International Journal of Applied and Natural Sciences (IJANS)
ISSN(P): 2319-4014; ISSN(E): 2319-4022
Vol. 3, Issue 4, July 2014, 1-14


International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

# APPRAISAL METHODS IN MUTUALLY EXCLUSIVE DEVELOPMENT PROJECTS: A PRAGMATIC ANALYSIS OF ALTERNATIVE TECHNIQUE

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## ABSTRACT

Appraisal techniques utilisations in mutually exclusive development project alternatives and their analysis are fundamental, and an inevitable process particularly in the planning, design and implementation of the development projects. At the same time, it's provided and promote for decision-making on development projects acceptance or rejection. The study aim is to investigate the appraisal methods in mutually exclusive development projects, identify when these methods cease to be appropriate for and the alternative techniques to adopt in such circumstance. Observation and purposive sampling was used to collect information for two development projects (prefabricating company and rock crushing company). A pragmatic illustration/analysis which utilise the spread sheets and other relevant functions in the Microsoft excel software packages were used in the analysis, as well as to sustain and achieve the state purpose of the study. The findings reveal that the most adopted appraisal methods are: the NPV; IRR; and BCR; and that these methods use in mutually development project alternatives may cease to be appropriate where there are resources budget constraints. Further, the findings reveal that the technique that should be practiced under this circumstance is the "Capital Rationing" approach.

The study reflection is to provide and promote a more understandings, knowledge and best practice to development projects investors, practitioners, government, decision makers and agencies in the management of mutually exclusive development projects alternatives in the social, political, environmental and economic system. Further, it should promote the awareness to relevant stakeholders that the benefits in undertaken more than a development project in the circumstance of resources constraints was what should not be allowed to be diminished in their goals and objective for economic growth and development of a country or countries.

**KEYWORDS:** Benefits Costs Ratio (BCR), Budget Constraints, Development Projects, Internal Rate of Return (IRR), Mutually Exclusive, Net Present Value (NPV)

## INTRODUCTION

Development Projects appraisals are an inevitable process in planning, design and implementation of development projects (Potts, 2002). This is because the resources to undertake all the development projects at the same time are scarce; the choice of project appraisal alternatives becomes necessary in development projects analysis. However, if there were sufficient resources at disposal, the possibility of undertaking every development projects deem beneficial would be realistic. This agrees to the fact that independent development projects are not competing for the same resources, and/or that the development projects that are dependent are mutually exclusive to a stand that the cost of undertaking one is the opportunity cost of not undertaking the other. This indicates resources constraints to the developers/investor, and to the development projects that are earmarked to be embarked upon in the built environment (Ifediora, 1993; Potts, 2002).

Development projects mutual exclusivity can be caused by one of a number of factors such as including; different versions of the same project with only one design of the same development project been implemented, and this is particular to a development project where the location, the technology and the scale to measure the various activities to the development of the projects are constraint; at the same time, if the development projects are competing for the same resources; if the development projects are competing for the same limited investment resources with capital rationing becoming an issue; and if the choice between development projects involves question of time relating to what best time to invest in a development project (Potts, 2002).

However, in the development projects appraisal techniques, capital outlays should include working capital and capital expenditure, which further details the cost of acquisition and monies spent on adaptations or improvements and should exclude depreciation allowances (Potts, 2002; Ifediora, 1993). At the same time, the receipts and payments are normally expected to be spread unevenly over the number of years for the development project (Ifediora, 1993). Though, every development projects are project anticipated to be promoting more of social benefits in the built environment irrespective of the financial and economic benefits that due obtained from their development. The development projects include housing, road, electricity, drainage, etc., in the built environment and the economy (Ihuah and Benebo, 2014; Ayodele and Alabi, 2011). The examination of these development projects in respects to their feasibility and viability is required, and mostly where the development projects are competing for the same resources and the budget is constraint for the project development such that their benefits actualisation are dwindling. Although, many techniques are used to determine the feasibility and viability of development projects, but under mutually exclusive development projects investment, the investigation is to make comparison between costs and benefits. This should assist to suggest whether the benefits compensate for the development project costs, and where it is emphasized that the resources for the development of the projects are scarce. Then, the application of the procedures of scaling preference and opportunity cost becomes important since it would allow and indicate how to make best the use of the limited resources (Potts, 2002). In this sense, the issue should be to examine alternative approaches or techniques that can be used to appraise mutually exclusive development projects where the other traditional methods of: Net Present Value (NPV); Internal Rate of Return (IRR); and Benefit Cost Ration (CBA); ceases to be appropriate to use in the appraisals of development projects.

Therefore, the purpose of this study is to investigate the various appraisal methods in mutually exclusive development projects, and with the supports of pragmatic analysis illustration, as well as promotes and address the following objectives/or questions of this study. These objectives are:

- What alternative investment appraisal techniques can be used for choosing between mutually exclusive investment projects;
- Under what circumstance do these methods cease to be appropriate;
- What technique should be used instead of the other methods.

The study exploration should benefit and suggest to the development projects investors, developers, government, owners, decision makers, agencies and other relevant stakeholders that the usually used traditional appraisal methods to analyses the feasibility and viability of development projects are not always better in all development projects. Rather, that a further technique is required to demonstrate that the resources under budget constraints scenarios is expected to be rationally compensated for, and in that, more than a development projects should still be developed with a surplus. Hence,

the study next sections investigate: the various alternative appraisal techniques in mutually exclusive development projects; the methodology; the pragmatic analysis, results and discussion; and the conclusion to the study.

