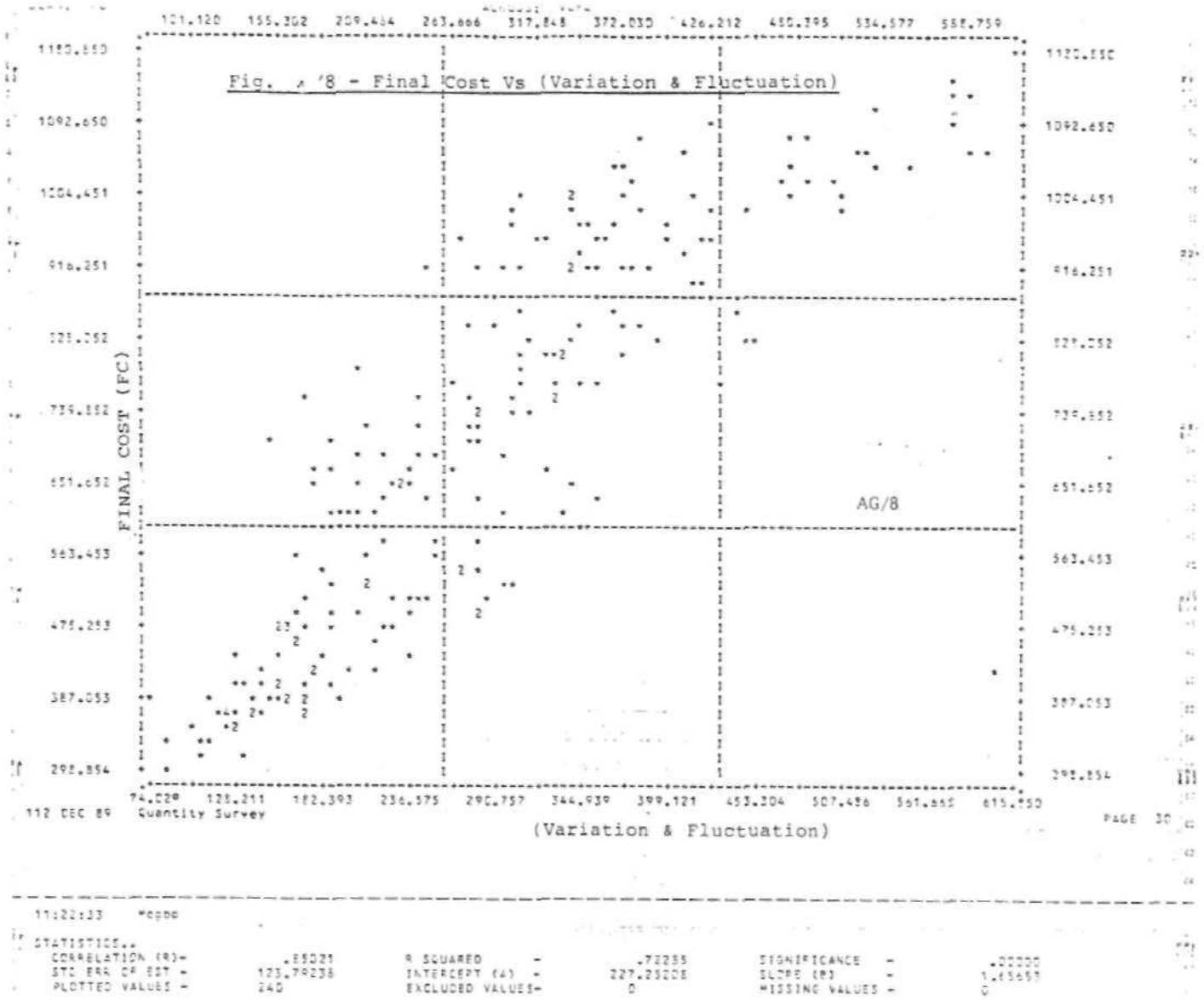
(5) The level of significance was zero

(6) Some co-efficients could not be computed.

(7) Graphical characteristics - The points appeared to form a curvlinear graph as well as a straight line.

(8) Inference - It may not be reliable to infer that there is a direct relationship between the Final Cost and the Increase in Contract Cost.

Fig. A '8 - Final Cost Vs (Variation & Fluctuation)



FINAL COST (X AXIS) Vs TOTAL DELAY TIME Y AXIS

REF. FIG. 4/9

EXPERIMENT NO. 9

The following were the results obtained after plotting 240 values:-

(1) There was a low correlation 0.1954

(2) The standard error of the estimate was 0.3797

(3) The slope was 0.00032

(4) The intercept was .3461

(5) The level of significance was 0.00118

(6) Some co-efficients could not be computed.

(7) Graphical characteristics - The points were scattered all over the graph.

(8) Inference - There was no existing relationship between the Final Cost and the Total Delay Time.

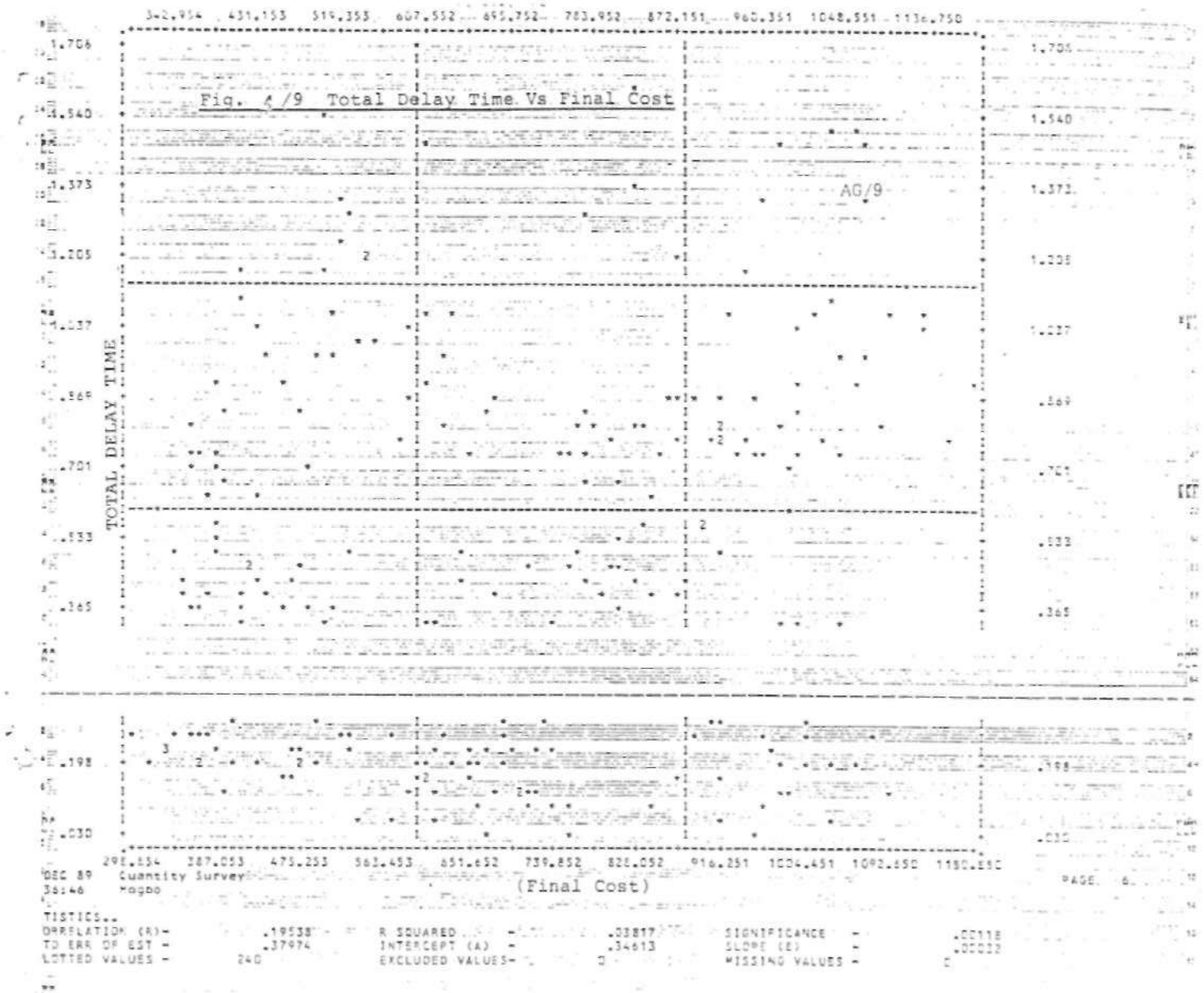


Fig. A/9 Total Delay Time Vs Final Cost

FINAL COST (X AXIS) Vs PAYMENT DELAY TIME Y AXIS

REF. FIG. 4 /10

EXPERIMENT NO. 10

The following were the results obtained after plotting 240 values:-

(1) There was a low correlation 0.1862

(2) The standard error of the estimate was .3014

(3) The slope was 0.00024

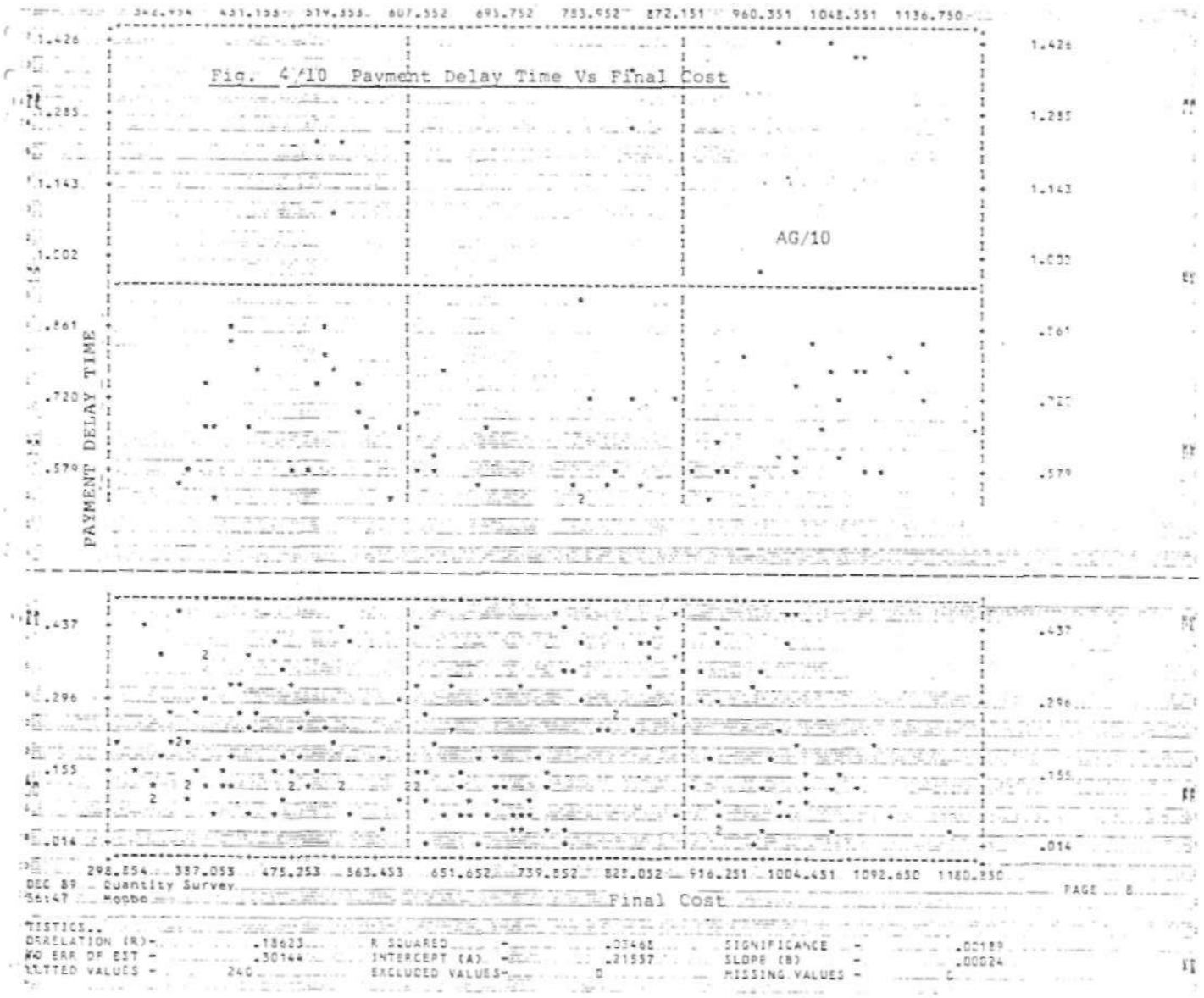
(4) The intercept was .2156

(5) The level of significance was 0.00189

(6) Some co-efficients could not be computed

(7) Graphical statistics - The points were scattered all over the graph.

(8) Inference - There was no existing relationship between the Final Cost and Payment Delay Time.


Fig. 4/10 Payment Delay Time Vs Final Cost
AG/10
PAYMENT DELAY TIME
Final Cost
DEC 89 Quantity Survey
PAGE 8
RELATION (R)- .18623
R SQUARED - .03468
SIGNIFICANCE - .00189
ED ERR OF EST - .30144
INTERCEPT (A) - .21537
SLOPE (B) - .00024
ITTED VALUES - 240
EXCLUDED VALUES- 0
MISSING VALUES - 0

FINAL COST (X AXIS) Vs VARIATION DELAY TIME Y AXIS

REF. FIG. 4/11

EXPERIMENT NO. 11

The following were the results obtained after plotting 240 values:-

(1) There was a low correlation 0.10821

(2) The standard error of the estimate was 0.0781

(3) The slope was 0.00004

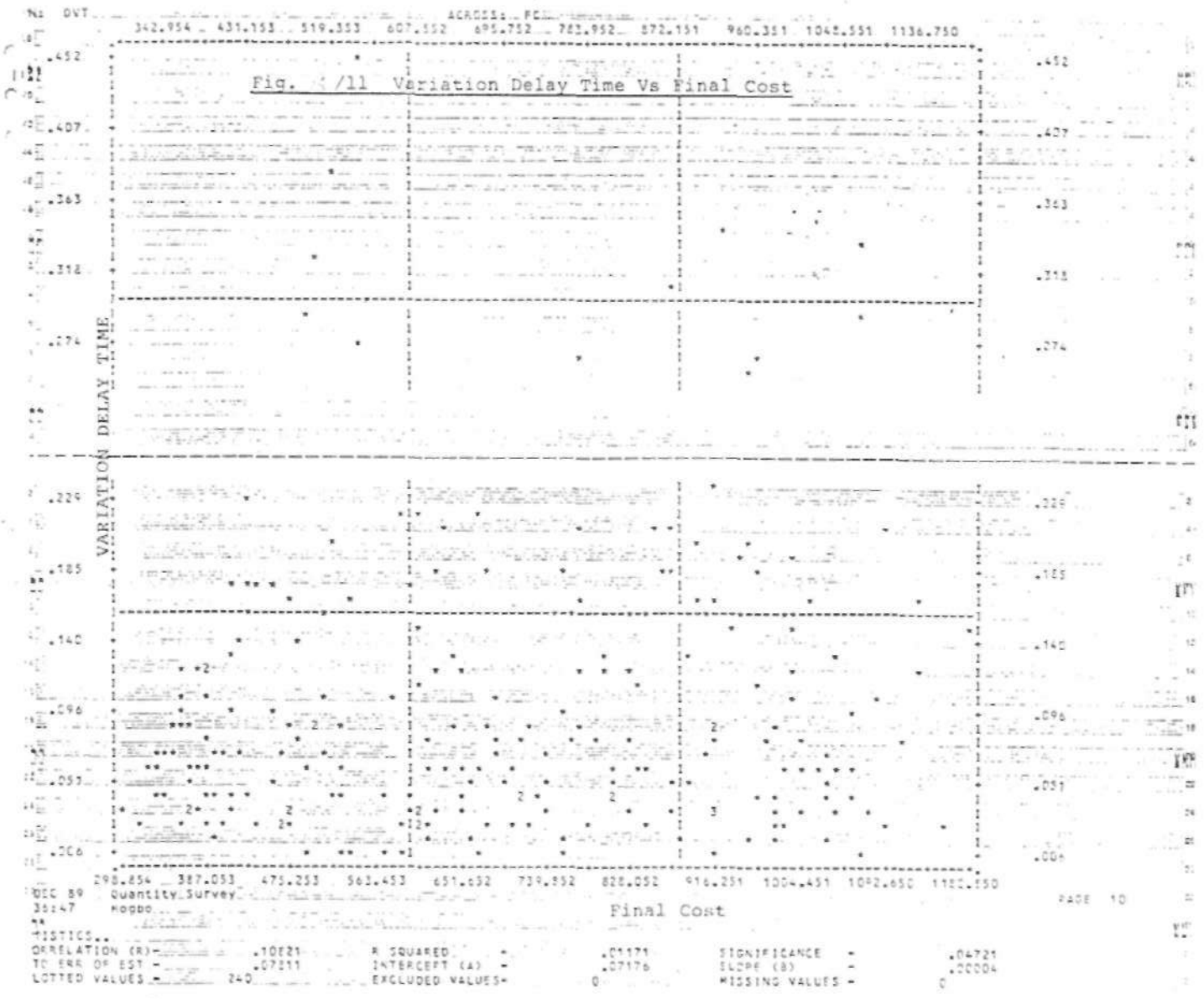
(4) The intercept was .07176

(5) The level of significance was 0.0472

(6) Some co-efficients could not be computed.

(7) Graphical characteristics - The points were scattered all over the graph.

(8) Inference - There was no existing relationship between the Final Cost and Variation Delay Time.


Fig. 7.11 Variation Delay Time Vs Final Cost
VARIATION DELAY TIME
Final Cost
342.954 431.153 519.353 607.552 695.752 783.952 872.151 960.351 1048.551 1136.750
298.854 387.053 475.253 563.453 651.652 739.852 828.052 916.251 1004.451 1092.650 1180.850
.452
.407
.363
.318
.274
.229
.185
.140
.096
.051
.006
DEC 89 Quantity_Survey
35147 Hogbo
PAGE 10
TISTICS..
ORRELATION (R)= .10E21 R SQUARED = .01171 SIGNIFICANCE = .04721
TD ERR OF EST = .07211 INTERCEPT (A) = .07176 SLOPE (B) = .00004
LOTTED VALUES = 240 EXCLUDED VALUES= 0 MISSING VALUES = 0

FINAL COST (X AXIS) Vs OTHER DELAY TIME (Y AXIS)

REF. FIG. 4/12

EXPERIMENT NO. 12

The following were the results obtained after plotting 240 values:-

(1) There was a low correlation 0.0310

(2) The standard error of the estimate was .0855

(3) The slope was .0001

(4) The intercept was .0778

(5) The level of significance was .31639

(6) Some co-efficients could not be computed.

(7) Graphical characteristics - The points were scattered all over the graph.

(8) Inference - There was no existing relationship between the Final Cost and "Other Delays" Time.

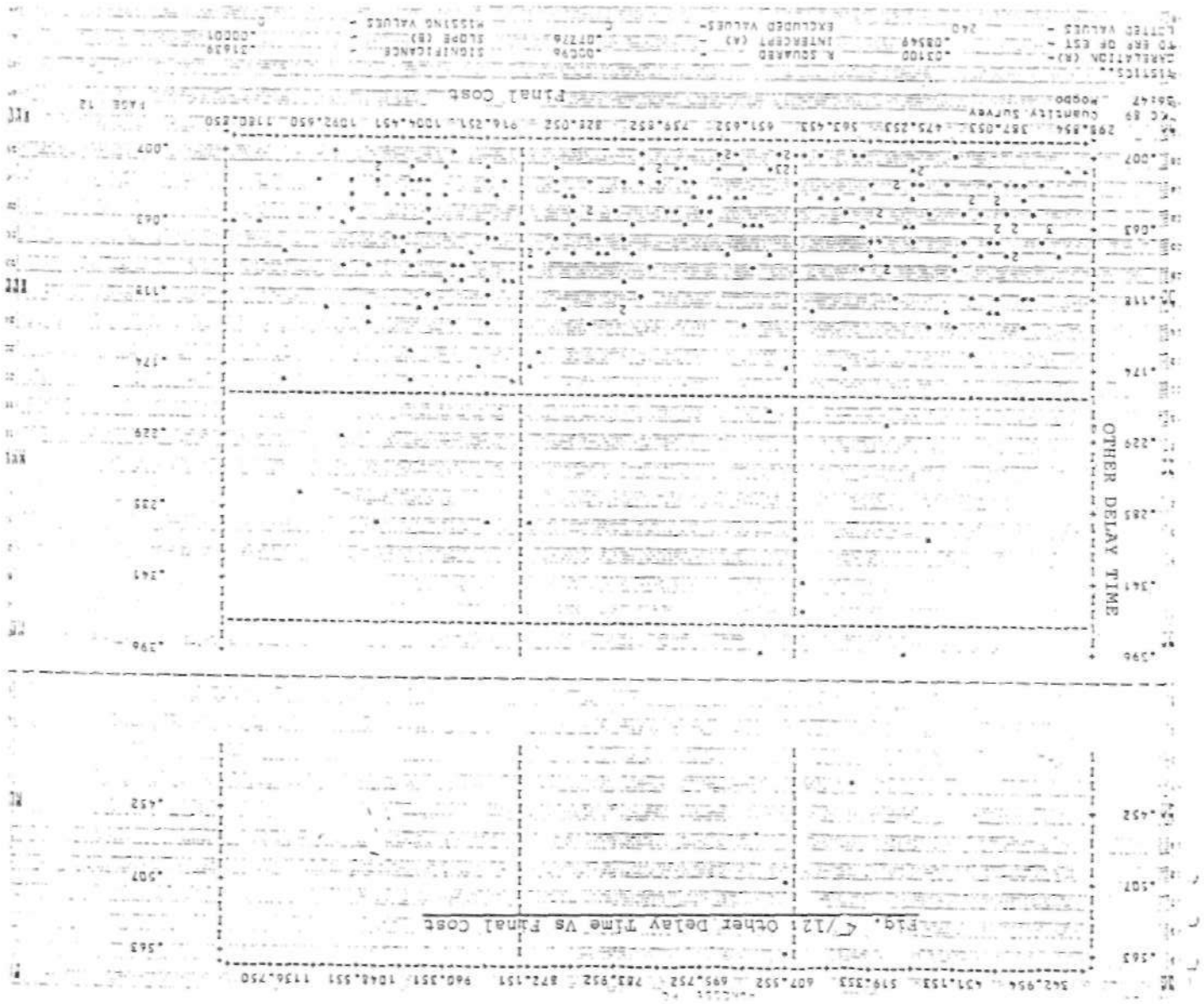


Fig. 4/12: Other Delay Time Vs Final Cost

FINAL COST (X AXIS) Vs FINAL TIME Y AXIS

REF. FIG. 4/13

EXPERIMENT NO. 13

The following were the results obtained after plotting 240 values:-

(1) There was a low correlation (0.1244)

(2) The standard error of the estimate was 0.1244

(3) The slope was .00020

(4) The intercept was .5423

(5) The level of significance was 0.02716

(6) Some co-efficient could not be computed.

(7) Graphical characteristics - The points were scattered all over the graph.

(8) Inference - There was no existing relationship between the Final Cost and the Final Time.

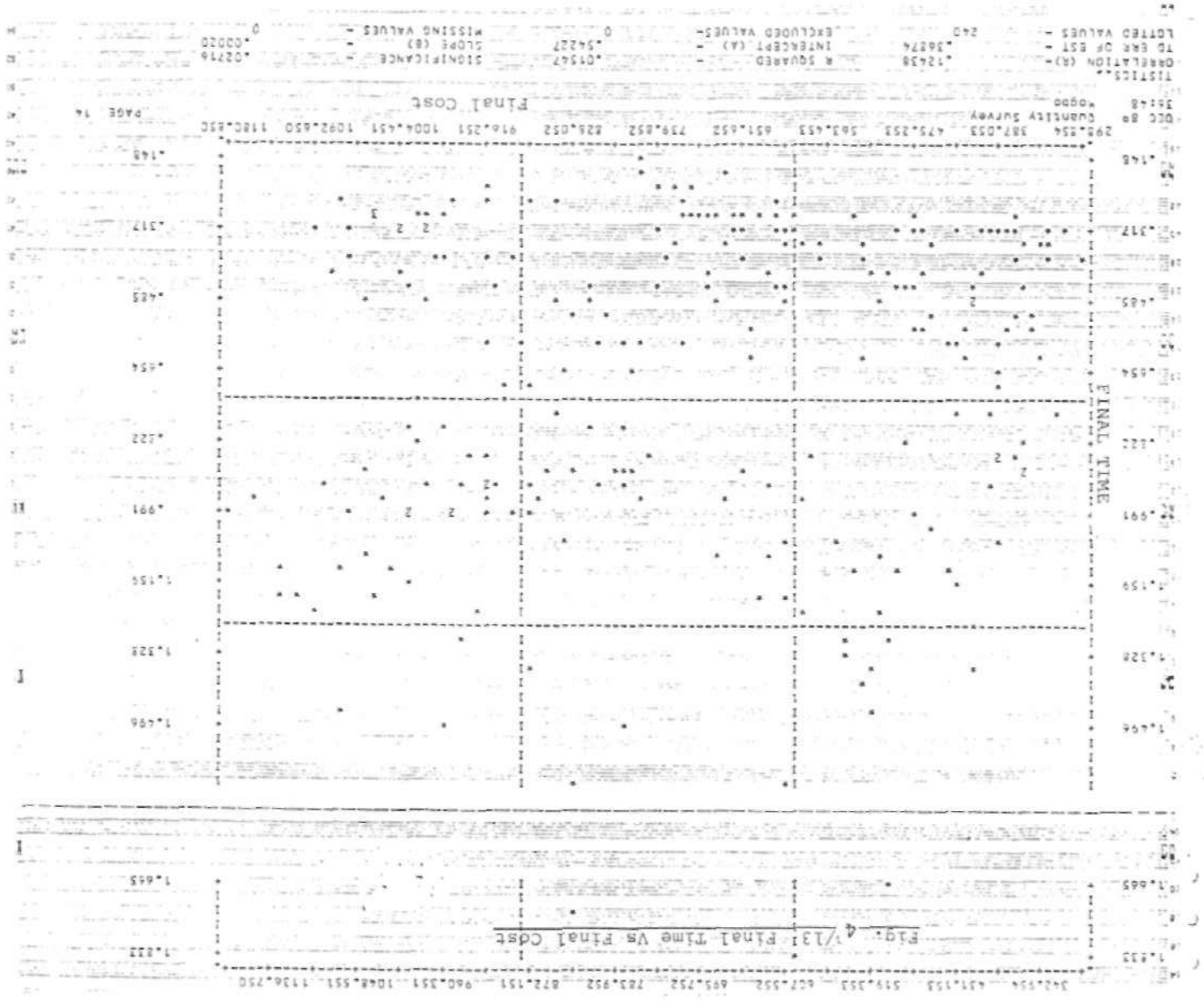


Fig. 4.1/31: Final Time Vs Final Cost

FINAL COST (X AXIS) Vs COST PERFORMANCE

REF. FIG. 4/14

EXPERIMENT NO. 14

The following were the results obtained after plotting 240 values:-

(1) The correlation R was low (0.1515)

(2) The standard error of the estimate was .2373

(3) The slope was 0.00015

(4) The intercept was 1.5894

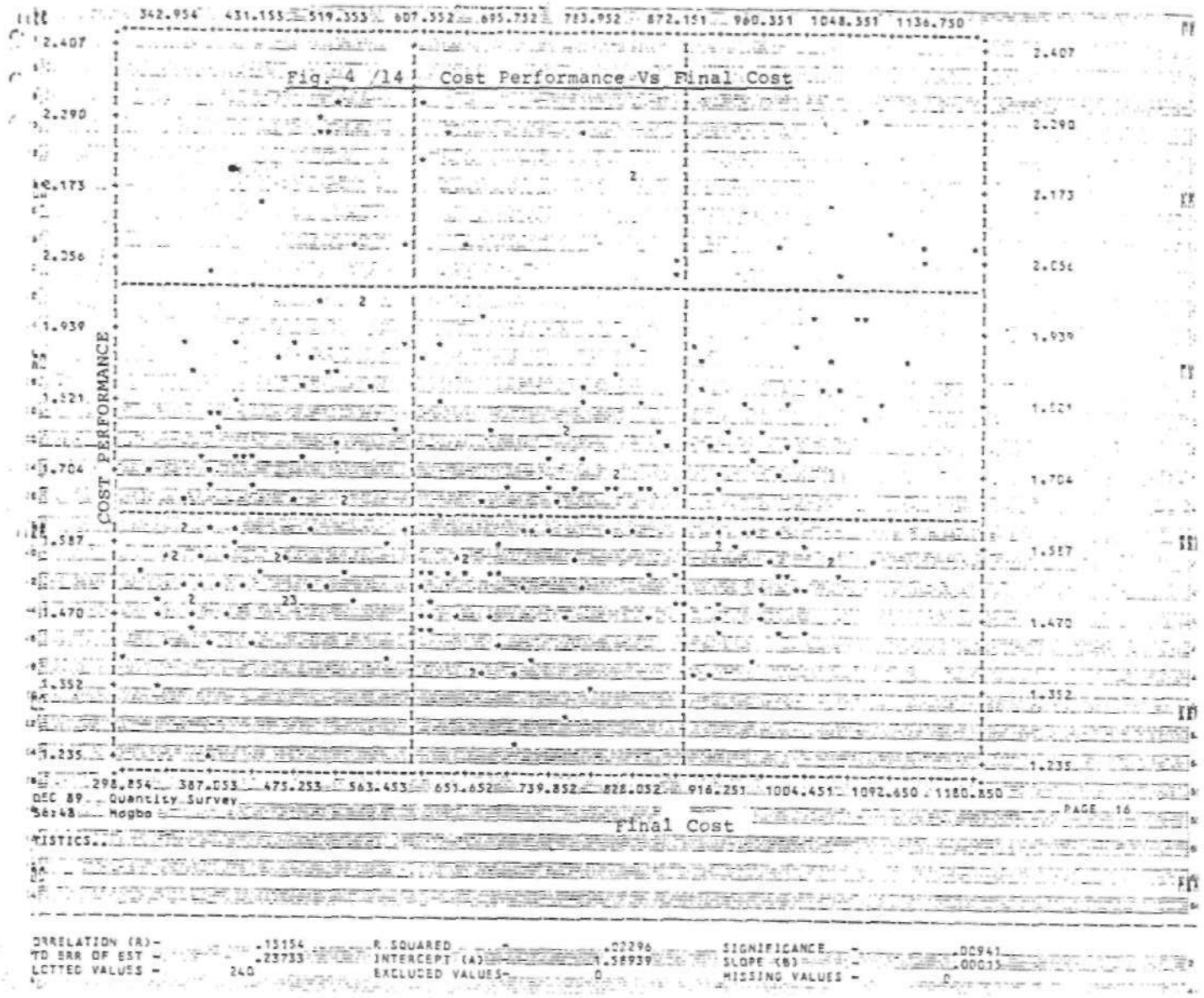
(5) The level of significance was .0094

(6) Some co-efficient could not be computed.

(7) Graphical statistics - Scattered all over time whole graph

(8) Inference - no established relationships.

Fig 4 /14 Cost Performance Vs Final Cost



FINAL COST (X AXIS) Vs TIME PERFORMANCE (Y AXIS)

REF. FIG. 4/15

EXPERIMENT NO. 15

The following were the results obtained after plotting 240 values:-

(1) The correlation R was low (.09368)

(2) The standard error of the estimate was large (7.817)

(3) The slope was (.00313)

(4) The intercept was 3.925

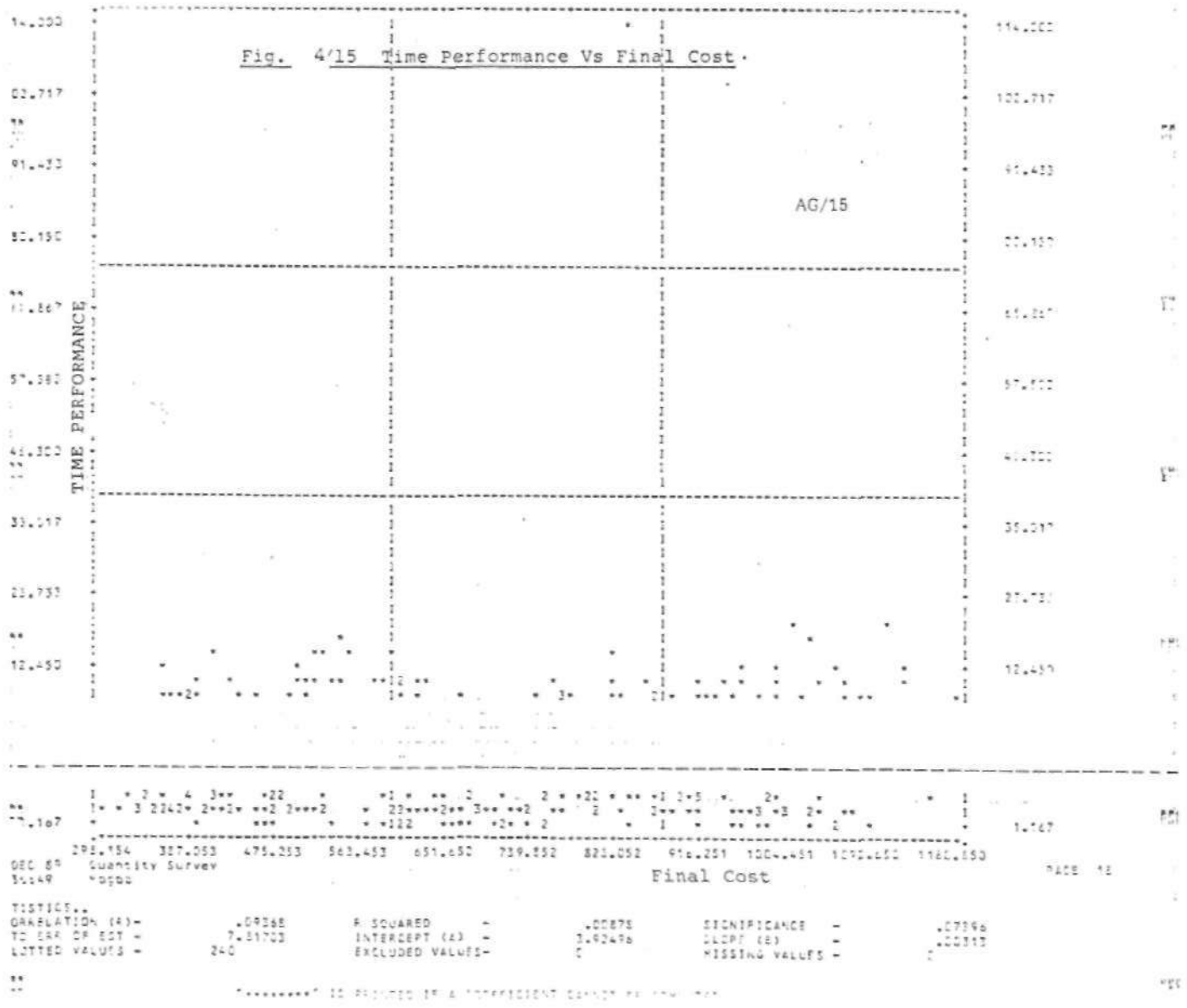
(5) The level of significance was (.074)

(6) Some co-efficients could not be computed.

(7) Graphical Statistics - Scattered all over the graph.

(8) Inference - No established relationship.

Fig. 4/15 Time Performance Vs Final Cost.



FINAL COST (X AXIS) Vs FINAL COST INTENSITY (Y AXIS)

REF. FIG. 4/16

EXPERIMENT NO. 16

The following were the results obtained after plotting 240 values:-

(1) The correlation R was high .4163

(2) The standard error of the estimate was high 855.07

(3) The slope was 1.665

(4) The intercept was 221.667

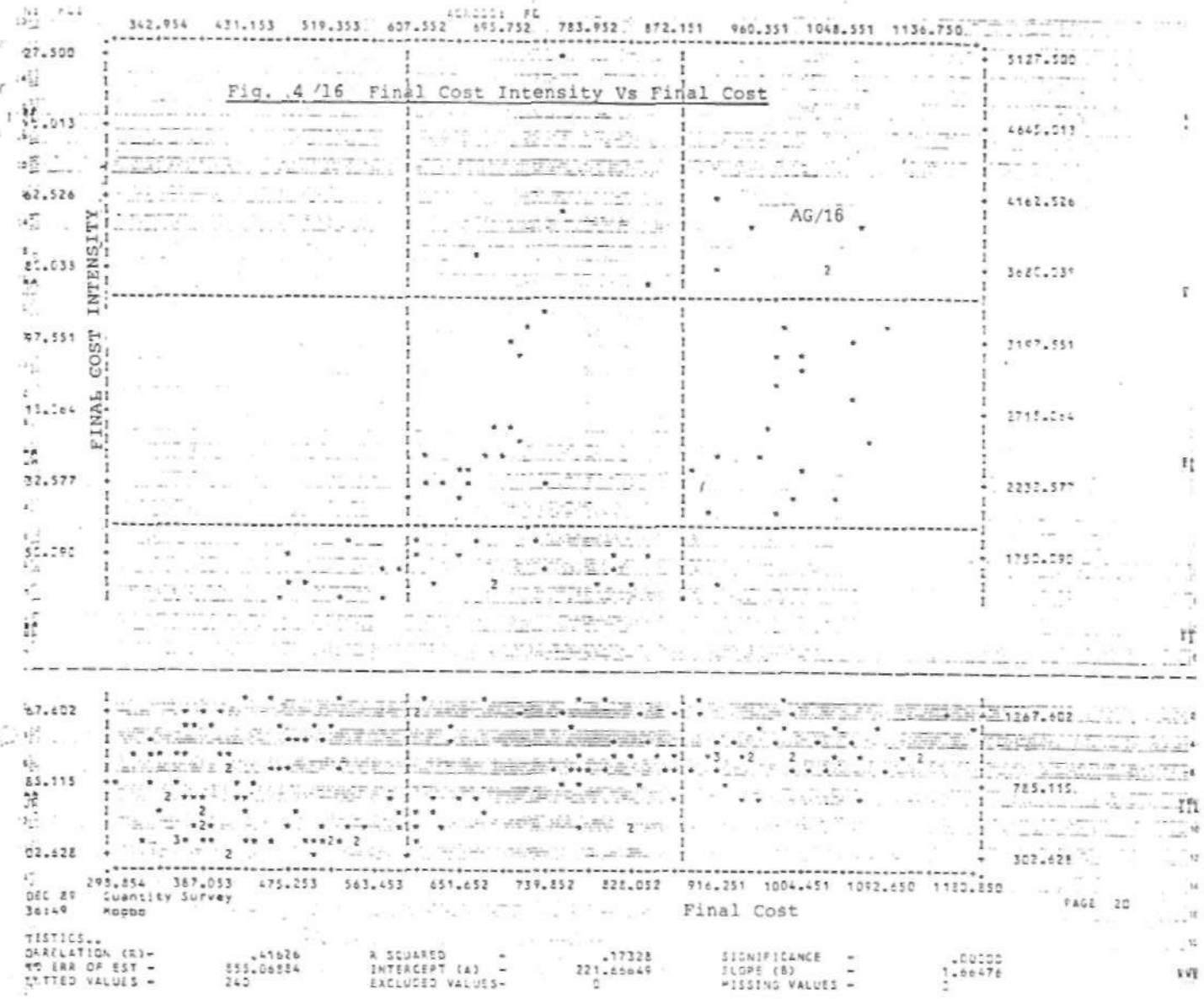
(5) The level of significance was .000

(6) Some co-efficients could not be computed.

(7) Graphical Statistics - Scattered all over with no defined shape.

(8) Inference - The R is high, no relationship can be established because of the high error and the graphical character.

Fig. 4 /16 Final Cost Intensity Vs Final Cost



TISTICS..
ORRELATION (R)- .41626 R SQUARED - .17328 SIGNIFICANCE - .00000
TD ERR OF EST - 551.06884 INTERCEPT (A) - 321.65049 SLOPE (B) - 1.66476
TTED VALUES - 240 EXCLUDED VALUES- 0 MISSING VALUES - 1

FINAL COST (X AXIS) Vs INITIAL COST INTENSITY (Y AXIS)

REF. FIG. 4/17

EXPERIMENT NO. 17

The following were the results obtained after plotting 240 values:-

(1) The correlation R was high (.2621)

(2) The standard error of the estimate was large (4806.47)

(3) The slope was 5.551

(4) The intercept was 64.54

(5) The level of significance was .00002

(6) Some co-efficient could not be computed.

(7) Graphical Statistics - No defined character; clustered around the X Axis.

(8) Inference - No established relationship due to the error and the graphical character.

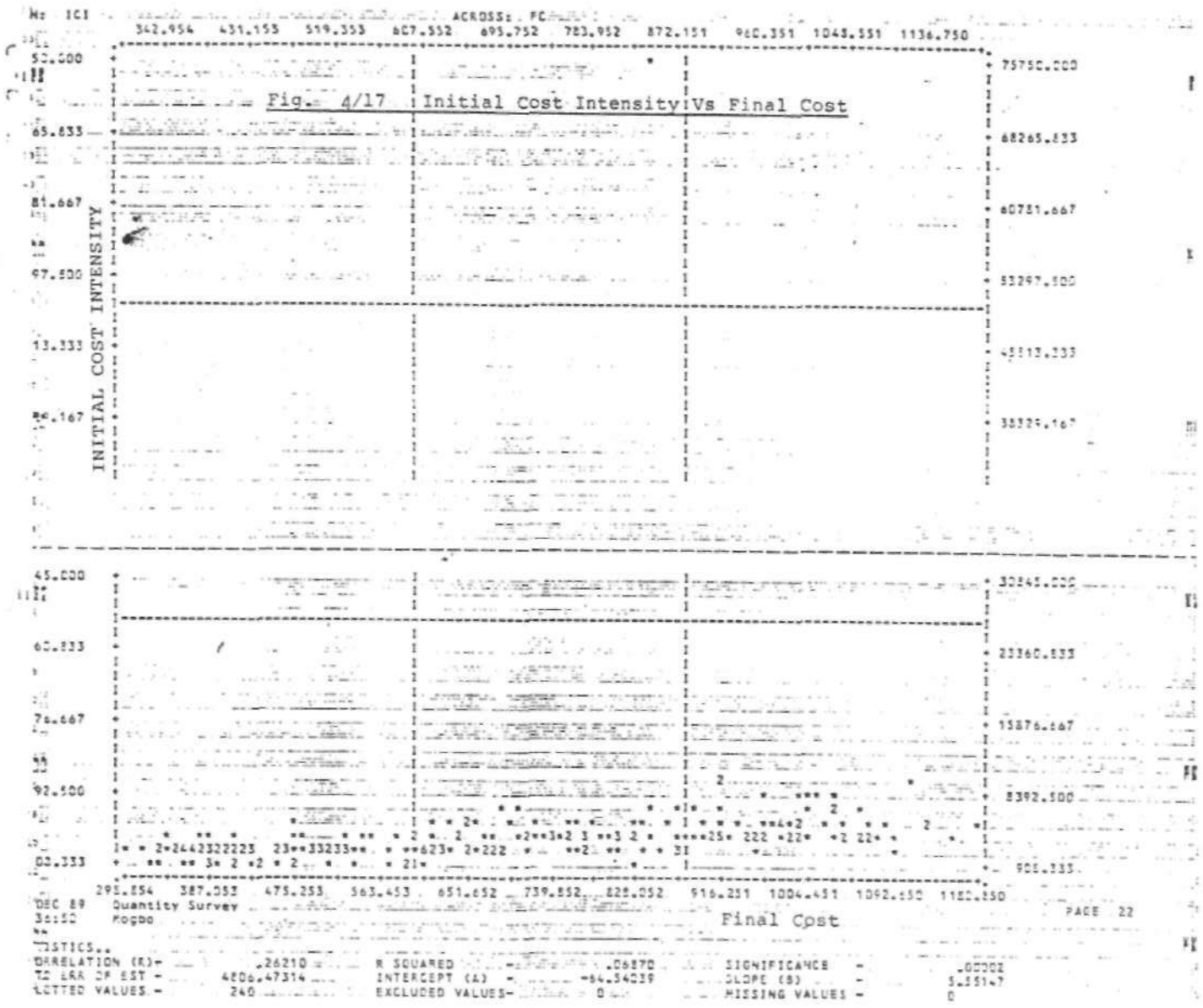


Fig. 4/17 Initial Cost Intensity Vs Final Cost

FINAL COST (X AXIS) Vs RELATIVE COST INTENSITY (Y AXIS)

REF. FIG. 4/17a

EXPERIMENT NO. 17a

The following were the results obtained after plotting 240 values:-

(1) The correlation R was low - .00225
(2) The standard error of the estimate was large .24797
(3) The slope was .0000
(4) The intercept was (.4187)
(5) The level of significance was (.486)
(6) Some co-efficients could not be computed.
(7) Graphical Statistics - Scattered all over the graph.
(8) Inference - No relationships were established.

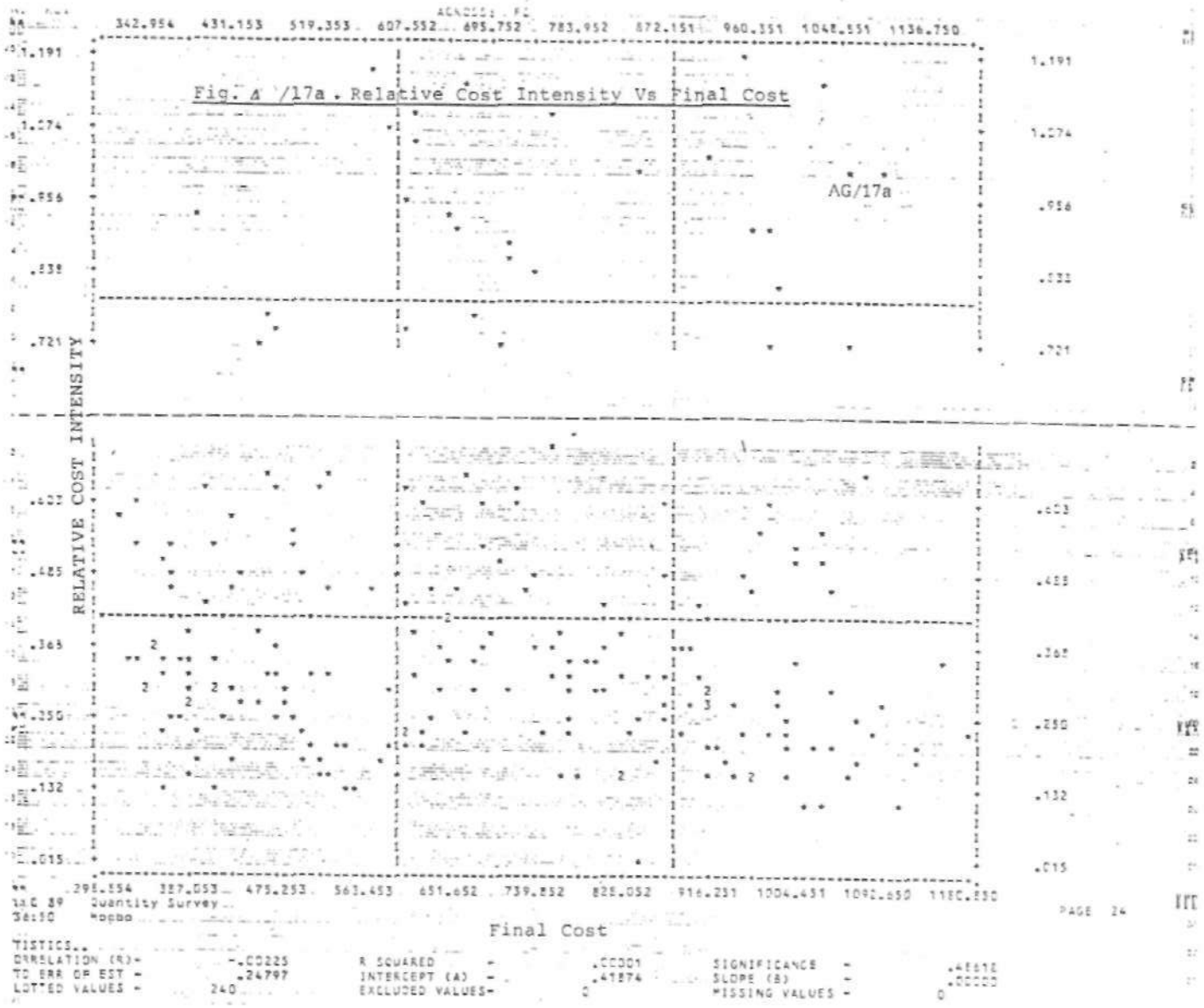


Fig. A /17a . Relative Cost Intensity Vs Final Cost

TISTICS..
CORRELATION (R)= -.00225 R SQUARED = .00001 SIGNIFICANCE = .48610
TD ERR OF EST = .24797 INTERCEPT (A) = .41874 SLOPE (B) = .00000
LOTTED VALUES = 240 EXCLUDED VALUES= 0 MISSING VALUES = 0

FINAL COST (X AXIS) Vs VARIATION COST (Y AXIS)

REF. FIG. 4/18

EXPERIMENT NO. 18

The following were the results obtained after plotting 240 values:-

(1) The correlation R was .42043

(2) The standard error of the estimate was large (31.490)

(3) The slope was .0621

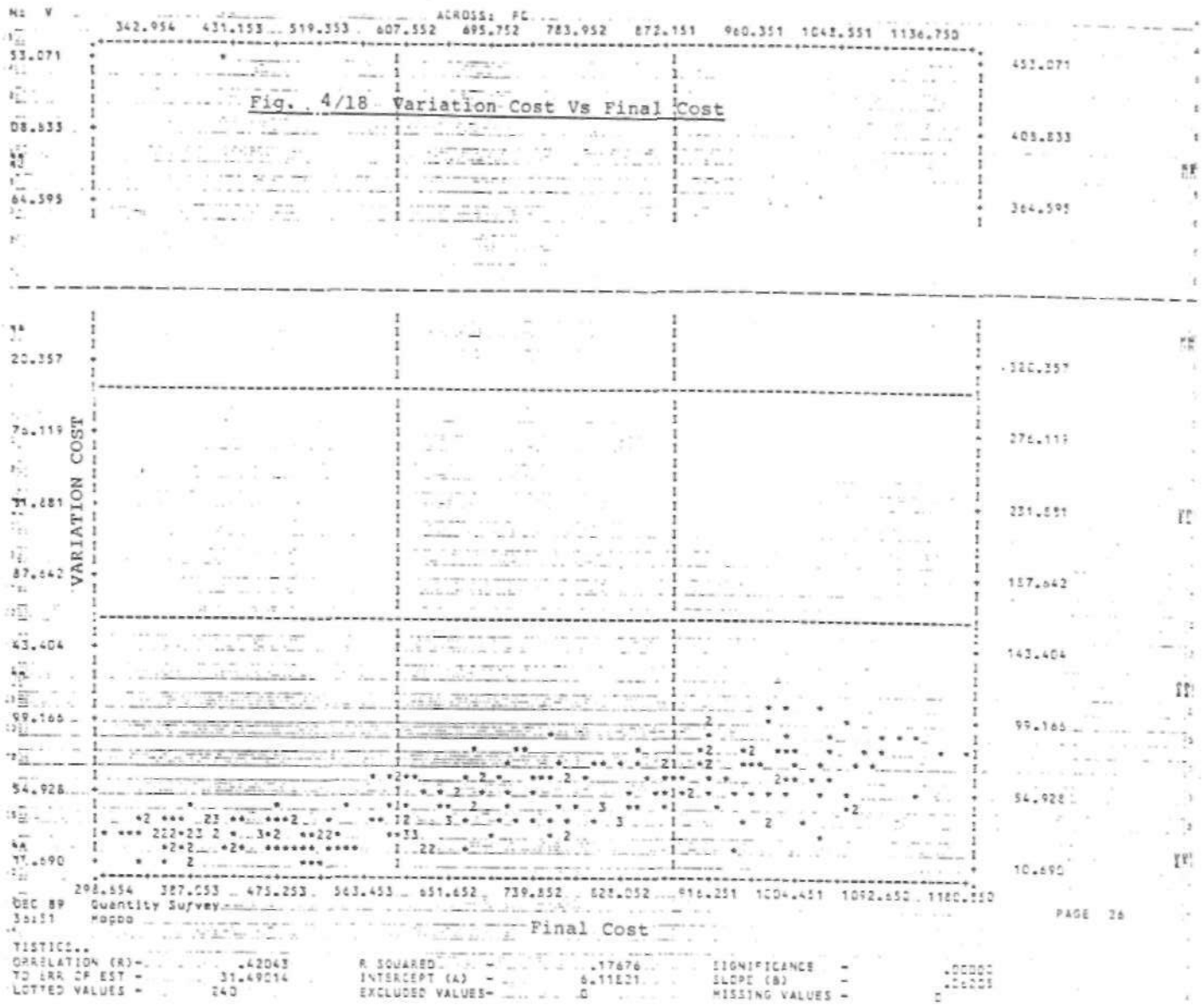
(4) The intercept was 6.118

(5) The level of significance was .0000

(6) Some co-efficient could not be computed.

(7) Graphical Statistics - showed a straight line characteristics.

(8) Inference - Because of the large errors, the linear relationships cannot be relied upon.


Fig. 4/18 Variation Cost Vs Final Cost
VARIATION COST
Final Cost
342.954 431.153 519.353 607.552 695.752 783.952 872.151 960.351 1048.551 1136.750
298.654 387.053 475.253 563.453 651.652 739.852 828.052 916.251 1004.451 1092.652 1180.850
53.071
88.833
64.595
20.357
70.119
87.642
43.404
99.166
54.928
77.690
453.071
408.833
364.595
320.357
276.119
231.881
187.642
143.404
99.166
54.928
10.690
DEC 89
Quantity Survey
PAGE 26
TISTICS..
CORRELATION (R)= .42043
TD ERR OF EST = 31.49014
LOTTED VALUES = 240
R SQUARED = .17676
INTERCEPT (A) = 6.11621
EXCLUDED VALUES= 0
SIGNIFICANCE = .00000
SLOPE (B) = .26203
MISSING VALUES = 0

FINAL COST (X AXIS) Vs FLUCTUATION COST (Y AXIS)

REF. FIG. 4/19

EXPERIMENT NO. 19

The following were the results obtained after plotting 240 values:-

(1) The correlation R was high (.80696)

(2) The standard error of the estimate was large 64.42

(3) The slope was .3743

(4) The intercept was - 26.751

(5) The level of significance was .0000

(6) Some co-efficient could not be computed.

(7) Graphical Statistics - Tended to behave both like a curve and a straight line.

(8) Inference - It could not be concluded that there is a relationship because of the large errors and the graphical character.

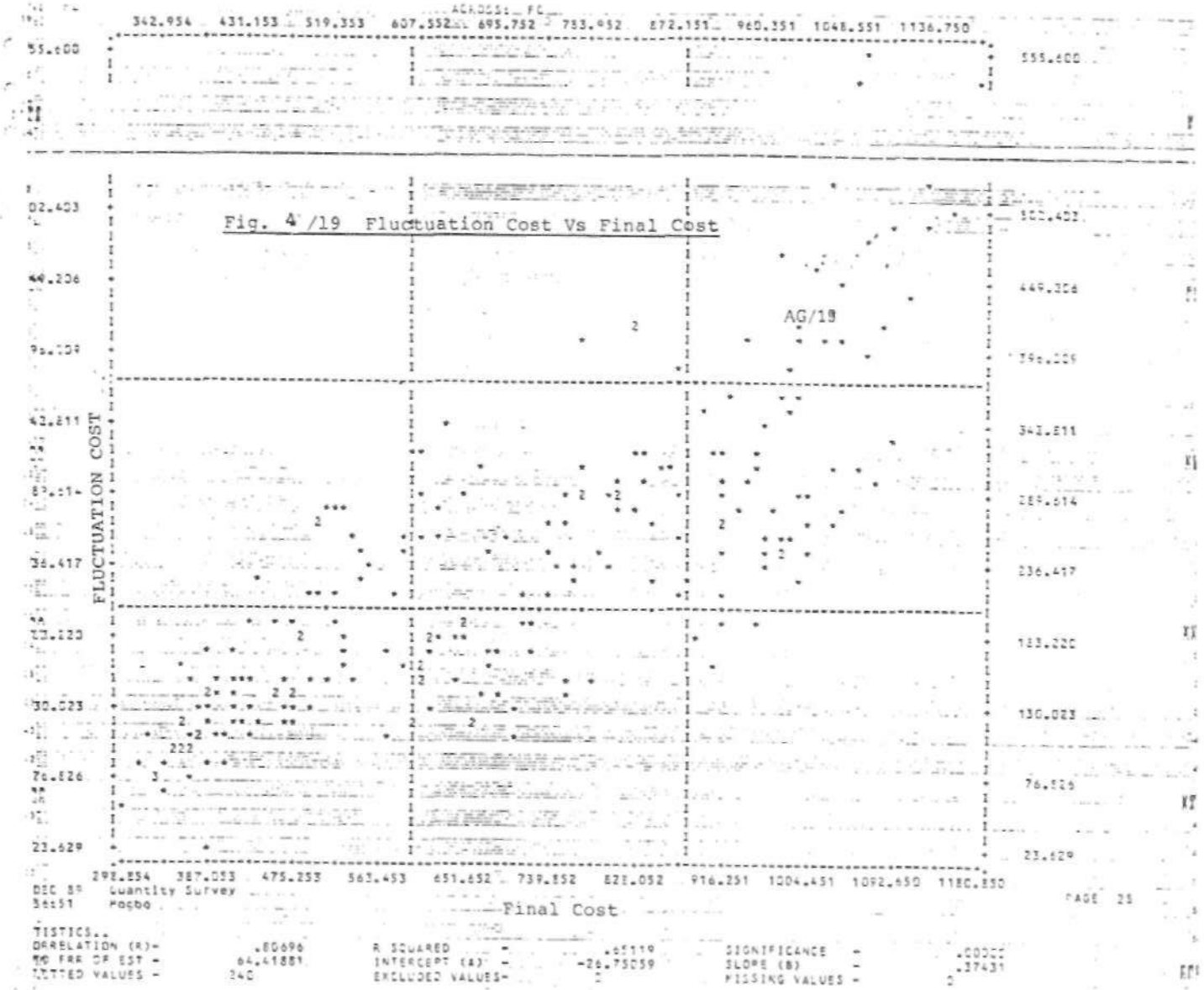


Fig. 4 /19 Fluctuation Cost Vs Final Cost

VARIATION COST (X AXIS) Vs FLUCTUATION COST (Y AXIS)

REF. FIG. 4/20

EXPERIMENT NO. 20

The following were the results obtained after plotting 240 values:-

(1) The correlation R was low .1934

(2) The standard error of the estimate was large (107.014)

(3) The slope was .608

(4) The intercept was 204.02

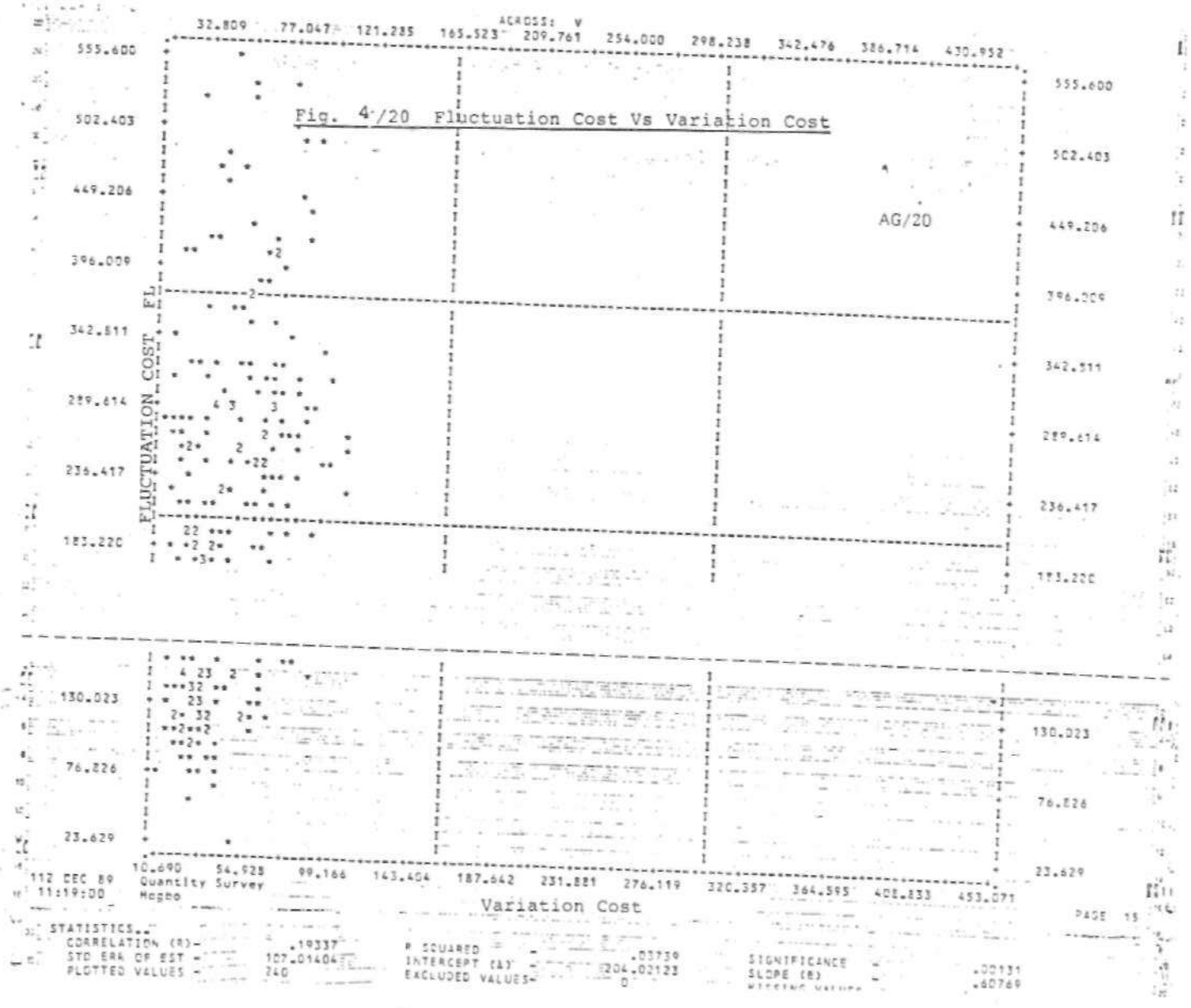
(5) The level of significance was .00131

(6) Some co-efficients could not be computed.

(7) Graphical Statistics - Not defined

(8) Inference - Variation cost has no relationship with fluctuation cost.

Fig. 4/20 Fluctuation Cost Vs Variation Cost



VARIATION COST (X AXIS) Vs FINAL COST (Y AXIS)

REF. FIG. 4/21

EXPERIMENT NO. 21

The following were the results obtained after plotting 240 values:-

(1) The correlation R was high .4204

(2) The standard error of the estimate was large 213.35

(3) The slope was 2.848

(4) The intercept was 556.077

(5) The level of significance was .000

(6) Some co-efficients could not be computed.

(7) Graphical Statistics - Not defined

(8) Inference - No relationship because of the large errors and graphical character.

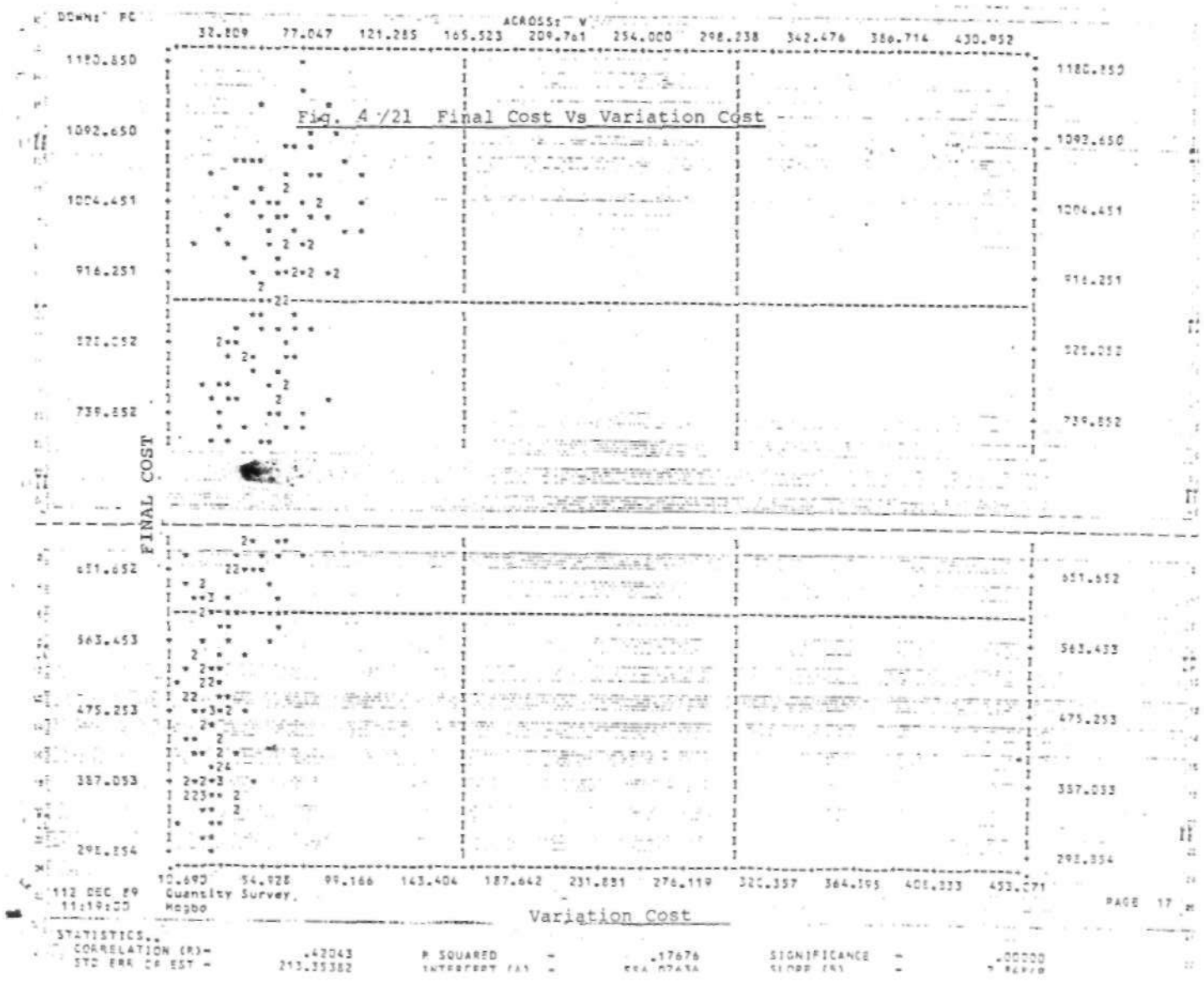


Fig. 4 /21 Final Cost Vs Variation Cost

VARIATION COST (X AXIS) Vs FINAL TIME (Y AXIS)

REF. FIG. 4/22

EXPERIMENT NO. 22

The following were the results obtained after plotting 240 values:-

(1) The correlation R was low - 0.1109

(2) The standard error of the estimate was large .3693

(3) The slope was - .00119

(4) The intercept was .73783

(5) The level of significance was .04318

(6) Some co-efficients could not be computed.

(7) Graphical Statistics - Not defined.

(8) Inference - No established relationship because of the graphical character and the low value of R

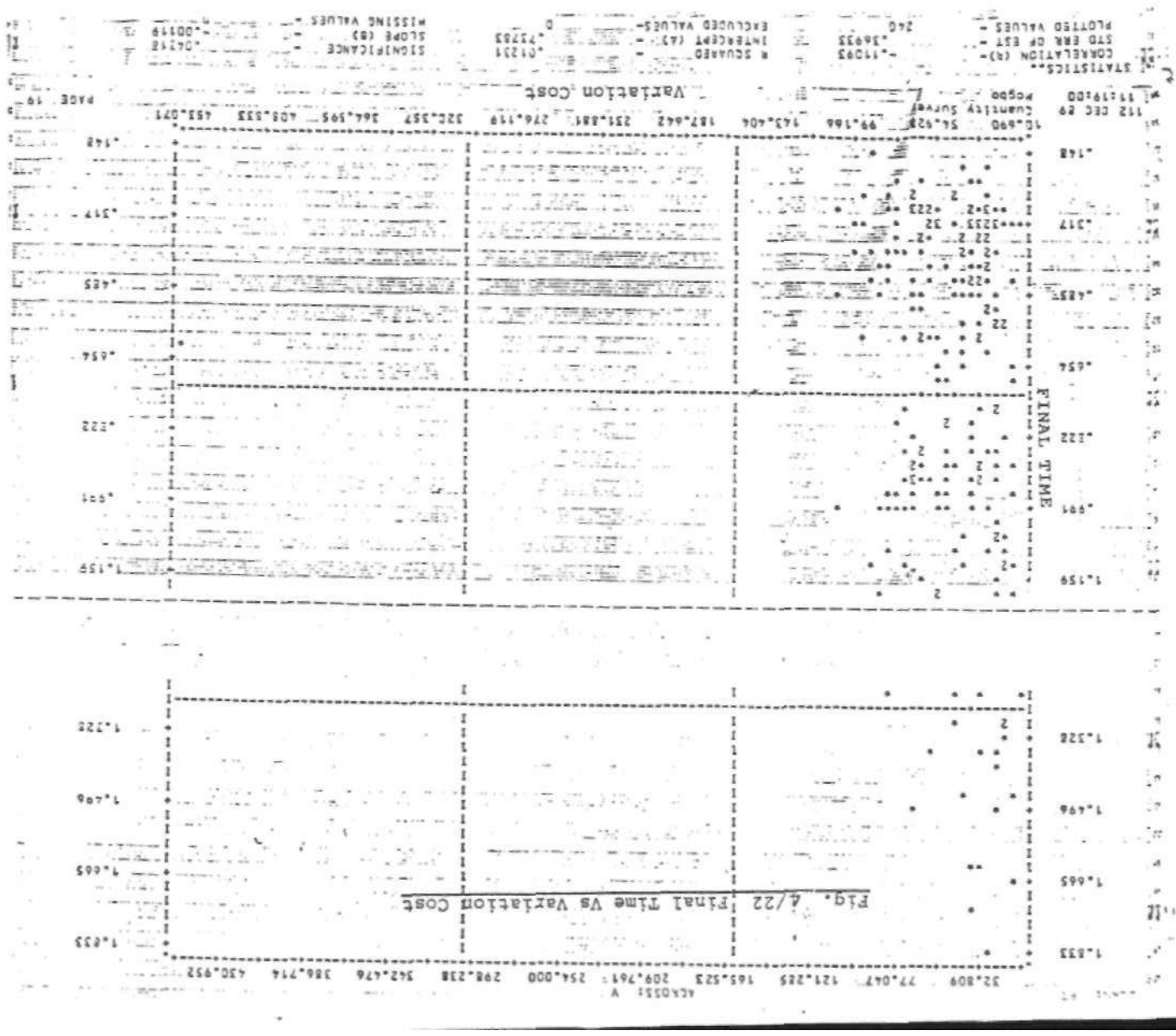


Fig. 4/22 Final Time Vs Variation Cost

VARIATION COST (X AXIS) Vs INITIAL TIME (Y AXIS)

REF. FIG. 4/23

EXPERIMENT NO. 23

The following were the results obtained after plotting 240 values:-

(1) The correlation R was low .07947

(2) The standard error of the estimate was .0431

(3) The slope was .00010

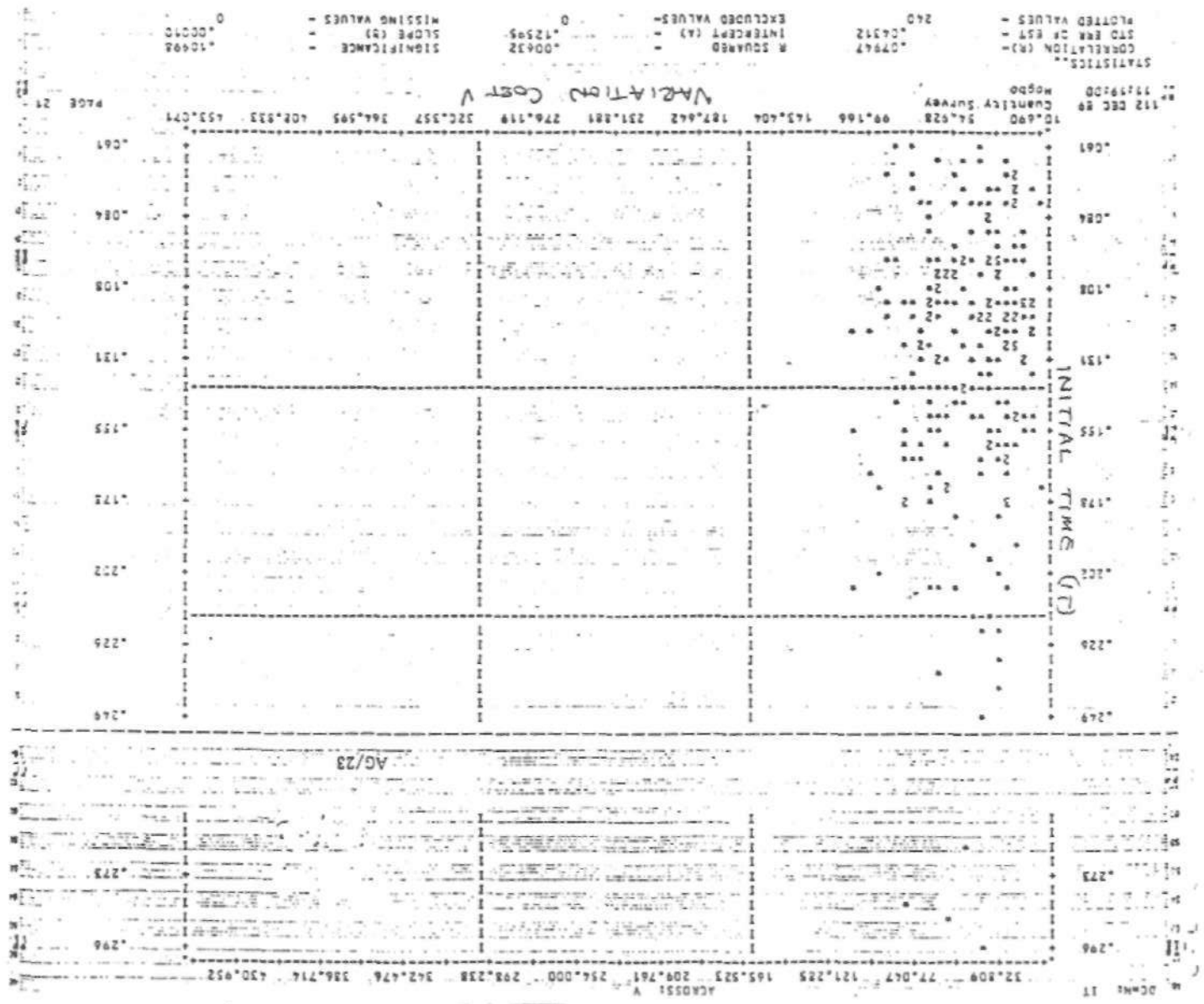
(4) The intercept was .12595

(5) The level of significance was .10998

(6) Some co-efficients could not be computed.

(7) Graphical Statistics - No defined character.

(8) Inference - No relationships existing between Variation Cost and Initial Time.



VARIATION COST (X AXIS) VS PAYMENT DELAY TIME (Y AXIS)

REF. FIG. 4/24

EXPERIMENT NO. 24

The following were the results obtained after plotting 240 values:-

(1) The correlation R was low (- .1341)

(2) The standard error of the estimate was .3040

(3) The slope was - .00119

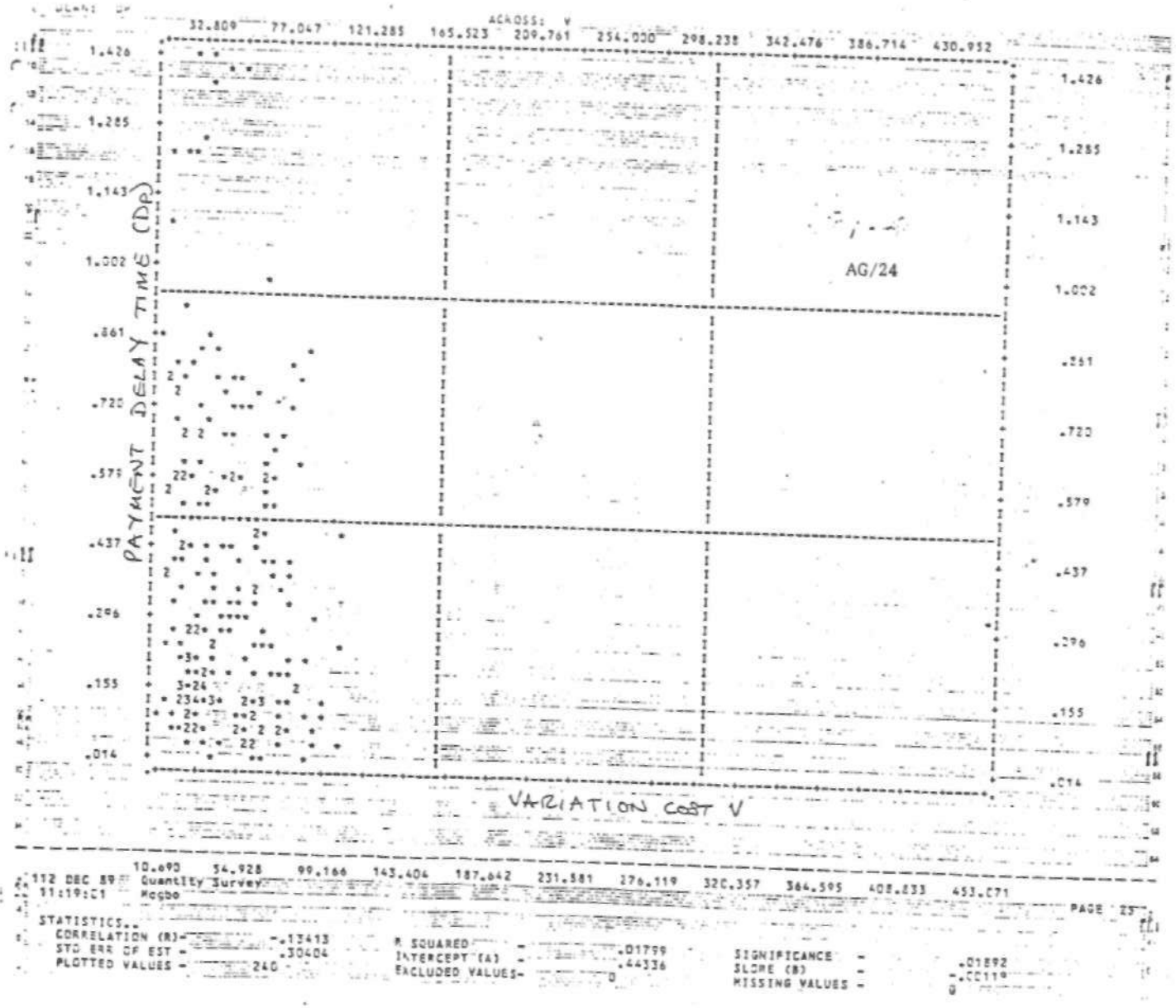
(4) The intercept was .4434

(5) The level of significance was .0189

(6) Some co-efficients could not be computed.

(7) Graphical Statistics - not defined; points clustered around the left side of the graph.

(8) Inference - No relationships exist between Variation cost and payment delay time.


ACROSS: V
32.809 77.047 121.285 165.523 209.761 254.000 298.238 342.476 386.714 430.952
1.426
1.285
1.143
1.002
.861
.720
.579
.437
.296
.155
.014
PAYMENT DELAY TIME (Dp)
AG/24
VARIATION COST V
10.690 54.928 99.166 143.404 187.642 231.881 276.119 320.357 364.595 408.833 453.071
12 DEC 89 Quantity Survey
11:19:C1 Mogbo
PAGE 25
STATISTICS..
CORRELATION (R)= -.13413
STD ERR OF EST = .30404
PLOTTED VALUES = 240
R SQUARED = .01799
INTERCEPT (A) = .44336
EXCLUDED VALUES= 0
SIGNIFICANCE = .01892
SLOPE (B) = -.CC119
MISSING VALUES = 0

VARIATION COST (X AXIS) VS VARIATION DELAY TIME (Y AXIS)

REF. FIG. 4/25

EXPERIMENT NO. 25

The following were the results obtained after plotting 240 values:-

(1) The correlation R was low (- 0.0804)

(2) The standard error of the estimate was low (.07832)

(3) The slope was - .00018

(4) The intercept was .10592

(5) The level of significance was .10737

(6) Some co-efficients could not be computed.

(7) Graphical Statistics - no defined character

(8) Inference - no relationship exist between Variation cost and Variation delay time.

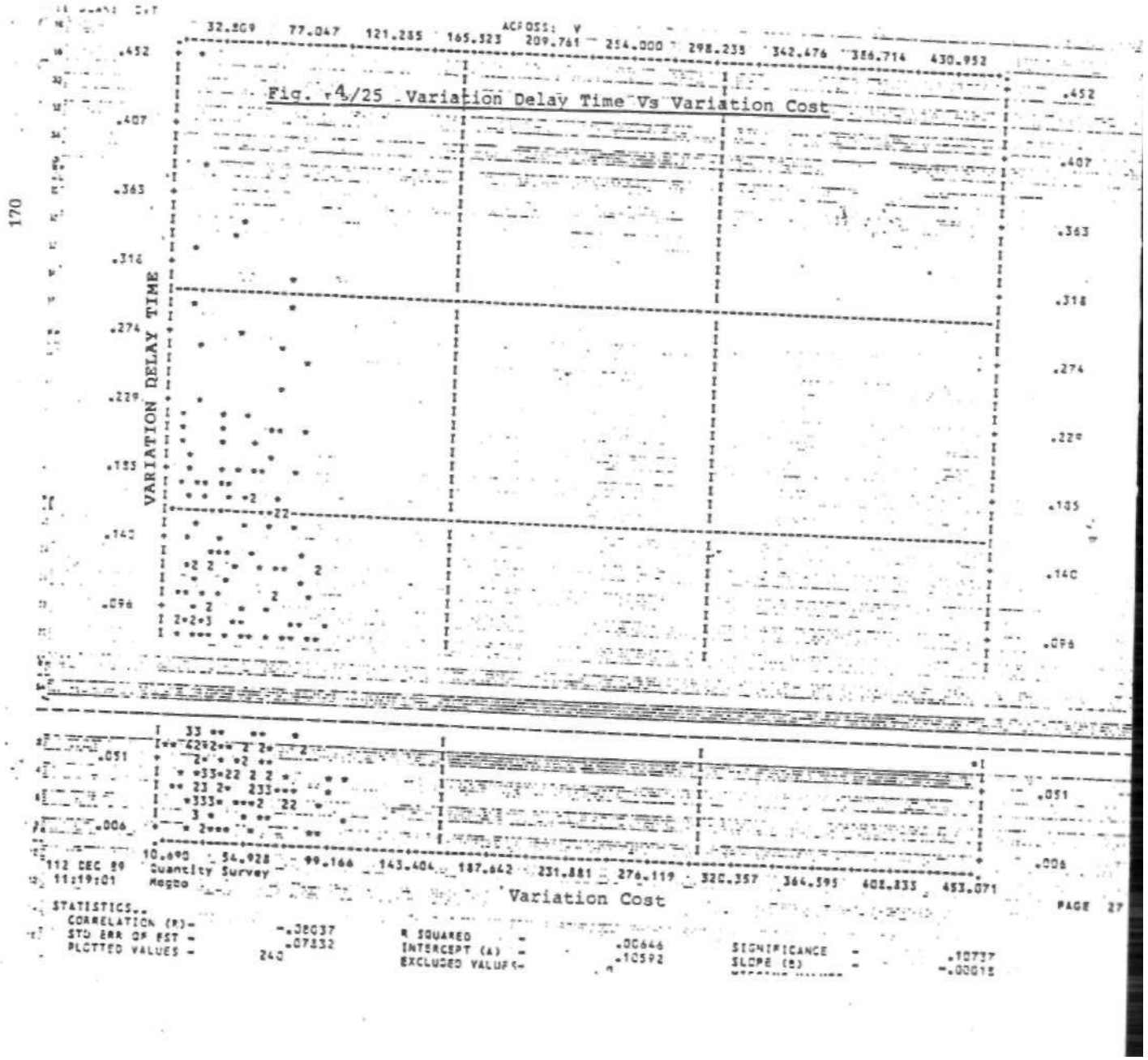


Fig. 4/25 Variation Delay Time Vs Variation Cost

VARIATION COST (X AXIS) AS OTHER VS OTHER DELAY TIME (Y AXIS)

REF. FIG. 4/26

EXPERIMENT NO. 26

The following were the results obtained after plotting 240 values:-

(1) The correlation R was low - .06319

(2) The standard error of the estimate was (.0854)

(3) The slope was - .00016

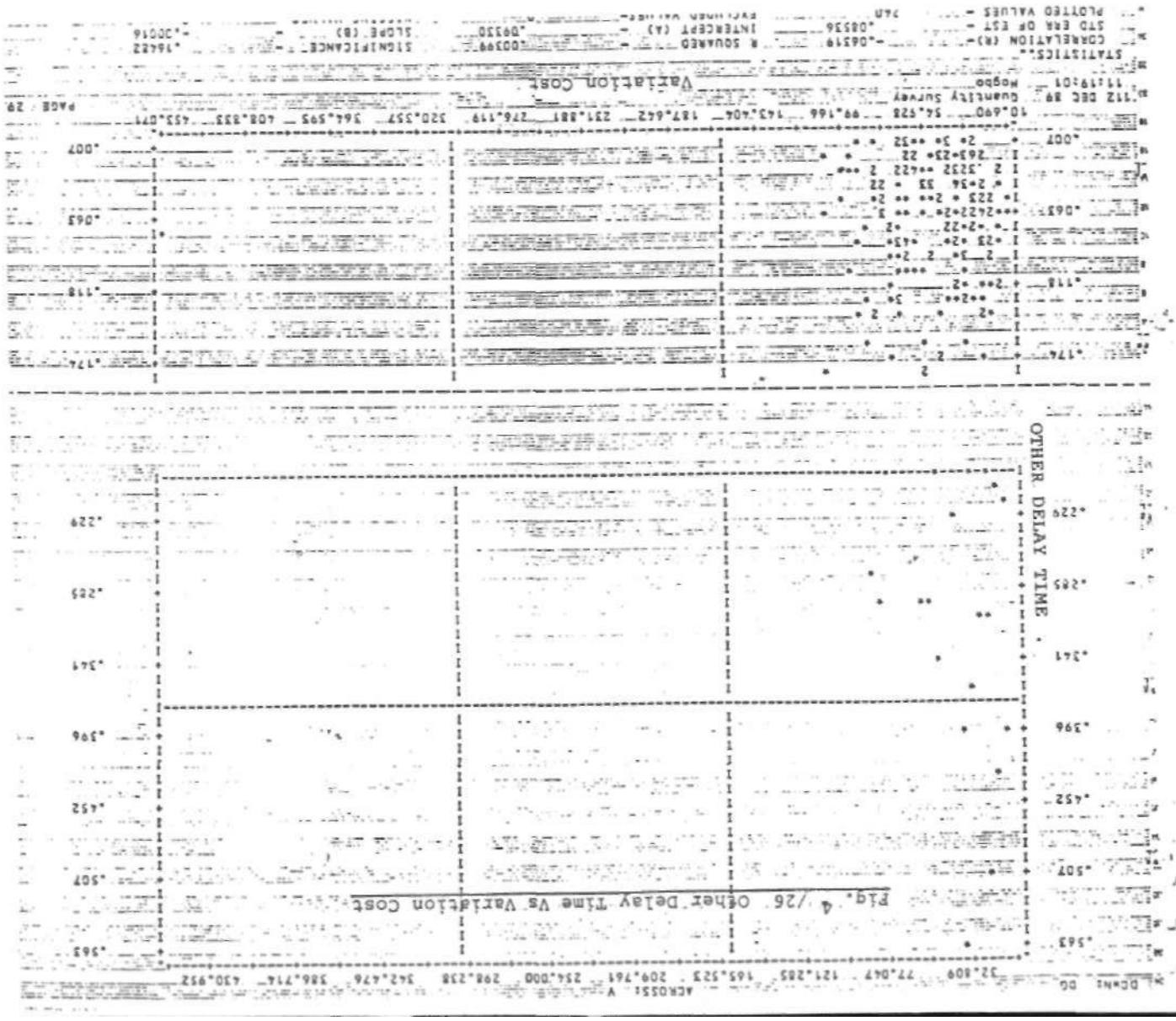
(4) The intercept was .09330

(5) The level of significance was .1648

(6) Some co-efficients could not be computed.

(7) Graphical Statistics - not defined

(8) Inference - no established relationships between Variation Cost and and "Other delay" Time


Variation Cost
OTHER DELAY TIME
.229
.285
.341
.396
.452
.507
.563
Fig. 4 /26 Other Delay Time Vs Variation Cost.

VARIATION COST (X AXIS) VS COST PERFORMANCE (Y AXIS)

REF. FIG. 4/27

EXPERIMENT NO. 27

The following were the results obtained after plotting 240 values:-

(1) The correlation R was low - .1034

(2) The standard error of the estimate was low .2388

(3) The slope was - .00072

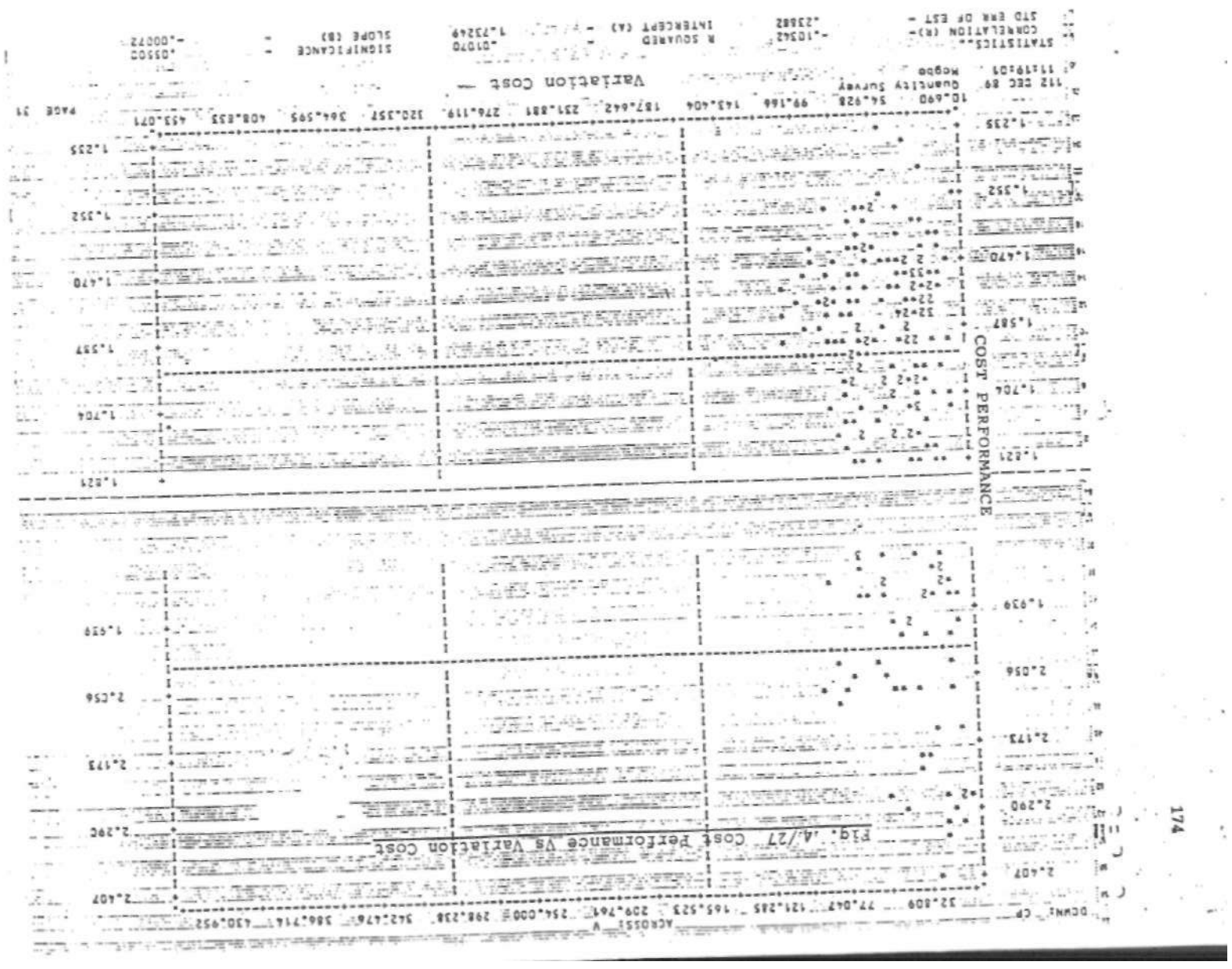
(4) The intercept was 1.732

(5) The level of significance was 0.055

(6) Some co-efficients could not be computed

(7) Graphical Statistic - not defined

(8) Inference - no established relationship between Variation Cost and Cost Performance.


COST PERFORMANCE
Variation Cost
Fig. 4.27 Cost Performance Vs Variation cost

VARIATION COST (X AXIS) VS TIME PERFORMANCE (Y AXIS)

REF. FIG. 4/28

EXPERIMENT NO. 28

The following were the results obtained after plotting 240 values:-

(1) The correlation R was - .1109

(2) The standard error of the estimate was 3.518

(3) The slope was - .0113

(4) The intercept was 6.212

(5) The level of significant was .043

(6) Some co-efficients could not be computed

(7) Graphical Statistics - not defined

(8) Inference - no relationships between Variation Cost and Time Performance.



Fig. 4/28 Time Performance Vs Variation Cost

VARIATION COST (X AXIS) VS FINAL COST INTENSITY (Y AXIS)

REF. FIG. 4/29

EXPERIMENT NO. 29

The following were the results obtained after plotting 240 values:-

(1) The correlation R was high (.2674)

(2) The standard error of the estimate was bery high 906.162

(3) The slope was 7.247

(4) The intercept was 1023.81

(5) The level of significance was .00001

(6) Some co-efficients could not be computed

(7) Graphical Statistics - not defined

(8) Inference - no direct relationship because of large errors and graphical character.

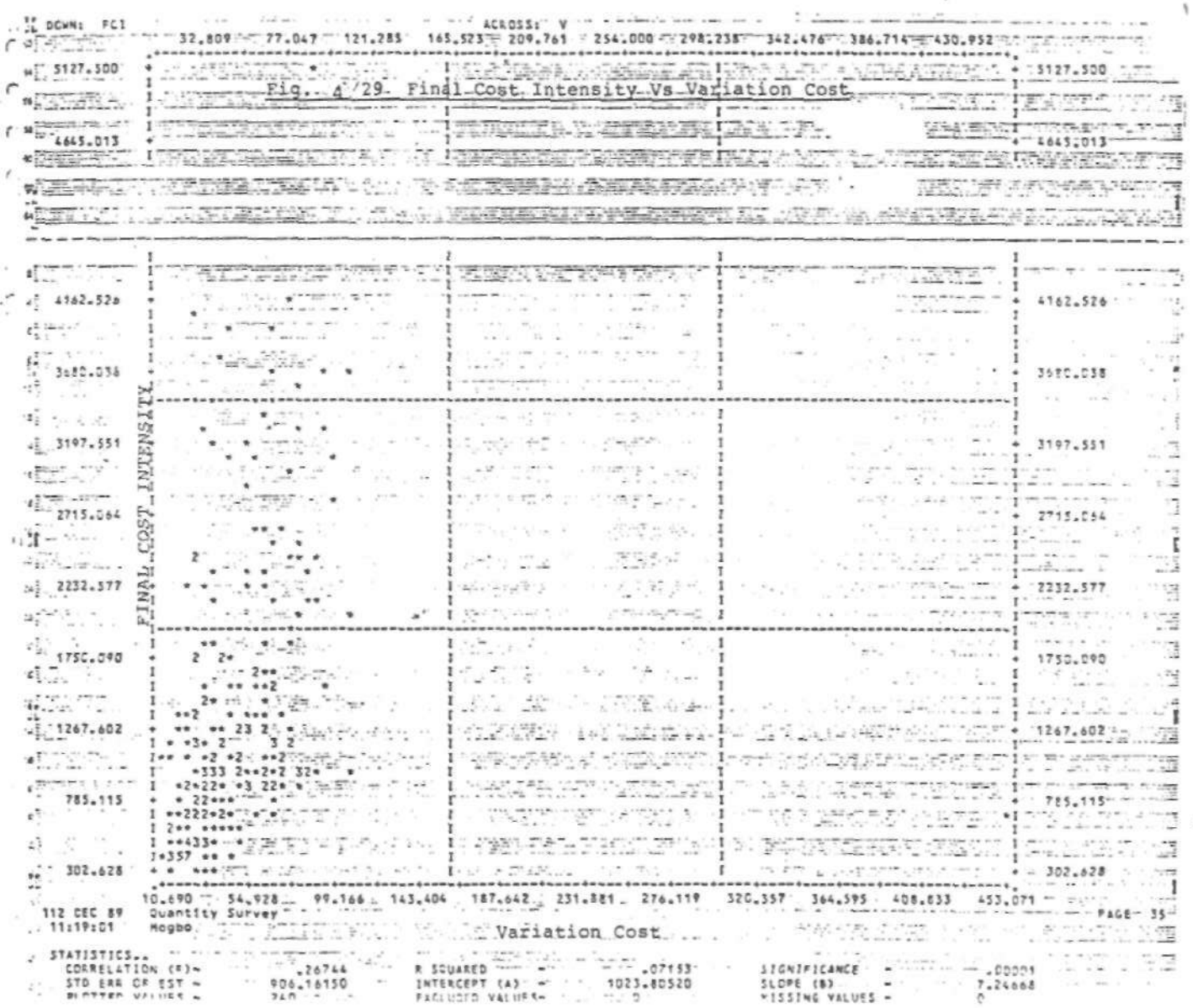


Fig. 4.29 Final Cost Intensity Vs Variation Cost

VARIATION COST (X AXIS) VS INITIAL COST INTENSITY (Y AXIS)

REF. FIG. 4/30

EXPERIMENT NO. 30

The following were the results obtained after plotting 240 values:-

(1) The correlation R was high .2594

(2) The standard error of the estimate was large (1663.441)

(3) The slope was 12.87

(4) The intercept was 2868.51

(5) The level of significance was (.00002)

(6) Some co-efficients could be computed

(7) Graphical Statistics - not defined

(8) Inference - no direct relationship existed between the Variation Cost and the Initial Cost Intensity.

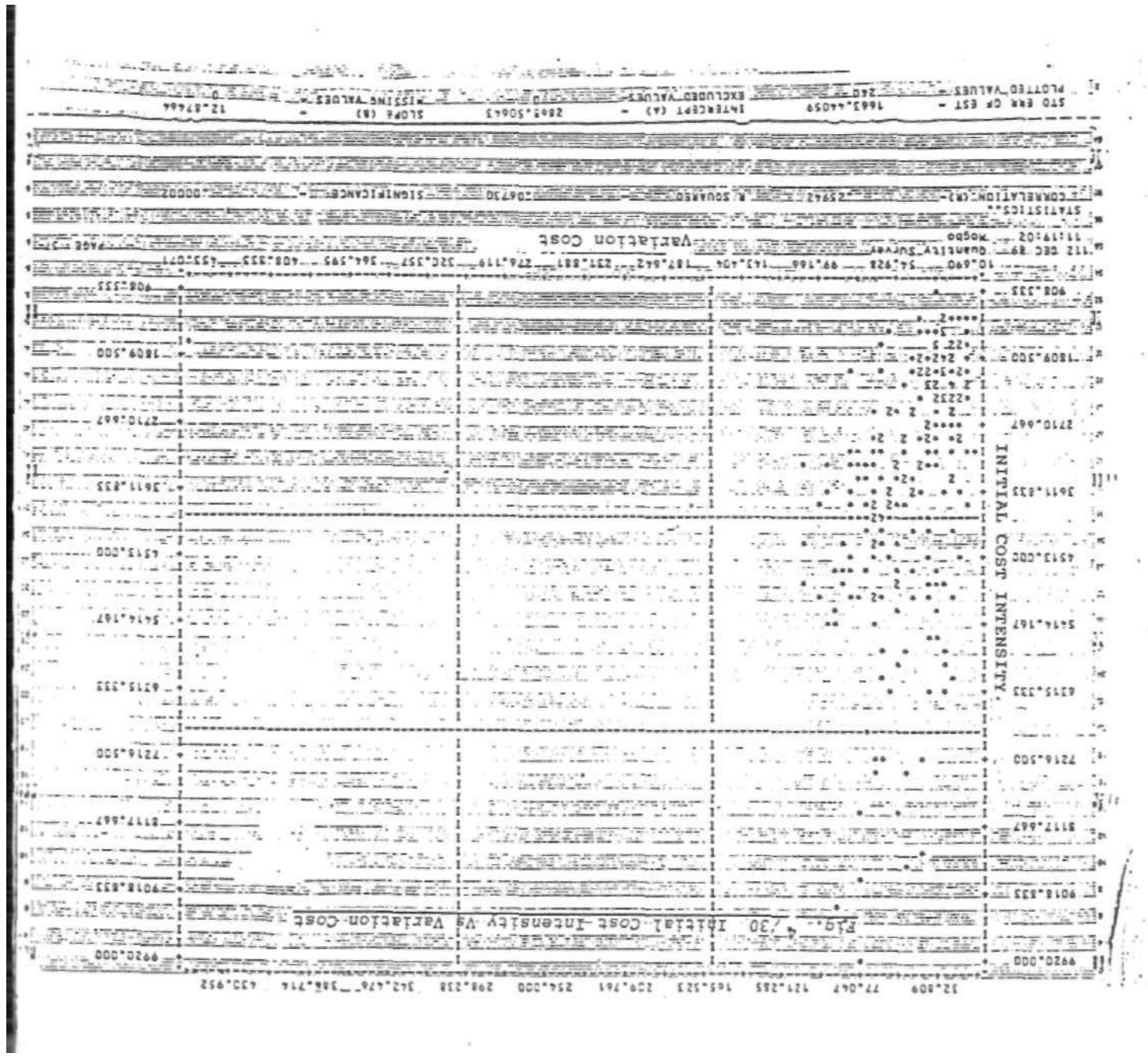


Fig. 4.30 Initial Cost Intensity Vs Variation Cost

VARIATION COST (X AXIS) VS RELATIVE COST INTENSITY (Y AXIS)

REF. FIG. 4/31

EXPERIMENT NO 31

The following were the results obtained after plotting 240 values:-

(1) The correlation R was low 0.1268

(2) The standard error of the estimate was low (.2448)

(3) The slope was .0009

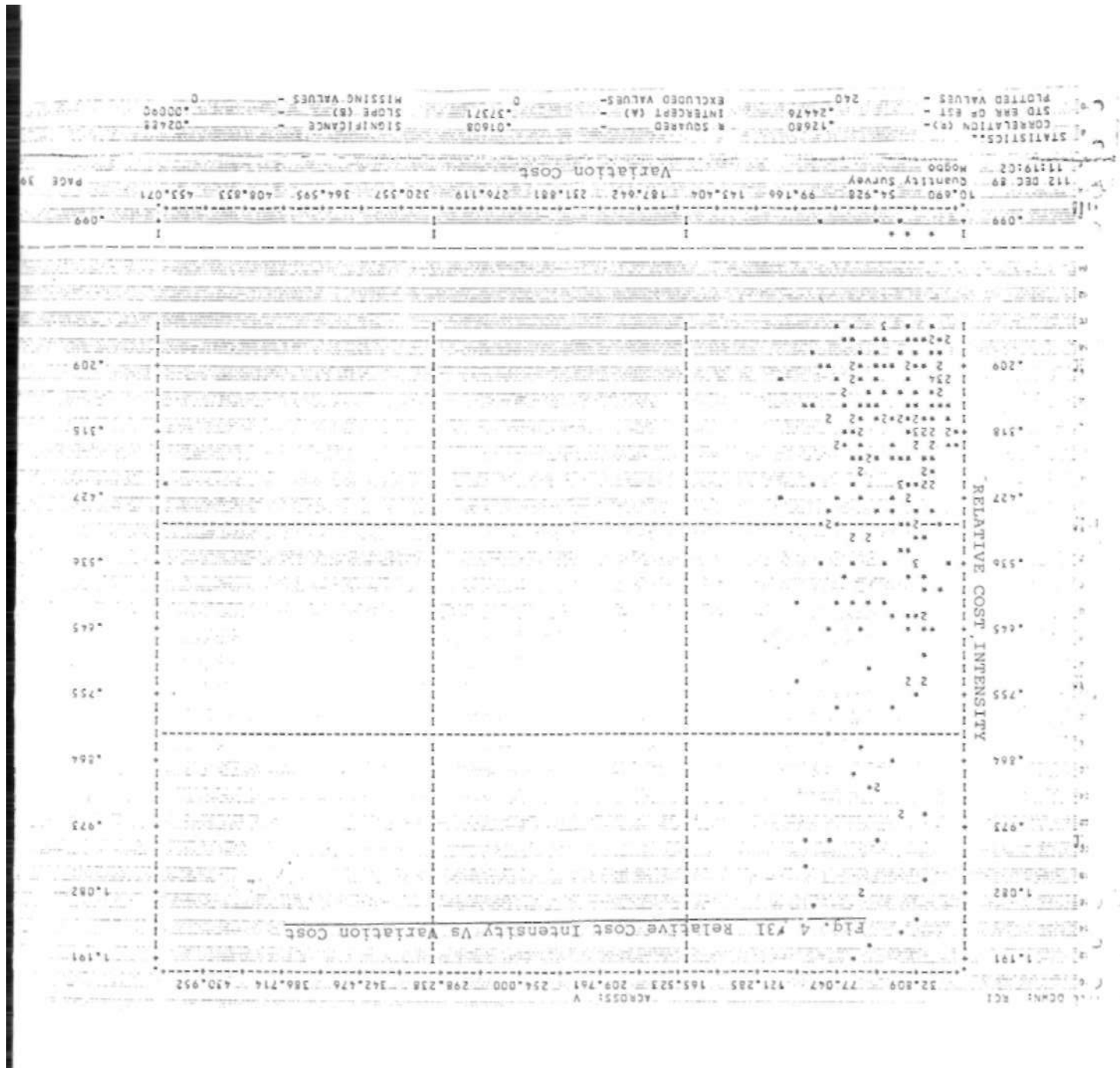
(4) The intercept was .3747

(5) The level of significance was .025

(6) Some co-efficients could not be computed

(7) Graphical Statistics - not defined

(8) Inference - no direct relationship between Variation Cost and Relative Cost Intensity.


Variation Cost
RELATIVE COST INTENSITY
Fig. 4 A31 Relative Cost Intensity Vs Variation Cost

VARIATION COST (A AXIS) VS VARIATION + FLUCTUATION COST (Y AXIS)

REF. FIG. 4/32

EXPERIMENT NO. 32

The following were the results obtained after plotting 240 values:-

(1) The correlation R was high .4623

(2) The standard error of the estimate was 107.01

(3) The slope was 1.608

(4) The intercept was 204.021

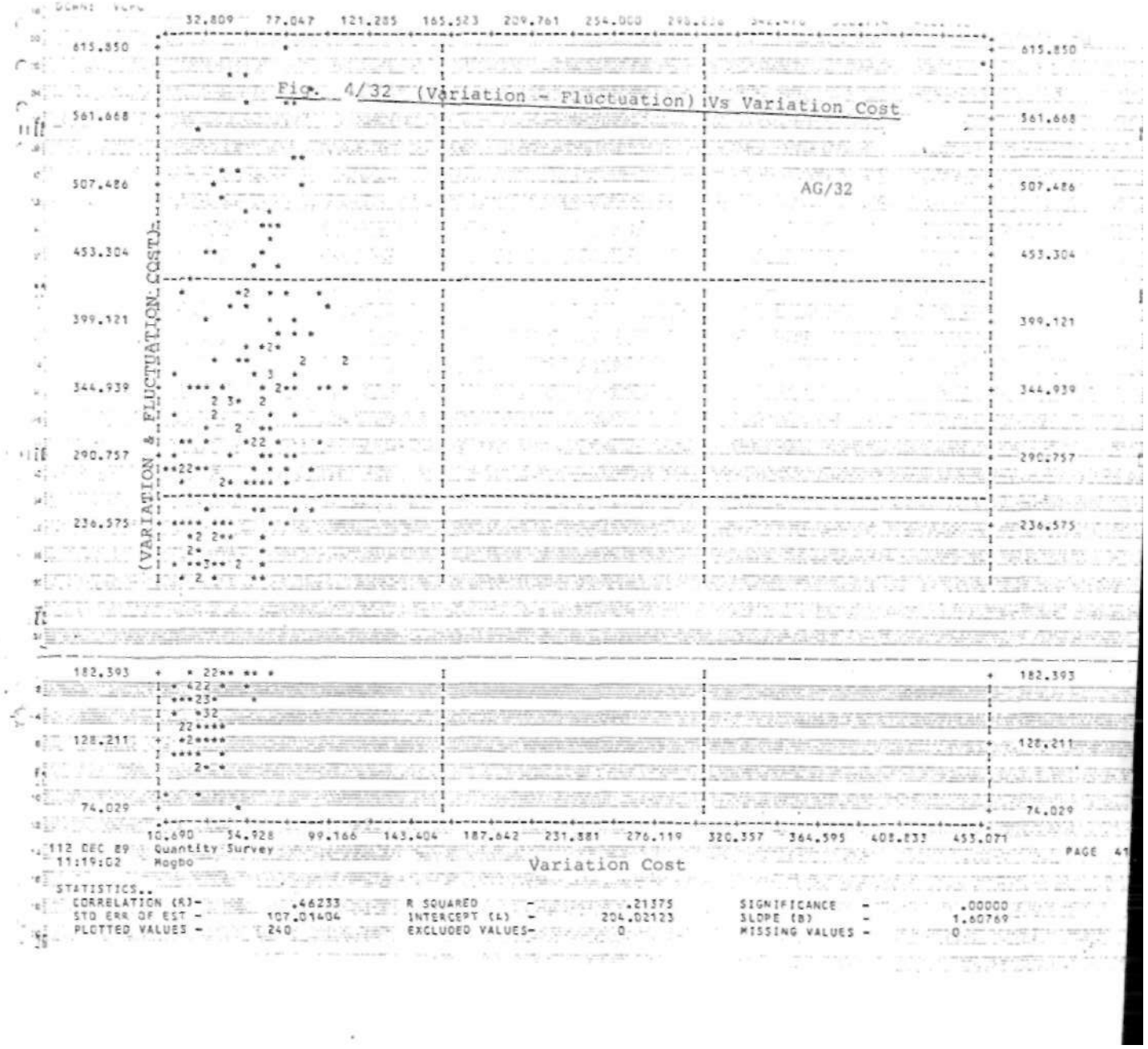
(5) The level of significance was .0000

(6) Some co-efficients could not be computed

(7) Graphical Statistics - not defined

(8) Inference - no direct relationship between Variation Cost and Increase in Initial contract cost

Fig. 4/32 (Variation - Fluctuation) Vs Variation Cost



FLUCTUATION COST (X AXIS) VS PAYMENT DELAY TIME (Y AXIS)

REF. FIG. 4/33

EXPERIMENT NO. 33

The following were the results obtained after plotting 240 values:-

(1) The correlation R was .5950

(2) The standard error of the estimate was .247

(3) The slope was .0017

(4) The intercept was - .0068

(5) The level of significance was .0000

(6) Some co-efficients could not be computed

(7) Graphical Statistics

(8) *Inference - Tended to show a straight line formation with* approximate equal points scattered around the top and bottom parts of the line.

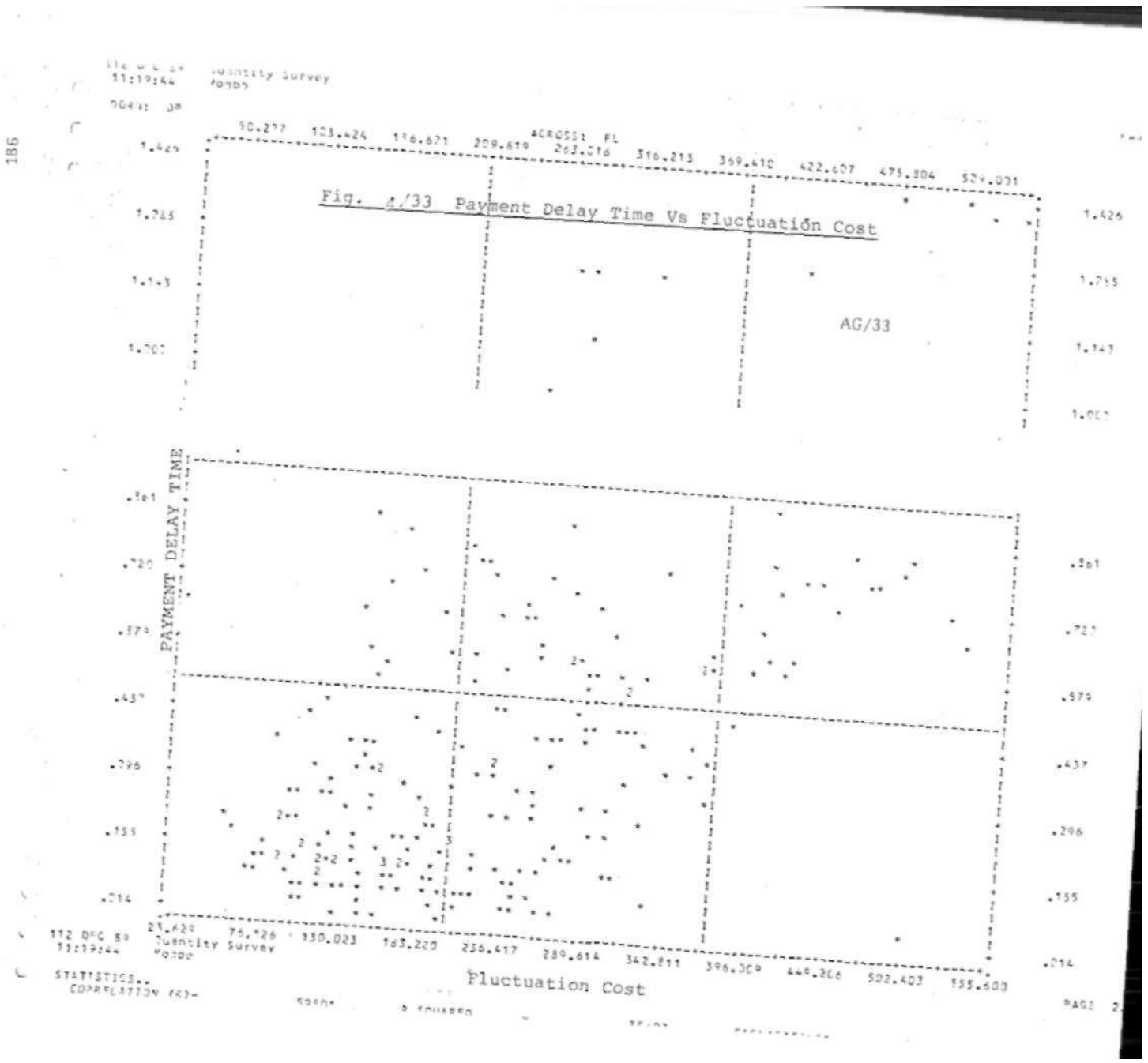


Fig. 4/33 Payment Delay Time Vs Fluctuation Cost

FLUCTUATION COST (X AXIS) VS VARIATION DELAY TIME (Y AXIS)

REF. FIG. 4/34

EXPERIMENT NO. 34

The following were the results obtained after plotting 240 values:-

(1) The correlation R was high .3632

(2) The standard error of the estimate was low .0732

(3) The slope was .00026

(4) The intercept was .3572

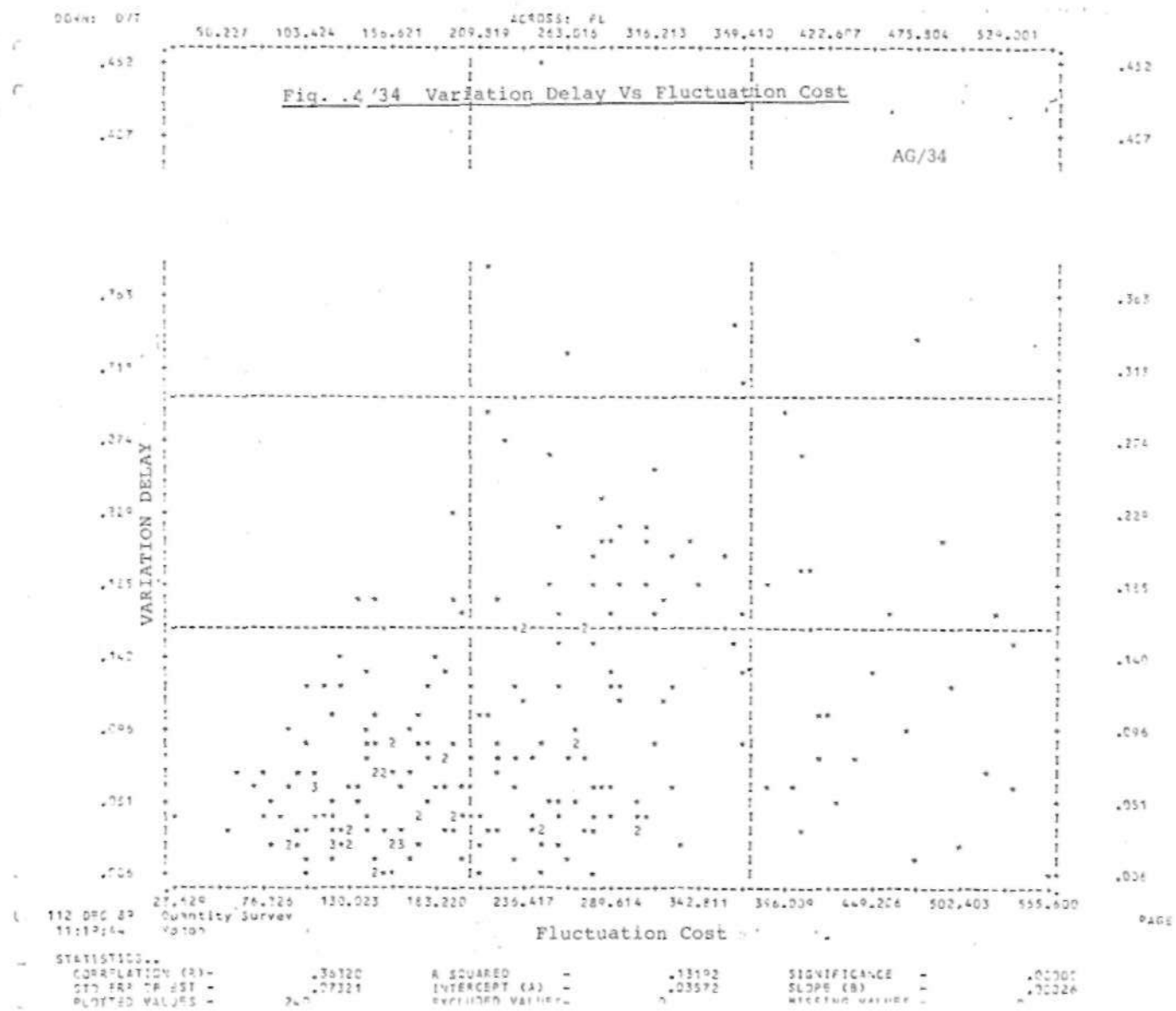
(5) The level of significance was .0000

(6) Some co-efficients could not be computed.

(7) Graphical Statistics - no defined character

(8) Inference - no direct relationship between Fluctuation Cost and Variation delay time.

Fig. .4 '34 Variation Delay Vs Fluctuation Cost



112 DEC 83 Quantity Surveyor
11:17:14 Value

PAGE

STATISTICS..

CORRELATION (R)-	.36320	R SQUARED -	.13192	SIGNIFICANCE -	.00301
STD ERR OF EST -	.07321	INTERCEPT (A) -	.03572	SLOPE (B) -	.00024
PLOTTED VALUES -	240	EXCLUDED VALUES -	0	MISSING VALUES -	0

FLUCTUATION COST (X AXIS) VS OTHER DELAYS TIME (Y AXIS)

REF. FIG. 4/35

EXPERIMENT NO. 35

The following were the results obtained after plotting 240 values:-

(1) The correlation R was high .2694

(2) The standard error of the estimate was low .08237

(3) The slope was .00021

(4) The intercept was .03618

(5) The level of significance was .00001

(6) Some co-efficients could not be computed

(7) Graphical Statistics - not defined character.

(8) Inference - no direct relationships existing between fluctuation cost and other delays time.

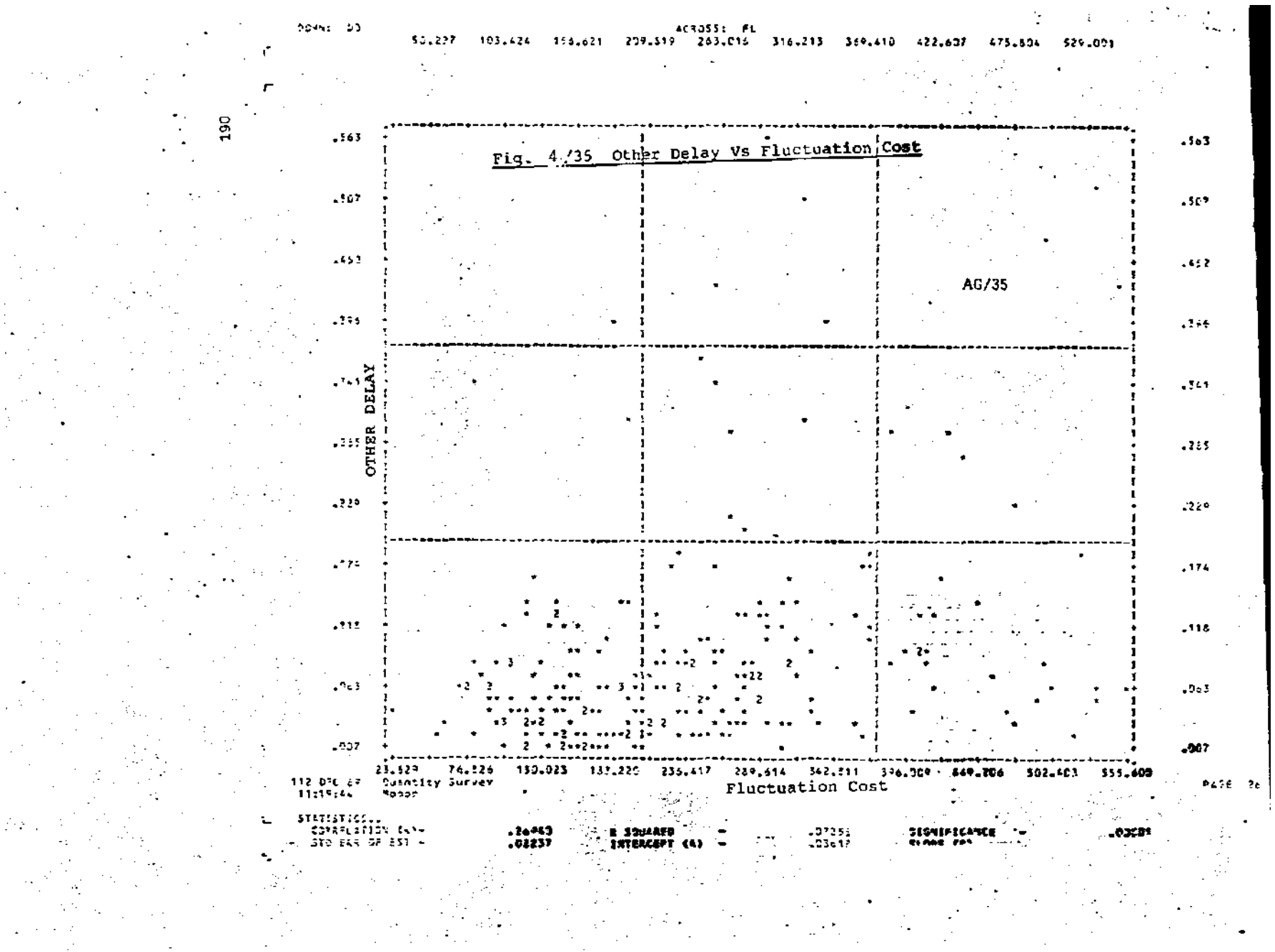


Fig. 4.35 Other Delay Vs Fluctuation Cost

FLUCTUATION COST (X AXIS) VS OTHER DELAYS TIME (Y AXIS)

REF. FIG. 4/35

EXPERIMENT NO. 35

The following were the results obtained after plotting 240 values:-

(1) The correlation R was high .2694

(2) The standard error of the estimate was low .08237

(3) The slope was .00021

(4) The intercept was .03618

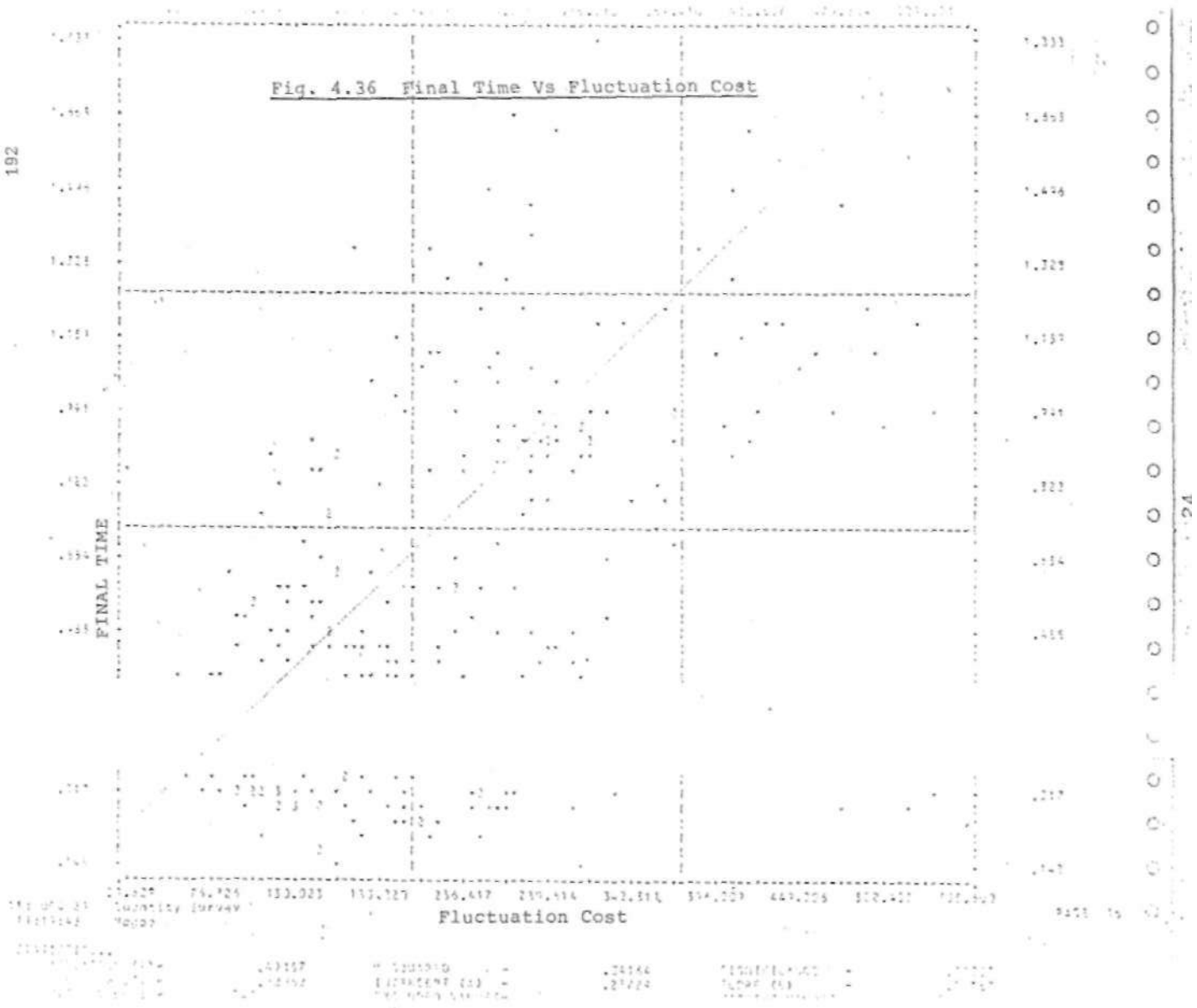
(5) The level of significance was .00001

(6) Some co-efficients could not be computed

(7) Graphical Statistics - not defined character.

(8) Inference - no direct relationships existing between fluctuation cost and other delays time.

Fig. 4.36 Final Time Vs Fluctuation Cost



FLUCTUATION COST (X AXIS) VS TOTAL DELAY TIME (Y AXIS)

REF. FIG. 4/37

EXPERIMENT NO. 37

The following were the results obtained after plotting 240 values:-

(1) The correlation R was .683

(2) The standard error of the estimate was .302

(3) The slope was .362

(4) The intercept was .052

(5) The level of significance was zero

(6) Some co-efficients could not be computed

(7) Graphical Statistics scattered all over the graph; no defined relationships

(8) Inference - There is no direct relationships between Fluctuation Cost and Total Delay Time.

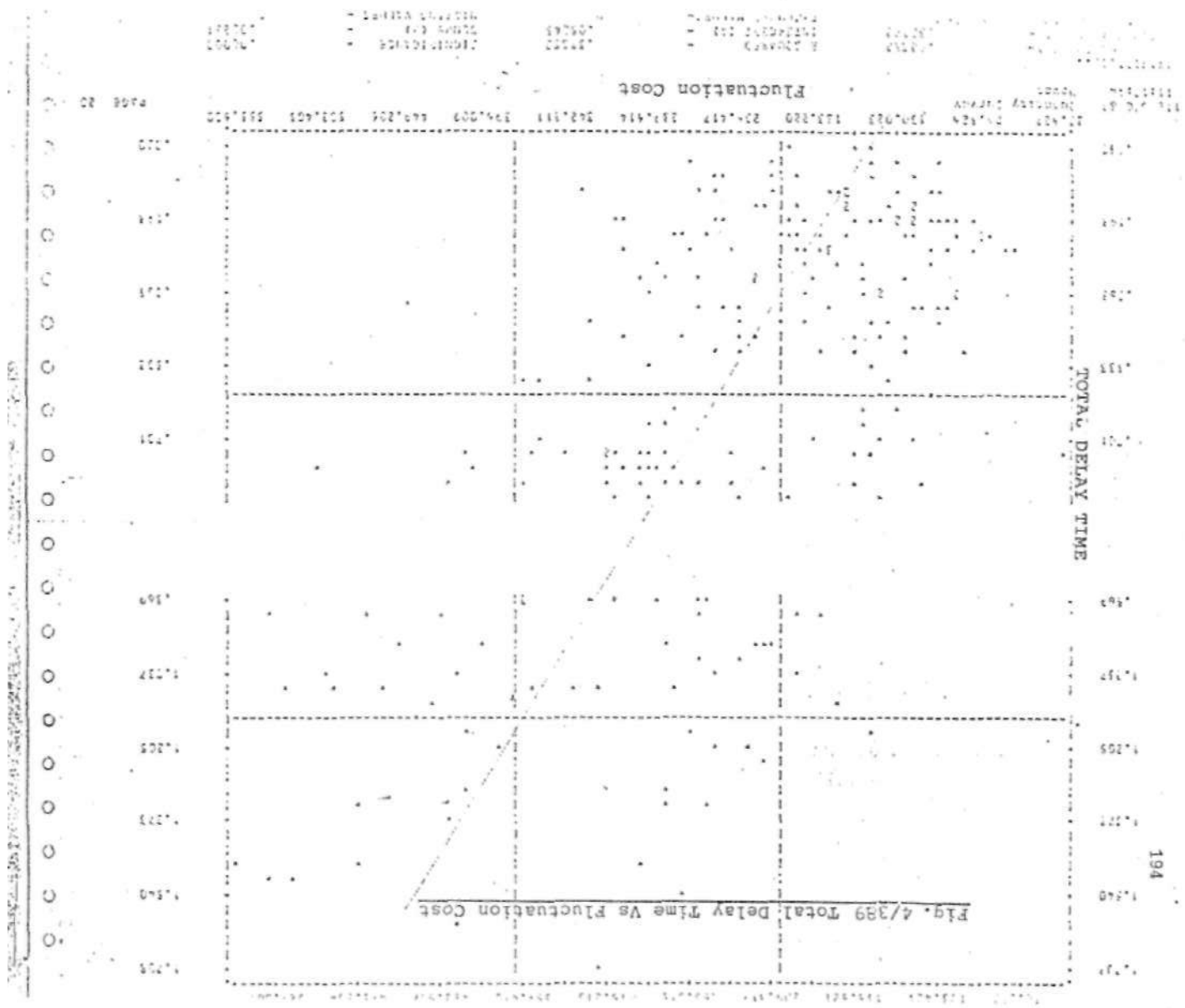
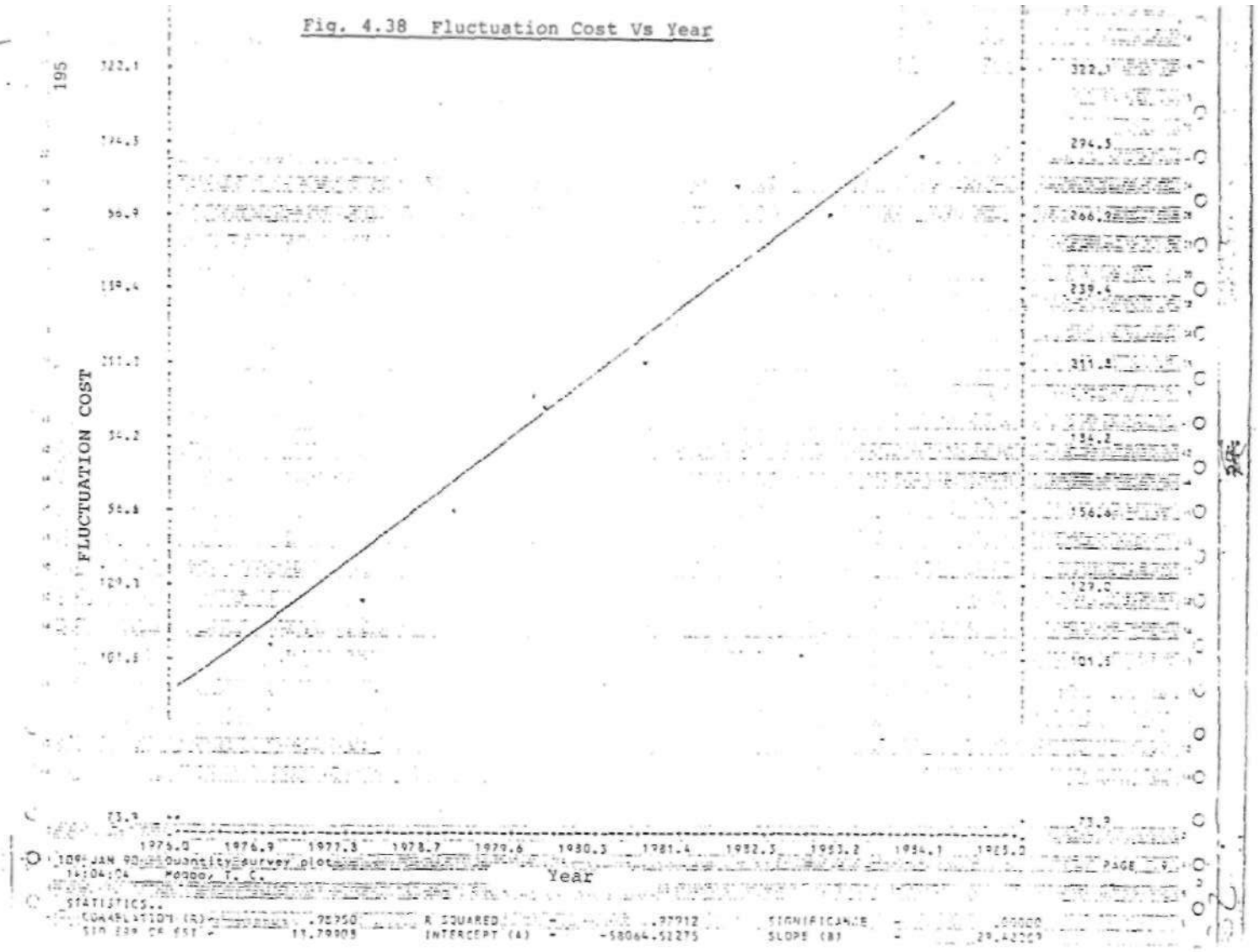


Fig. 4/389 Total Delay Time Vs Fluctuation Cost

Fig. 4.38 Fluctuation Cost Vs Year



INCREASE IN INITIAL CONTRACT COST (VcFc) CORRELATED WITH VARIOUS FACTORS.

Graph Ref.	X Axis	Y Axis	Corr R	Std Error	Graphical Statistics	Inference
4/1	VcFv Variation + Fluctuation	CP Cost Per formance	.5691	.1974	Appears Scattered at top and bottom of graph.	Error is small, R is Significant. VcFc increases as CP increases.
4/2	"	TP Time Per-formance	.3797	3.274	Appears to show no relationships	Error is large, Although R is significant, Relationship is doubtful because of unreliable time constraint.
4/3	"	FCI Final Cost Intensity	.1053	935.193	Ditto	Error is large, R is not significant. No relationship confirmed.
4/4	"	ICI Initial cost intensity	.4388	1457.754	Scattered across the graph	Error is large, It is not reliable to infer that VCFC increases as ICI increases.
4/5	"	RCI Relative cost Intensity	-.2048	.2415	Scattered across the graph but appears to give curulinear shape.	Although error is small, R is not significant No straight line relationship.
4/6	"	V Variation	.4623	30.774	Shallow shape	Error is large, many co-effs could not be calculated there is no reliability in relationships.
4/7	"	Fluctua-tion (FL)	.9594	30.774	Defined straight line	Although error is large, relationship is defined.
4/8	"	Final cost (FC)	.8502	123.79	ditto	ditto.

FINAL COST (FC) CORRELATED WITH VARIOUS FACTORS.

Graph Ref.	X Axis	Y Axis	Corr R	Std Error	Graphical Characteristics	Inference.
4/9	Final cost FC	Total Delay Time DT	.1954	.3797	Scattered across the graph	No significant relationship.
4/10	"	Payment Delay Time DP	.1862	.3014	ditto	"
4/11	"	Variation Delay Time DVT	.1082	.0781	ditto	"
4/12	"	Other Delay Time DO	.0310	.0855	ditto	"
4/13	"	Final Time Ft	.1244	.3687	ditto	"
4/14	"	Cost Performance CP	.1515	.2373	ditto	"
4/15	"	Time Performance TP	.0937	7.817	ditto	" (large error - shows likely unreliability in Time components.

FINAL COST CORRELATED WITH VARIOUS FACTORS

Graph Ref.	X Axis	Y Axis	Corr R	Std Error	Graphical Statistics	Inference
4/16	Final cost FC	Final cost Intensity FCI	.4163	855.069	Scattered top and bottom of graph	Though significant, no clear relationship is established
4/17	"	Initial Cost Intensity	.2621	4806.473	Very shallow shape	Error is too large. No relationship can be assumed.
4/17a	"	Relative Cost Intensity RCI	-.0023	.2480	Scattered and no relation-	Error is small but no defined relationship.
4/18	"	Variation V	.4204	31.490	Shallow shape	No relationship can be assumed. Error is also large
4/19	"	Fluctuation FL	.8070	64.419	Shows defined character	As Fluctuation cost increases, Final cost also increases.

VARIATION (V) CORRELATED WITH OTHER FACTORS.

Graph Ref.	X Axis	Y Axis	Corr. R	Std. Error	Graphical Characteristics	Inference.
4/20	Variation V	Fluctuation Cost FL	.1934	107.014	Shallow shape	No significant relationship, large errors.
4/21	"	Final Cost FC	.4204	213.353	Not defined	Although there is a significant relationship, character is not defined unreliable because of error.
4/22	"	Final Time	.1109	.3693	ditto	No significant relationship
4/23	"	Initial Time	.0795	.043	ditto	ditto
4/24	"	Payment Delay Time Dp	-.1341	.304	ditto	ditto
4/25	"	Variation Delay time DVT	-.080	.078	ditto	ditto

VARIATION (V) CORRELATED WITH OTHER FACTORS .4.10

Graph Ref	X Axis	Y Axis	Corr R	Std Error	Graphical characteristics	Inference
4/26	Variation Cost V	(Do) Other Delay	-.0631	.0854	Not defined	No significant Relationship
4/27	"	Cost Performance (TP)	-.1034	.2388	" "	"
4/28	"	Time Performance (TP)	-.1109	3.518	" "	" Large errors
4/29	"	Final Cost Intensity F_{CI}	.2674*	906.162	" "	Significant but large errors.
4/30	"	Initial Cost Intensity I_{CI}	.2594*	1663.441	" "	Ditto
4/31	"	Relative cost Intensity R_{CI}	.1268	.2448	" "	Not Reliable
4/32	"	Variation Fluctuation V_{CF}	.4623*	107.014	" "	" "

FLUCTUATION COST CORRELATED WITH OTHER FACTORS

4.11

Graph Ref	XAxis	YAxis	CorrR	Std Error	Graphical Character	Inference.
4/33	Fluctuation cost FL	Payment Delay DP	.5950*	.247	Scattered top & bottom of graph	Significant Defined
4/34	"	Variation Delay Time DVT	.363*	.073	Shallow slope	Significant Not well defined.
4/35	"	Other Delays (DO)	.269*	.073	"	"
4/36	"	Initial Cost (Ic)	.5109*	123.24	Not defined	Large errors
4/37	"	Variation & Fluctuation Cost (VcFc)	.9573*	34.05	Defined straight line	"
4/38	"	~~Fund~~ Final cost Intensity FcI	.0314	139.956	Not Defined	"
4/39	Fluctuation Cost FL	Initial Cost Intensity (ICI)	.4030*	1576.39	Not Defined	Large errors & significant
4/40	"	Relative Cost Intensity RcI	.0633	703.85	"	"

COST INTENSITY (COST/TIME) COMPONENTS

DESCRIPTION	INITIAL COST INTENSITY ICI	FINAL COST INTENSITY FCI	RELATIVE COST INTENSITY RCI
Obs No	240	240	240
Minimum	908.33	302.63	.10
Maximum	9920.00	5127.50	1.19
Mean	3503.83	1387.41	.42
S.E. Mean	110.95	60.58	.016
Range	9011.67	4824.97	1.09
Sum	840,919.42	331,537.68	100.77
Skewness	1.19	1.37	1.33
S. E. Skew	.16	.16	.16
Kurtosis	1.61	1.42	1.25
S. E. Kurtosis	.31	.31	.31
Variance	2,954,282.08	880,684.09	.061
Std. Dev	1,718.80	983.45	.246

CORRELATION CO-EFFICIENTS

COST PERFORMANCE IN (X Axis) (Final Cost) / Initial Cost

SUBJECT MATTER in Y AXIS	Corr R	R^2	Error	Slope	Intcp	Sig
Initial Time It	-.052	.003	.043	.009	.147	.211
Total Delay Dt	.830*	.689	.216	1.339	-1.702	.000
Payment Delay Dp	.776*	.603	.193	.992	-1.299	.000
Variation Delay DVT	.512	.262	.068	.167	-.187	.000
Other Delay Do	.499*	.249	.074	.178	-.216	.000
Final Time Ft	.737*	.543	.251	1.141	-1.257	.000
Time Performance Tp	.639*	.409	2.722	9.425	-10.342	.000
Final Cost Intensity FCI	.412*	.170	856.86	-1614.010	4120.678	.000
Initial Cost Intensity ICI	-.132	.017	1707.33	-947.242	5111.478	.020
Relative Cost Intensity RCI	-.429*	.184	.223	-.444	1.167	.000

CORRELATION CO-EFFICIENT

$\frac{\text{(FINAL TIME)}}{\text{INITIAL TIME}}$ TIME PERFORMANCE

T.4.14

SUBJECT MATTER in Y Axis (n=240)	TIME PERFORMANCE (in X AXIS) n = 240					
	CorrR	R^2	Error	Slope	Intcp	Sign
Initial Time Ic	.340*	.155	.041	-.0019	.142	.000
Total Delay D_t	.366*	.134	.360	.018	.460	.0000
Payment Delay Dp	.321*	.103	.291	.0125	.308	.0000
Variation Delay DVT	.306	.094	.075	.0031	.078	.0000
Other Delay Do	.221	.049	.083	.0024	.071	.00029
Final Time Ft	.384*	.147	.343	.0182	.568	.0000
Final Cost Intensity FCI	-.278	.077	903.28	-33.327	1584.836	.00001
Cost Performance CP	.284*	.081	.230	.0087	1.6442	.0000
Initial Cost Intensity ICI	.872*	.760	2441.53	552.897	427.920	.0000
Relative Cost Intensity	-.440*	.193	.223	-.0139	.502	.0000

T.4.15

CORRELATION CO-EFFICIENTS

SUBJECT MATTER in Y Axis is (n = 240)	RELATIVE COST INTENSITY(RCJ) in X axis, n = 240					
	Corr R	R^2	Error	Slope	Intercept	Signifi-cants
Initial Time It	.516*	.266	.038	.092	.092	.0000
Total Delay Time Dt	.632*	.399	.300	-.987	.982	.0000
Payment Delay Dp	-.510*	.260	.264	-.631	.648	.0000
Variation Delay DVT	-.558*	.311	.065	.177	.171	.0000
Other Delay Do	-.447*	.200	.077	-.154	.150	.0000
Final Time	-.685*	.469	.271	-1.027	1.107	.0000

/ Indicates significant.

CORRELATION CO-EFFICIENTS T.4.16

TIME VARIABLES IN Y AXIS	EFFICIENCY VARIABLES IN X AXIS			
	RELATIVE COST INTENSITY (RCI)	FINAL COST INTENSITY (FCI)	INITIAL COST (ICI)	COST PERFORMANCE CP
Initial Time	.516*	-.027	-.023	-.052
Final Time	-.685*	-.497*	-.147	.737*
Total Delay	-.632*	.535*	-.032	.830*
Payment Delay	-.510*	.497*	-.071	.776*
Variation Delay	-.558*	.506*	-.048	.512*
Other Delay	-.447*	-.410*	.065	.497*

* Indicates Significant

@* Indicates significant

Literature reviews suggested that both the initial contract cost and initial contract time are generally unreliable due to organisational problems, the execution of variation, delayed payment, climatic factors, mode of contractor selection, shortages of resources, geographical location, the size, shape and height of construction. It also suggested that variation and fluctuation are inevitable due to changes in tastes, policies, technical factors and the unstable international market. Previous studies on time-cost relationships suggested that good regression equations can be exhibited when cost and time parameters are plotted graphically. Also, they pointed out that the sector, contract type and building type are significant variables in determining construction time.

From the pilot studies, it was found out (a) that bungalow units situated in the Northern part of Nigeria formed a suitable study sample, (b) the time-cost studies displayed a bias towards a simple regressional analysis. A suitable questionnaire for the main study was formed based on the past experiences of other researchers and the lessons drawn from the pilot surveys. The questionnaire was structured to obtain information for the main research on the following:- area of building, final cost, Initial cost, variation, fluctuation, delays due to: (payment, execution of variation and other factors), year of commencement, year of completion, initial contract time, final contract time. The theme of the hypothesis was "fluctuation cost (which contributes significantly more than variation cost in the initial contract cost) increased significantly as the delay in payment was significantly increased. To significantly curtail fluctuation

cost, the following have to be significantly curtailed, (i) delay time due to non-payment, (ii) Time Performance, (iii) Cost Performance and (iv) Cost Intensity". The above hypothesis was proved to be correct.

5.2 CONCLUSION

It could be inferred from the foregoing analysis in chapter 4, that the following statistical facts have been established:

(A) Initial cost (Ic) has no significant relationship with:- Initial time, final time, total delay time, payment delay time, variation delay time and other delay times.

(B) Variation cost has no significant relationship with Initial Time, Final Time, Total Delay Time, Payment Delay Time, Variation Delay Time and Other delay Time.

(C) (1) Fluctuation cost has no significant relationship with Initial Time.

(2) Fluctuation cost has significant relationship with Final Time, Total Delay Time, Payment Delay Time, Variation Delay Time and other delay time.

(3) Considering the components of delays, Payment Delay Time Dp has the strongest relationship with fluctuation cost than DVT and Do each have with Fluctuation cost.

(4) Total Delay Time has a stronger relationship with Fluctuation Cost (.623) than Final Time has with fluctuation cost (0.492).

(D) (1) Total increase in Initial Contract cost i.e. (Variation + fluctuation) cost has no significant relationship with Initial time, and Other Delay Time.

(2) Total Increase in initial contract cost had significant relationship with final time, total delay time, payment delay time and variation delay time. It should be noted however that as was shown in B above, variation cost also has significant relationship with any of the time components.

(E) (1) Cost performance (Final Cost/Initial cost) had no signifi cant relationship with Initial Time.

(2) Cost Performance had significant relationships with the following:- Final Time, Total Delay Time, Payment Delay Time, Variation Delay Time and other delays.

(3) Examining the delay time components, Payment Delay Time (.776) Co-efficient was greater than Variation Delay Time co-efficient (.512) as well as other Delay Co-efficient (.497) in relationship with Cost Performance.

(F) (1) As the Final Time significantly increased, the fluctuation cost also significantly increased.

(2) As the Total Delay Time significantly increased, the fluctuation cost also significantly increased.

(G) (1) As the years increased (1975-1985), the fluctuation cost significantly increased (.99).

(2) As the years increased (1975-1985), the years increased (1975-1985) the Total Delay Time significantly increased (.867).

(3) As the total delay Time significantly increased, the fluctuation cost significantly increased.

5.3 RECOMMENDATIONS

The following are recommendations focusing on data, planning, research, design, execution, and policy.

Data

Project information should be collected on all public housing projects and the vital information to be assembled are areas, height, type, initial cost, variation, fluctuation initial time, final time and analysis of delays. It should be mandatory on all projects managers and consultants engaged on public housing projects to supply such related information to a central or national data bank. Other information to be supplied are details of cost and characteristics of labour, materials, plant overhead, profit, and productivity times.

These type of data would help in the formulation of national price indices. This recommendation is evidenced by the discussions held on the subject of Research Methodology which portrayed the difficulties encountered in this study. The problems encountered centred on the non-availability of data on construction resources and the general unwillingness of executors of projects to release such information.

Planning

With the available statistical information as suggested above, it could be possible to:- (a) properly plan the

financing of a project, (b) select contractors on the basis of accuracy of their initial cost and initial time, (c) forecast the likely final cost and final time, (d) relate the available and not the anticipated financial resources to the actual number of housing stock that can be constructed at a given time,

Research

It is strongly suggested that similar researches be undertaken into various housing projects in Nigeria. The study of time-cost relationships on housing projects should be carried out on some on-going, past, and future projects. More detailed studies can be made on relationships between, (a) the frequency of payment and the progress of the work, (b) time and labour utilisation, (c) time and material utilisation, (d) time and plant utilisation, (e) time and profit.

The framework of this research thesis was evolved by studying the various published works of different countries: The United Kingdom, the United States of America, Sweden, Singapore, Australia and New Zealand. It is therefore of essence that suitable links be maintained with appropriate overseas institutions to compare research findings, co-ordinate researches and possibly obtain technical and financial assistance on the subject of time-cost relationships of housing projects.

Design

It may be necessary to review the design of the three and four bedroom types of housing units used as a subject of research in this thesis. It can be done by reducing the floor area because it was shown that cost increased as areas increased.

As it was established in this study that the variation delay time had significant relationship with the Final Cost, it is expedient to minimise the volume of variation by satisfactorily completing pre-tender documents.

Execution

If at any time it becomes expedient that some housing projects must be completed within a given period and it later became obvious that the client was not in a position to effect timely payment, the following steps could be taken:-

(a) arrange for contractor - financed contract

(b) seek local, foreign or international assistance;

(c) authorise the contractor to borrow money from the bank with an understanding that the client would pay later including bank charges and interest.

As the analysis showed that delays due to other factors (like climatic and administrative) had significant relationship with the Final Cost, it becomes imperative that efforts should be made towards (a) minimising the degree of public "red-tape", and (b) ensuring that construction is planned to coincide with the period of good weather.

Policy

The policy of erecting residential buildings for the Nigerian Public Service may be reviewed in the light of escalating cost of construction and the proven inability of the government to honour payments when due.

The options left to the government may be:-

(a) provide basic superstructure of the houses for the servants and request them to complete them at their own expense.

(b) enter into association with housing societies to construct such houses for the public servants.

It should be noted that fluctuation cost as defined by the JCT does not include adjustments for the rise and fall of a contractor's profit-margin as well as cost of finance which may be affected as the initial time is significantly prolonged because of significant delays in payment. It is therefore equitable that serious dialogue be entered into between the client and contractor to arrive at a fair means of compensations for the losses in finance cost and profit. A contractor who is principally in business to make profit and whose profit level is drastically reduced may take any of the following steps, (a) reduce the quality of the work, (b) abandon the project at any stage, (c) pay low wages and possibly, cause disruptions in the industrial relations system, and (d) frustrate the contract.

5.4 IMPLEMENTATION

The research findings in this thesis should be passed on to (a) the general public by way of mimeographs and publications, (b) Tender Boards, (c) professional institutions, (d) individuals responsible for the award of contracts, and the administration of housing project and, (e) the research institutions.

Policy makers should be instructed to abide by the policy of work flow equals cash flow and not to overstretch the government unduly.

Professional advisers like Quantity Surveyors should be more scientific in their analysis of tenders. On receiving tenders based on open competition, all the vital information should be extracted from each contractor's bill of quantities e.g. Floor Area, Initial Time, Initial Cost. All the inputs should be fed into the computers. The computer would be able to compare the Initial Time and Initial Cost with statistical packages of past project information and be able to recommend which would likely satisfy the general requirements. The formulation of such statistical packages should be encouraged. Such statistical packages would be able to provide early warning signs of the Final Time, Delays due to payments, Delays due to variation, Delays due to other factors, Final Cost, Variation Cost and Fluctuation. With the above information, the client would be better advised on how to phase out the construction programme. Special training programme on such procedures should be devised for practicing quantity surveyors and undergraduates.

The study of time-cost relationships of construction resources has to start from the school. School curriculae should emphasise on that study. Also, books on building and construction economics have to devote more spaces for that topic. Having received adequate institutional training on the topic, graduands would be well equipped to enforce its mode of operation in the field.

The funding of studies into time-cost relationships could be assisted by the Nigerian government, private establishments and external bodies like the World Bank such studies shall be of immense national and international interest.

Government organisations in particular should be informed through seminars of the need to adopt effective strategies for housing programmes. They should be educated on the need to plan housing construction works strictly in relation to the available but not anticipated revenues and to relate allocated project cost to both the time of execution as well as the time for the generation of the revenue.

Effort should be made towards designing residential buildings within given cost and time limits. Statistical modelling strategies incorporating due consideration to time and cost should be encouraged.

At the policy levels, there is a need to phase out the old planning systems of arbitrarily allocating money for public

housing construction. In its place should be replaced, some workable statistical models that would consider the following parameters simultaneously:- the Gross National Product (GNP), the present and past revenue trends, the population for housing stock, the anticipated allocation for public housing sector, labour and materials resources, final cost/m^2 of previous project cost, final and Initial times of construction. Scientific basis would thus be established for taking sound management decisions.

5.5 SUGGESTIONS FOR FURTHER WORK

(1) It is essential to re-examine this study using the same type of public bungalow buildings to cover a period of 1986 to 1992 in order to find out whether there have been significant departures from the period (1975-1985) which was the time of study for this work. The period 1986-1992 is relevant in that it covered the time that the Naira was first devalued

(2) Similar studies of private sector housing in Nigeria should be studied in order to know the trends existing in that sector.

(3) Comparative cost-time studies of both the public and private housing construction could be undertaken to find out the strength and weaknesses in the planning and management in each sector.

(4) Cost-time studies are needed also on the construction of other types of buildings e.g: (a) two storey residential buildings, (b) three and four storey office blocks, (c) hospital blocks, (d) school blocks and, (e) "low cost" housing schemes. The studies may provide some explanations to the results obtained in this study.

(5) Attempts should be made to study the relationships existing between (a) Final Labour Cost and Final Labour Time (b) Final Labour Cost and Final Construction Time of building projects. This is because, labour has now become a significant construction resource. It is also a resource which is both difficult to manipulate and to estimate.

(6) The profit margin of contractors are not compensated on building construction projects. There is a need to study the following:- (a) volume of loss on profit due to prolongation of contracts (b) the effect that the loss in profit of contractors had on the abandonment of projects (c) the effect that the loss in profit of contractors had in the prolongation of a project. The results may provide guidelines for future reviews of the conditions of contract and may assist in evolving appropriate clauses in the JCT that would adequately compensate contractors.

(7) Building and Civil Engineering operations have close associations in the construction sector. There is a need to carry out comparative time-cost studies in order to

find out ways of improving planning and management in appropriate cases, particularly when the two activities are carried out simultaneously on common sites.

(8) At a national level, it is necessary to develop suitable cost-time models that would simultaneously take into consideration, the following parameters:- (i) derived revenue (ii) anticipated revenue, (iii) Gross National and Gross Domestic Products (iv) previous allocation to housing sector, (v) previous allocation to the housing sector, (vi) population to be served, (vii) occupants, (viii) past final and initial construction cost trends, (ix) past final and initial construction time trends.

(9) It was pointed out in the literature review that the retention money which is always paid at the practical completion of a contract is detrimental to a contractor's performance. Research should therefore be undertaken to study the effect of "retention" on the speed of construction.

(10) Work study techniques should also be used in studying time-cost relationships on housing construction sites since the studies based on past project records may not provide some vital information like labour productivity and lapses in management.

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dc	DELAY BREAK DOWN PAYMENT TIME (WKS) dp	DELAY BREAK DOWN VAR. TIME (WKS) dvt	DELAY BREAK DOWN OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
031	125	43,125	02,911	20,269	066,305	048	20	028	015	008	005	78	78
032	125	41,875	02,931	18,844	063,650	060	16	044	029	009	006	78	79
033	125	40,000	03,500	22,400	065,900	078	15	063	053	011	001	78	80
034	130	44,200	03,315	53,040	100,555	195	25	170	119	034	017	78	82
035	130	49,400	04,446	54,340	108,186	210	30	180	162	010	008	79	82
036	130	50,050	05,756	32,533	088,339	140	28	112	085	024	003	79	81
037	130	48,880	04,766	53,768	107,414	225	15	210	178	021	011	79	83
038	130	28,600	01,859	34,606	065,065	215	16	199	159	011	029	76	81
039	130	33,600	04,368	13,104	051,072	063	14	049	031	013	005	76	77
040	140	34,300	03,430	21,609	059,339	085	20	65	045	010	010	76	78

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dc	DELAY BREAK DOWN PAYMENT TIME (WKS) dp	DELAY BREAK DOWN VAR. TIME (WKS) dvt	DELAY BREAK DOWN OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
041	140	62,720	09,408	24,461	096,589	064	25	39	017	014	008	80	81
042	140	58,100	06,101	26,145	090,346	077	18	59	032	018	009	80	81
043	140	59,500	08,628	37,485	105,613	081	15	66	049	013	004	80	82
044	140	60,200	07,224	28,294	095,718	060	20	40	024	011	005	80	81
045	120	55,320	05,532	21,022	081,874	058	12	46	035	010	001	81	82
046	120	57,600	05,472	34,560	097,632	056	14	42	031	005	006	81	82
047	120	58,800	05,145	27,636	091,581	078	20	58	041	009	008	81	82
048	120	59,400	05,198	35,640	100,238	125	30	95	066	014	015	81	83
049	125	70,000	06,300	32,200	108,500	084	33	51	033	006	012	83	84
050	125	69,125	10,369	39,401	118,895	125	35	90	040	032	018	83	85

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dt	DELAY BREAK DOWN PAYMENT TIME (WKS) dp	DELAY BREAK DOWN VAR. TIME (WKS) dvt	DELAY BREAK DOWN OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
051	125	73,750	07,375	36,875	118,000	116	20	96	063	020	013	83	85
052	125	74,375	09,297	49,831	133,503	140	20	120	072	036	012	83	85
053	130	58,500	8,483	30,420	097,403	110	15	095	061	021	93	81	83
054	130	58,500	10,238	26,325	095,063	052	15	037	025	006	006	81	82
055	130	78,650	14,157	33,820	126,627	061	16	045	032	005	008	84	85
056	130	81,900	13,104	31,941	126,945	041	16	025	014	004	007	84	84
057	140	92,400	11,550	23,100	127,050	062	20	042	026	010	006	85	85
058	140	93,800	12,194	39,396	145,390	067	20	047	020	009	018	85	85
059	140	96,600	11,109	42,504	150,213	60	25	035	029	005	001	85	85
060	153	85,680	10,282	62,546	158,508	136	22	114	095	005	014	83	85

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dt	DELAY BREAK DOWN PAYMENT TIME (WKS) dp	VAR. TIME (WKS) dvt	OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
061	153	87,975	11,877	76,538	176.390	144	25	119	006	004	009	83	85
062	153	88,893	9,778	41,780	140,451	142	26	116	006	005	005	83	84
063	153	90,270	9,478	35,205	134,953	091	23	068	055	003	010	83	84
064	150	82,650	12,398	31,407	126,455	035	23	012	58	003	004	83	83
065	150	77,250	9,077	19,313	105,640	040	21	019	012	003	004	82	82
066	150	78,000	9,750	61,620	149,370	176	20	156	112	029	015	82	85
067	150	81,000	13,770	74,520	169,290	170	15	155	124	018	013	82	85
068	150	77,850	12,456	73,958	164,264	185	25	160	120	032	008	82	85
069	150	69,235	8,334	55,560	133,344	150	18	132	085	020	027	81	84
070	145	93,235	12,121	37,294	142,650	43	23	020	012	004	04	84	85

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dt	DELAY BREAK DOWN: PAYMANT TIME (WKS) dp	DELAY BREAK DOWN: VAR. TIME (WKS) dvt	DELAY BREAK DOWN: OTHER do	YEAR: INITIAL Iy	YEAR: FINAL Fy
071	145	91,640	12,371	41,238	145,249	63	21	042	023	009	010	84	85
072	145	89,175	13,822	30,320	133,317	36	25	011	007	001	003	84	84
073	145	96,135	15,382	38,454	149,971	41	30	011	007	002	002	85	85
074	145	99,470	9,947	28,846	138,263	35	30	005	002	002	001	85	85
075	152	32,680	4,575	21,242	058,497	129	22	107	076	012	019	76	78
076	152	33,440	3,678	22,739	059,857	116	15	101	079	011	011	76	78
077	152	33,440	5,016	19,395	057,851	110	16	094	076	005	013	76	78
078	152	33,440	6,019	13,042	052,501	96	18	078	060	007	011	76	77
079	152	37,240	4,841	16,013	058,094	084	22	062	039	018	005	76	77
080	143	36,465	5,834	19,326	061,625	86	24	062	036	025	001	77	79

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dt	DELAY BREAK DOWN PAYMENT TIME (WKS) dp	DELAY BREAK DOWN VAR. TIME (WKS) dvt	DELAY BREAK DOWN OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
081	143	35,750	3,933	13,585	053,268	074	24	050	032	009	009	77	78
082	143	35,750	4,469	31,450	061,669	109	19	090	054	022	014	77	79
083	135	25,650	2,565	23,855	052,070	144	20	124	100	016	008	76	79
084	135	25,650	3,527	14,621	43,798	100	20	080	060	008	012	76	78
085	135	25,650	1,924	21,290	048,864	122	21	101	073	012	016	76	79
086	135	27,000	3,275	19,980	050,355	117	16	101	080	012	009	76	79
087	130	28,600	2,789	15,730	047,119	106	15	091	060	013	018	76	78
088	130	27,950	2,935	25,155	056,040	150	14	136	088	030	018	76	79
089	130	28,600	2,288	34,320	065,208	168	17	151	096	042	013	76	80
090	135	31,050	2,018	19,562	052,630	086	16	070	050	014	006	77	79

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIMEQ (WKS) ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dt	DELAY PAYMENT TIME (WKS) dp	BREAK VAR. TIME (WKS) dvt	DOWN OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
091	135	40,500	3,038	19,845	063,383	074	15	059	047	009	003	77	78
092	135	43,200	2,484	19,008	064,692	075	12	63	42	12	9	78	79
093	135	37,800	2,268	25,326	065,394	060	10	50	31	10	9	78	80
094	135	37,125	3,156	12,251	052,532	041	11	30	18	3	9	78	79
095	135	54,000	5,670	22,140	081,810	063	40	23	19	5	-1	80	81
096	135	56,025	5,603	26,332	087,960	050	30	20	18	4	-2	80	81
097	140	58,800	3,969	22,344	085,113	049	25	24	17	4	3	80	80
098	140	56,700	8,789	28,350	093,839	051	20	31	24	8	-1	80	81
099	140	56,700	8,505	14,742	079,947	048	40	008	6	1	1	80	80
100	140	58,100	9,296	16,849	084,245	040	15	025	19	5	1	80	81

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dt	DELAY PAYMENT TIME (WKS) dp	BREAK VAR. TIME (WKS) dvt	DOWN OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
101	140	56,560	3,959	26,018	086,537	064	16	048	37	8	3	80	81
102	140	44,100	3,969	17,640	065,709	058	25	033	25	4	4	79	79
103	140	44,800	5,264	17,024	067,088	061	30	013	23	4	4	79	80
104	150	72,000	9,360	21,600	102,960	040	10	030	13	10	7	81	81
105	150	72,450	8,332	18,113	98,895	045	15	030	016	008	006	81	81
106	150	71,100	7,110	29,151	107,361	035	20	015	007	006	002	81	81
107	150	69,750	8,370	80,213	158,333	050	22	228	211	009	008	81	85
108	155	72,850	5,464	73,579	151,893	043	15	228	221	003	004	81	85
109	155	71,765	6,818	86,118	164,701	041	14	227	217	001	009	81	85
110	155	74,710	4,483	80,687	159,880	046	12	234	220	011	003	81	85

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dt	DELAY PAYMENT TIME (WKS) dp	BREAK VAR. TIME (WKS) dvt	DOWN OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
111	160	92,800	4,640	23,200	120,640	030	16	014	008	003	003	83	83
112	160	88,960	6,005	17,792	112,759	035	14	021	005	010	006	83	83
113	160	94,400	10,856	34,928	140,184	040	13	027	009	005	013	83	83
114	160	99,200	12,400	34,720	146,320	035	10	025	010	005	010	84	85
115	160	101,600	14,224	30,480	146,304	060	11	049	014	012	023	84	85
116	144	92,448	9,245	25,885	127,578	055	15	040	018	007	015	84	85
117	144	94,752	8,528	35,058	138,338	040	25	015	007	006	002	85	85
118	144	98,064	7,845	35,303	141,212	048	30	018	010	003	005	85	85
119	145	34,800	1,914	19,488	056,020	102	22	080	54	009	017	76	78
120	145	32,625	1,550	39,803	073,978	180	25	155	125	023	007	76	80

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dt	DELAY BREAK DOWN: PAYMENT TIME (WKS) dp	DELAY BREAK DOWN: VAR. TIME (WKS) dvt	DELAY BREAK DOWN: OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
121	145	29,725	2,304	32,103	064,132	163	20	143	112	025	005	76	80
122	145	32,625	2,121	40,781	075,527	210	15	185	156	029	010	76	81
123	145	40,600	2,233	49,126	091,959	171	18	153	114	031	008	77	81
124	140	42,280	3,171	32,556	078,007	150	10	140	092	042	006	78	81
125	140	44,100	7,056	3,308	045,464	120	15	105	094	006	005	78	80
126	140	50,400	5,040	24,192	079,632	054	16	038	027	006	005	79	80
127	140	61,600	7,084	21,560	090,244	087	18	069	044	012	013	79	80
128	140	57,680	5,047	21,918	084,645	046	20	026	020	003	003	79	79
129	140	58,800	4,116	23,520	086,436	035	25	018	015	002	001	79	79
130	135	48,600	4,374	19,926	072,900	040	30	010	008	001	001	79	79

									DELAY	BREAK	DOWN		
PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) Ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dt	PAYMENT TIME (WKS) dp	VAR. TIME (WKS) dvt	OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
131	135	49,275	08,377	21,681	079,333	048	32	016	012	003	001	79	79
132	135	51,705	07,756	25,335	084,796	055	20	035	028	004	003	79	80
133	135	52,650	08,424	20,534	081,608	065	18	47	42	004	001	79	80
134	165	84,975	05,523	45,887	136,385	145	15	130	118	006	006	82	84
135	165	84,975	06,798	75,628	167,401	185	10	175	136	027	012	82	85
136	165	88,275	08,165	77,682	174,122	162	12	150	127	016	007	82	84
137	165	88,275	11,917	50,317	150,509	141	13	128	104	005	019	82	84
138	160	87,200	08,720	68,888	164,808	189	11	179	124	008	047	82	85
139	160	93,600	14,040	70,200	177,840	191	10	181	125	013	034	82	85
140	160	90,400	12,656	85,880	188,936	160	18	142	108	024	010	82	85

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dt	DELAY PAYMENT TIME (WKS) dp	BREAK VAR. TIME (WKS) dvt	DOWN OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
141	160	86,400	10,368	61,344	158112	115	17	098	076	009	013	82	84
142	150	84,000	10,500	42,840	137,340	151	19	132	85	036	011	83	85
143	150	86,250	06,469	34,500	127,219	072	12	060	048	009	003	83	84
144	150	87,000	07,613	54,810	149,423	119	10	109	086	022	003	83	85
145	150	87,600	09,855	42,048	139,503	126	15	111	076	022	013	83	84
146	150	88,650	05,762	48,758	143,170	148	20	128	084	030	014	83	85
147	150	86,250	04,959	55,200	146,409	140	18	122	092	0013	017	83	85
148	150	87,000	07,395	23,490	117,885	135	15	120	109	003	008	83	84
149	120	27,000	04,860	11,610	043,470	44	14	030	024	003	003	76	77
150	120	27,000	04,523	17,820	049,343	150	10	140	105	021	014	76	79

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dt	DELAY PAYMENT TIME (WKS) dp	BREAK VAR. TIME (WKS) dvt	DOWN OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
151	120	29,400	03,381	23,814	056,595	120	20	100	170	020	009	76	79
152	120	29,760	03,199	38,688	071,647	220	15	205	147	021	037	76	81
153	120	38,400	02,880	31,104	072,384	125	15	110	071	018	021	78	80
154	125	35,000	02,450	15,400	052,850	70	12	58	034	017	007	77	78
155	125	34,100	05,797	27,962	067,859	160	10	150	094	034	022	76	79
156	125	32,500	04,875	14,300	051,675	62	12	50	040	005	005	76	77
157	125	27,250	03,951	20,983	052,184	170	30	140	103	012	025	76	79
158	125	38,500	03,850	31,185	073,535	155	25	130	084	001	045	78	81
159	125	38,750	04,650	18,600	062,000	58	20	038	034	001	003	78	79
160	130	26,780	03,481	10,712	040,973	40	15	025	020	003	002	77	78

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dt	DELAY PAYMENT TIME (WKS) dp	BREAK VAR. TIME (WKS) dvt	DOWN OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
161	130	28,600	04,290	10,010	042,900	45	16	029	015	006	008	77	77
162	130	27,950	03,913	6,988	038,851	48	14	034	027	004	003	77	78
163	130	35,750	03,575	27,170	066,495	140	15	125	103	013	009	76	79
164	130	29,250	03,218	35,978	068,446	180	12	168	159	001	008	76	80
165	163	40,261	03,825	17,312	061,398	54	12	042	23	010	009	76	77
166	163	41,239	03,093	15,671	060,003	47	15	032	014	005	013	77	78
167	163	41,239	02,784	16,908	060,931	50	18	032	022	006	004	77	78
168	150	54,750	02,745	16,470	064,965	49	20	029	011	006	012	78	79
169	150	47,400	05,214	26,070	078,684	55	15	040	020	006	014	79	81
170	150	47,850	04,187	19,619	071,656	40	10	030	019	005	006	79	80

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) Ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dt	DELAY PAYMENT TIME (WKS) dp	BREAK VAR. TIME (WKS) dvt	DOWN OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
171	147	59,976	03,299	29,388	092,663	014	12	029	011	009	009	79	80
172	147	61,152	03,669	26,295	091,116	046	10	036	023	011	002	80	81
173	147	64,680	04,851	39,455	108,986	048	14	034	024	007	003	80	82
174	145	60,900	05,177	28,623	094,700	045	12	033	021	006	006	79	80
175	145	60,175	04,212	36,707	101,094	042	10	032	017	008	007	79	81
176	143	61,204	05,508	26,930	093,642	040	11	029	012	008	009	80	81
177	143	61,204	09,181	35,498	105,883	031	15	016	008	005	003	79	80
178	143	62,205	11,197	23,016	096,418	040	20	020	010	004	006	79	80
179	143	62,205	09,953	29,858	102,016	041	22	019	009	006	04	80	81
180	128	54,400	04,624	37,536	096,560	121	25	096	057	024	015	80	82

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) ft	DELAY BREAK DOWN: INITIAL TIME (WKS) It	DELAY TIME (WKS) Dt	PAYMENT TIME (WKS) dp	VAR. TIME (WKS) dvt	OTHER do	YEAR: INITIAL Iy	YEAR: FINAL Fy
181	128	54,400	04,080	40,256	098,736	115	20	095	006	011	014	80	82
182	128	53,760	08,602	37,094	099,456	120	15	105	068	021	0016	80	82
183	135	56,700	08,222	16,443	081,365	041	14	027	017	006	004	80	80
184	135	82,350	12,353	39,528	134,231	063	16	047	027	016	004	84	84
185	135	86,400	11,232	31,968	129,600	054	17	37	017	015	005	84	84
186	135	85,725	09,430	34,290	129,445	202	20	182	131	036	015	84	85
187	135	74,250	07,425	70,538	152,213	160	15	145	098	022	025	82	85
188	123	66,789	05,343	58,774	130,906	180	17	163	094	041	028	82	85
189	123	67,527	06,415	39,166	113,108	115	18	097	053	020	024	82	84
190	123	81,180	13,395	28,413	122,988	120	19	101	059	019	023	85	85

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VAIRATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dt	DELAY BREAK DOWN PAYMENT TIME (WKS) dp	DELAY BREAK DOWN VAR. TIME (WKS) dvt	DELAY BREAK DOWN OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
191	123	81,795	11,451	40,898	134,144	041	25	016	010	003	003	85	85
192	118	76,818	11,523	35,873	125,214	45	20	025	016	005	004	85	85
193	118	65,018	07,802	47,463	120,283	113	13	090	078	007	005	83	85
194	118	70,210	08,074	49,147	127,431	108	14	094	067	012	015	83	85
195	148	36,260	01,813	10,878	048,951	047	12	035	016	009	010	76	76
196	148	36,260	05,983	11,966	054,209	055	15	040	020	008	012	76	76
197	148	35,520	6,038	9,235	050,793	050	10	040	026	010	04	76	76
198	160	38,400	05,376	22,656	066,432	070	12	058	031	021	006	76	77
199	155	39,525	04,743	33,992	078,260	066	16	050	022	14	014	77	80
200	155	39,525	04,941	19,367	063,833	075	25	050	020	005	025	77	78

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dt	DELAY PAYMENT TIME (WKS) dp	BREAK VAR. TIME (WKS) dvt	DOWN OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
201	155	35,650	04,813	19,251	059,714	090	15	075	045	019	011	76	78
202	160	36,000	04,680	15,840	056,520	085	20	065	045	011	009	76	7
203	160	36,000	05,040	22,680	063,720	150	16	134	107	007	020	77	80
204	160	36,000	03,960	18,360	058,320	142	12	130	078	020	032	77	80
205	160	52,000	05720	34,840	092,560	135	13	122	085	016	021	78	80
206	145	45,675	06,851	42,021	094,547	130	22	108	070	018	020	77	80
207	145	41,325	07,025	37,606	085,956	140	14	126	044	032	050	77	80
208	145	37,700	05,467	26,767	069,934	120	18	102	025	020	057	77	79
209	145	42,775	04,278	19,677	066,730	049	23	026	010	008	008	77	77
210	150	76,800	09,216	30,720	116,736	086	20	066	043	019	004	82	83

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) Ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dt	DELAY PAYMENT TIME (WKS) dp	BREAK VAR. TIME (WKS) dvt	DOWN OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
211	140	72,800	10,192	44,408	127,400	130	23	107	074	022	011	82	84
212	140	72,800	09,828	40,040	122,668	130	24	106	064	030	012	82	84
213	150	74,250	11,138	34,898	120,286	086	18	068	037	018	013	81	84
214	150	74,250	12,623	63,113	149,986	148	15	133	093	016	024	81	84
215	150	74,250	08,168	46,778	129,196	142	14	128	075	028	025	81	83
216	155	71,145	10,672	36,995	118,812	138	13	125	087	025	013	81	83
217	155	71,145	08,537	50,513	130,195	101	12	089	064	009	006	81	82
218	155	71,145	08,893	34,150	114,188	070	16	054	019	011	004	81	82
219	135	38,475	04,521	16,160	059,156	080	25	055	035	003	017	78	79
220	150	75,750	10,605	40,905	127,260	114	19	95	060	024	011	82	84

PROJ NO	FLOOR AREA (M) Fa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dt	DELAY PAYMENT TIME (WKS) dp	BREAK VAR. TIME (WKS) dvt	DOWN OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
221	150	73,500	08,269	53,655	135,424	108	21	087	052	030	005	81	83
222	155	74,400	09,672	48,360	132,432	136	24	112	066	033	013	81	83
223	155	74,400	05,580	44,640	124,620	143	25	118	085	021	012	81	83
224	155	74,400	07,068	44,640	126,108	114	30	084	067	009	008	81	83
225	155	75,175	07,518	43,602	126,295	124	22	102	091	006	005	81	83
226	145	65,250	05,709	41,760	112,719	115	16	099	058	031	010	80	82
227	145	63,075	10,092	44,153	117,320	070	14	066	038	007	021	80	82
228	145	64,525	11,292	28,391	104,208	053	20	033	014	012	007	80	81
229	145	61,770	09,266	18,531	089,567	040	30	010	004	004	002	80	80
230	140	44,100	04,851	16,758	065,709	045	23	022	015	004	003	77	77

PROJ NO	FLOOR AREA (M) Pa	INITIAL COST (N) Ic	VARIATION COST (N) Vc	FLUCTUATION COST (N) fL	FINAL COST (N) Fc	FINAL TIME (WKS) Ft	INITIAL TIME (WKS) It	DELAY TIME (WKS) Dt	DELAY PAYMENT TIMEE (WKS) dp	BREAK VAR. TIME (WKS) dvt	DOWN OTHER do	YEAR INITIAL Iy	YEAR FINAL Fy
231	140	41,300	04,130	27,258	072,688	060	21	039	029	006	004	77	78
232	140	40,040	06,406	19,620	066,066	042	16	026	018	005	003	77	77
233	140	38,500	05,390	12,705	056,595	045	19	026	016	003	007	77	78
234	135	65,475	05,565	19,643	090,683	024	20	004	002	001	001	81	81
235	135	65,475	07,693	16,369	089,537	038	25	013	010	002	001	81	81
236	135	65,475	08,348	32,738	106,561	070	15	055	033	011	011	81	82
237	135	69,525	12,167	20,858	102,550	020	15	005	003	001	001	82	82
238	140	72,100	04,687	24,514	101,301	031	14	017	010	004	003	82	83
239	140	72,800	02,548	56,784	132,132	180	16	164	114	027	013	82	85
240	140	72,800	06,188	50,960	129,948	172	20	152	080	048	024	82	85

APPENDIX

The following tables AT/1-AT/5 are Cost and Time compoents divided by the floor area. Refer to the raw Dat in the main research. The treated date in AT/1to AT/5 were what was used in tre analysis contained in the main research and also for those in the appendix.

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NO	I	V	FL	FC	FT	IT
52	595.00	74.38	398.65	1068.02	1.12	.16
53	450.00	65.25	234.00	749.25	.85	.12
54	450.00	78.75	202.50	731.25	.40	.12
55	605.00	108.90	260.15	974.05	.47	.12
56	630.00	100.80	245.70	976.50	.32	.12
57	660.00	82.50	165.00	907.50	.44	.14
58	670.00	87.10	281.40	1038.50	.48	.14
59	690.00	79.35	303.60	1072.95	.43	.12
60	560.00	67.20	405.80	1036.00	.89	.14
61	575.00	77.63	500.25	1152.85	.94	.16
62	581.00	63.91	273.07	917.98	.93	.17
63	590.00	61.95	230.10	882.05	.59	.15
64	551.00	52.65	209.38	843.03	.23	.15
65	515.00	60.51	128.75	704.27	.27	.14
66	520.00	65.00	410.80	995.80	1.17	.13
67	540.00	91.80	496.80	1128.60	1.13	.10
68	519.00	83.04	493.05	1095.09	1.23	.17
69	465.00	55.56	370.40	888.96	1.00	.12
70	643.00	83.59	257.20	983.79	.30	.16
71	632.00	85.32	284.40	1001.72	.43	.14
72	615.00	95.32	209.10	919.43	.25	.17
73	663.00	106.08	265.20	1034.28	.28	.21
74	686.00	68.60	198.94	953.54	.24	.21
75	215.00	30.10	139.75	384.85	.85	.14
76	220.00	24.20	149.60	393.80	.76	.10
77	220.00	33.00	127.60	380.60	.72	.11
78	220.00	39.60	85.80	345.40	.63	.12
79	245.00	31.85	105.35	382.20	.55	.14
80	255.00	40.80	135.15	430.94	.60	.17
81	250.00	27.50	95.00	372.50	.52	.17
82	250.00	31.25	150.00	431.25	.76	.13
83	190.00	19.00	176.70	385.70	1.07	.15
84	190.00	26.13	108.30	324.43	.74	.15
85	190.00	14.25	157.70	361.96	.90	.16
86	200.00	25.00	148.00	373.00	.87	.12
87	220.00	21.45	121.00	362.45	.82	.12
88	215.00	22.58	193.50	431.08	1.15	.11
89	220.00	17.60	264.00	501.60	1.29	.13
90	230.00	14.95	144.90	389.85	.64	.12
91	300.00	22.50	147.00	469.50	.55	.11
92	320.00	19.40	140.80	479.20	.56	.09
93	280.00	16.80	187.60	484.40	.44	.07
94	275.00	23.38	90.75	389.13	.30	.08
95	400.00	42.00	164.00	606.00	.47	.30
96	415.00	41.50	195.05	651.56	.37	.22
97	420.00	28.35	159.60	607.95	.35	.12
98	405.00	62.78	202.50	670.28	.36	.14
99	495.00	60.75	105.30	571.05	.34	.29
100	415.00	66.40	120.35	601.75	.29	.11
101	404.00	28.28	185.54	618.12	.46	.11
102	315.00	28.35	126.00	469.35	.41	.18

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NO	I	V	FL	FC	FT	IT

NO	I	V	FL	FC	FT	IT
154	280.00	19.60	123.20	422.80	.56	.10
155	272.80	46.38	223.70	542.87	1.28	.08
156	260.00	39.00	114.40	413.40	.50	.10
157	218.00	31.61	167.86	417.47	1.36	.24
158	308.00	30.80	249.48	588.28	1.24	.20
159	310.00	37.20	148.80	496.00	.46	.16
160	206.00	26.78	82.40	315.18	.31	.12
161	220.00	33.00	77.00	330.00	.35	.12
162	215.00	30.10	53.75	298.85	.37	.11
163	275.00	27.50	209.00	511.50	1.08	.12
164	225.00	24.75	276.75	526.51	1.38	.09
165	247.00	23.47	106.21	376.67	.33	.07
166	253.00	18.98	96.14	368.12	.29	.09
167	253.00	17.08	103.73	373.81	.31	.11
168	305.00	18.30	109.80	433.10	.33	.13
169	316.00	34.76	173.80	524.56	.37	.10
170	319.00	27.91	130.79	477.71	.27	.07
171	408.00	22.44	199.92	630.36	.28	.08
172	416.00	24.96	178.88	619.84	.31	.07
173	440.00	33.00	268.40	741.40	.33	.10
174	420.00	35.70	197.40	653.10	.31	.08
175	415.00	29.05	253.15	697.20	.29	.07
176	428.00	38.52	188.32	654.84	.28	.08
177	428.00	64.20	248.24	740.44	.22	.10
178	435.00	78.30	160.95	674.25	.28	.14
179	435.00	69.60	208.80	713.40	.29	.15
180	425.00	36.13	293.25	754.38	.95	.20
181	425.00	31.88	314.50	771.38	.90	.16
182	420.00	67.20	289.80	777.00	.94	.12
183	420.00	60.90	121.80	602.70	.30	.10
184	610.00	91.50	292.80	994.30	.47	.12
185	640.00	83.20	236.30	960.00	.40	.13
186	635.00	69.85	254.00	958.85	1.50	.15
187	550.00	55.00	522.50	1127.50	1.19	.11
188	543.00	43.44	477.84	1064.28	1.46	.14
189	549.00	52.15	318.42	919.58	.93	.15
190	660.00	108.90	231.00	999.90	.98	.15
191	665.00	93.10	332.50	1090.60	.33	.20
192	651.00	97.65	312.48	1061.14	.38	.17
193	551.00	66.12	402.23	1019.35	.96	.11
194	595.00	68.42	416.50	1079.92	.92	.12
195	245.00	12.25	73.50	330.75	.32	.03
196	245.00	40.43	80.85	366.28	.37	.10
197	240.00	40.80	62.40	343.20	.34	.07
198	240.00	33.60	141.60	415.20	.44	.07
199	255.00	30.60	219.30	504.90	.43	.10
200	255.00	31.88	124.95	411.83	.48	.16
201	230.00	31.05	124.20	385.25	.58	.10
202	225.00	29.25	99.00	353.25	.53	.13
203	225.00	31.50	141.75	398.25	.94	.10
204	225.00	24.75	114.75	364.50	.89	.07

103	320.00	37.60	121.60	479.20	.44	.21
104	480.00	62.40	144.00	656.40	.27	.07
105	483.00	55.55	120.75	659.30	.30	.10
106	474.00	47.40	194.34	715.74	.23	.13
107	465.00	55.80	534.75	1055.55	.33	.15
108	470.00	35.25	474.70	979.95	.28	.10
109	463.00	43.99	555.60	1062.59	.26	.09
110	432.00	28.92	520.56	1031.48	.30	.03
111	580.00	29.00	145.00	754.00	.19	.10
112	556.00	37.53	111.20	704.74	.22	.09
113	590.00	67.85	218.30	876.15	.25	.08
114	620.00	77.50	217.00	914.50	.22	.06
115	635.00	38.90	190.50	914.40	.38	.07
116	642.00	64.20	179.76	885.96	.38	.10
117	658.00	59.22	243.46	960.68	.28	.17
118	681.00	54.48	245.16	980.64	.33	.21
119	240.00	13.20	134.40	387.60	.70	.15
120	225.00	10.69	274.50	510.19	1.24	.17
121	205.00	15.89	221.40	442.29	1.12	.14
122	225.00	14.63	281.25	520.88	1.45	.10
123	280.00	15.40	338.20	634.20	1.18	.12
124	302.00	22.65	232.54	557.19	1.07	.07
125	315.00	50.40	23.63	339.03	.86	.11
126	360.00	36.00	172.30	568.80	.39	.11
127	440.00	50.60	154.00	644.60	.62	.13
128	412.00	36.05	156.56	604.61	.33	.14
129	420.00	29.40	168.00	617.40	.25	.18
130	360.00	32.40	147.60	540.00	.30	.22
131	365.00	62.05	160.60	537.65	.36	.24
132	383.00	57.45	187.67	628.12	.41	.15
133	390.00	62.40	152.10	604.50	.48	.13
134	515.00	33.47	278.10	826.58	.88	.09
135	515.00	41.20	458.35	1014.55	1.12	.06
136	535.00	49.46	470.30	1055.28	.98	.07
137	535.00	72.22	304.95	912.18	.85	.08
138	545.00	54.50	430.55	1030.05	1.18	.07
139	585.00	87.75	438.75	1111.50	1.19	.06
140	565.00	79.10	536.75	1180.85	1.00	.11
141	540.00	64.80	383.40	988.20	.72	.11
142	560.00	70.00	285.60	915.60	1.01	.13
143	575.00	43.13	230.00	848.13	.48	.08
144	580.00	50.75	365.40	996.15	.79	.07
145	534.00	65.70	280.32	930.02	.84	.10
146	591.00	38.41	325.05	954.47	.99	.13
147	575.00	33.06	368.00	976.06	.93	.12
148	580.00	49.30	156.60	785.90	.90	.10
149	225.00	40.50	96.75	362.25	.37	.12
150	225.00	37.69	148.50	411.19	1.25	.03
151	245.00	28.17	198.45	471.63	1.00	.17
152	248.00	26.66	322.40	597.06	1.83	.13
153	320.00	24.00	259.20	603.20	1.04	.13

AT/5

NO	I	V	FL	FC	FT	IT
205	325.00	35.75	217.75	578.50	.64	.05
206	315.00	47.25	238.50	652.05	.90	.15
207	285.00	48.45	259.35	592.80	.97	.10
208	260.00	37.70	184.60	442.30	.53	.12
209	295.00	20.50	135.70	460.21	.36	.16
210	512.00	61.44	204.50	778.24	.57	.13
211	520.00	72.80	317.20	910.00	.93	.16

212	325.00	70.20	286.00	870.20	.93	.17
213	495.00	74.25	232.65	801.91	.87	.13
214	495.00	84.15	420.75	999.31	.59	.13
215	495.00	54.45	311.85	861.31	.95	.09
216	459.00	39.95	433.68	766.53	.39	.07
217	459.00	55.08	325.89	839.97	.65	.08
218	454.00	57.37	220.32	726.70	.45	.10
219	285.00	31.49	119.70	638.16	.59	.13
220	375.00	75.75	272.70	961.42	.75	.13
221	490.00	55.13	357.70	902.33	.72	.14
222	450.00	62.40	312.00	854.40	.87	.11
223	480.00	36.00	288.00	804.00	.42	.16
224	495.00	45.60	281.00	813.40	.74	.13
225	485.00	48.50	281.30	814.91	.80	.14
226	450.00	39.77	282.00	777.37	.79	.11
227	435.00	69.60	304.50	809.10	.48	.10
228	445.00	77.88	195.10	715.67	.39	.14
229	420.00	63.63	127.60	617.70	.38	.21
230	315.00	34.65	119.70	469.35	.32	.15
231	295.00	29.50	194.70	519.20	.43	.15
232	266.00	45.78	142.14	471.92	.30	.11
233	275.00	38.50	90.75	404.25	.32	.14
234	455.00	41.32	145.50	671.73	.33	.15
235	495.00	56.99	121.25	853.24	.28	.19
236	495.00	61.94	242.55	759.34	.32	.11
237	515.00	90.13	154.50	759.65	.35	.11
238	515.00	33.46	175.10	723.51	.22	.10
239	520.00	18.20	405.60	943.90	1.29	.11
240	520.00	44.20	264.00	928.20	1.23	.14

NUMBER OF CASES READ = 240 NUMBER OF CASES LISTED = 240

112 DEC 89 11:19:58 Quantity Survey Page 6

* PRECEDING TASK REQUIRED 5.22 SECONDS CPU TIME; 7.00 SECONDS ELAPSE

```
    25  0
    26 * C          condescriptive i to rei
                    statistics all
** DWARNING 11002
   >The new default column-style printing cannot be used for this CONDESCRIPTIVE,
   >as there are too many statistics to print on one line per variable.  Old styl
   >printing will be used instead.

 0THERE ARE      996672 BYTES OF MEMORY AVAILABLE.
  THE LARGEST CONTIGUOUS AREA HAS      996592 BYTES.
 0        1200 BYTES OF MEMORY REQUIRED FOR CONDESCRIPTIVE PROCEDURE.
           120 BYTES HAVE ALREADY BEEN ACQUIRED.
          1080 BYTES REMAIN TO BE ACQUIRED.

 112 DEC 89     Quantity Survey
** 11:19:59     Page 8
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TYPICAL FIELD QUESTIONNAIRE

Ahmadu Bello University Zaira

Dept. of Building

Inquiry on construction of Public Residential Bungalows

State.....

Name of Public Organisation.....

A Total Floor Area.....m^2

B Initial Cost N.....

C Variation Cost N.....

D Fluctuation Cost N.....

E Final Cost N.....

F Initial Time .....Wks

G Final Time .....Wks

H Delay Time .....Wks

Delays are caused by (i) Delayed payment (ii) Time for Execution of variation, (iii) Other factors.

Please assign percentages of Total delay due to:-

(i) Delayed payment .....%

(ii) Execution of variation .....%

(iii) Other factors.....%

Total 100%

I Year Project Commenced 19.....

J Year Project Ended 19.....

_____

Name & Signature of Officer

AHMADU BELLO UNIVERSITY, ZARIA

Department of Building

Research Into Housing Construction Costs

The enclosed questionnaire is designed to obtain and analyse data on housing construction costs in Nigeria. You are kindly requested to respond to the questions

Your co-operation is appreciated. The excercise is purely for academic purposes only.

Dr. Tim .O. Mosaku
Head of Department of Building
A. B. U. Zaria.

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