## A NOTIONAL REVIEW OF APPRAISAL METHODS IN MUTUAL EXCLUSIVE DEVELOPMENT PROJECTS

### The Net Present Value (NPV) Method

The Net Present Value (NPV) practice is that based on the discount cash flow approach of financial investments techniques, and it is most times referred to as the budget rate or the target rate of interest (Potts, 2002; Ifediora, 1993). It is a method considered better by many researchers' from an investor's perspective, (Cuthbert and Cuthbert, 2012), however, it may not be a better practice to adopt in appraising a social development projects (Potts, 2002). The NPV is defined as the present value of all monies flowing-out and flowing-in as a result of the investment of capital sum into a development project. Therefore, the definition indicates that the difference between the present value of capital outlay and the present value of the benefits from the investment is the net present value (NPV) of that development project (Potts, 2002). Hence, Potts (2002); Ifediora (1993) and Gittinger (1982), states that the net present value is otherwise mathematically defined as thus:

$$NPV = \sum_{T=1}^{n} \frac{(Rt - Ct)}{(1 + r)^t}$$

*Where,*

*Rt* = *return value of the development project in year t;*

*Ct* = *development project cost outlay value in year t;*

*r* = *the rate of discount;*

*n* = *the number of years in the development project investment life.*

The appraisal of development projects applying this practice should show three possible outcomes for a development project NPV, and this would include a positive, zero and negative NPV (Potts, 2002; Snell, 1997; Perkins, 1994; Ifediora, 1993). In a positive NPV scenario, it indicates that the present value of a development project benefits is more than the present value of the capital outlay in the development project. This reveals to the investor that the investment will produce benefits, and that the development project would be yielding benefits greater than the adopted rate of interest (that is the target rate) utilised in the analyses. Hence, should be accepted (Cuthbert and Cuthbert, 2012; Osborne, 2010; Potts, 2002). While in a zero NPV scenario, it suggests that both capital outlay and capital inflow are equal. Therefore, where the net present value is zero, it reveals to the investor that the expected development project will neither produce a benefit or a loss. Hence, it is suggesting that the anticipated development project would be at marginal (Potts, 2002). But, in a negative NPV case, the scenario is in contrast to the positive NPV as it would shows that the present value of development project capital-outlay would be/or is higher than the capital in-flow from the investment after completion. This further provides that the net present value is negative, and that the development project benefits would be/or is at rate of return lower than the target rate (Potts, 2002; Gittinger, 1982; Ifediora, 1993; Kirkpatrick and Weiss, 1996; Irivn, 1976). Therefore, the development project decision for the investor should be not to accept rather to reject it

(Potts, 2002).

However, the NPV method has a profound advantage such as it is simple to apply in order to determine development project worth, and that of taking a quicker decision on the development fortune. Further, it is a comfortable method to mutually exclusive development projects for decision-making by investors without any adjustment or manipulation (Cuthbert and Cuthbert, 2012; Potts, 2002). The NPV should assists to measure the absolute benefits obtained from a development project. It is also capable of dealing with both capitals and recurrent costs incurred in development project, and this, the other methods do not consider separating (Potts, 2002). But, the NPV suffer the pitfalls inherent of the target rate which is usually obtained manually or externally through techniques of calculation to reveal the development project with most efficient resources use (Perkins, 1994). Appreciating the benefits of utilising the net present value (NPV) technique wherein comparing or choosing between alternative development projects, it should be worth using the best acceptable development project with the highest net present value; but, it is not necessarily that of development projects with the biggest rate of return to the capital-outlay (Ifediora, 1993). However, a pragmatic illustration of how this method works in development project appraisal is provided in the analysis, results and discussions section of this study.

**The Internal Rate of Return (IRR)**

The internal rate of return is defined as the rate of interest at which the present value of capital-outlay in an investment or development project is equal to the present value of the benefits from the initial investment cost of that development project (Cuthbert and Cuthbert, 2012; Osborne, 2010; Potts, 2002; Brown and Kwansa, 1999; Ifediora, 1993). Therefore, it is the actual rate at which the net present value of a development project is zero (NPV=0). Hence, Potts (2002) Gittinger (1982) and Perkins (1994)suggests that the internal rate of return is the likely rate of interest at which the NPV is zero, and it's mathematically expressed as thus:

$$IRR = NPV = \sum_{t=1}^{n} \frac{(Rt - Ct)}{(1+r)} = 0$$

The IRR is the development project internal discounted rate, and that which does not rely on a selected discount rate (Potts, 2002). This rate is assumed to be the discounted rate at which the predictable development project on completion is beneficial. In the financial appraisal system, the IRR is the rate at which the project is capable to recoup the original capital outlay and the operating cost (Brown and Kwansa, 1999).In addition, it is the rate at which the supposing returns/ benefits of such project development, and after the deduction of the costs of constructing the project, is obtained and sustained from the developed project (Ifediora, 1993). Under mutually exclusive development projects, the acceptability decisions, however, follows the rules that, the internal rate of return must be greater than the target rate of return or discounted rate (Abelson, 1996). But, within a practice scenario where the rate of interest used to discount for the return is very high, it is possible that the net present value of the development project costs could outweigh or exceed the net present value of the returns/benefits. Where the rate of interest used to discount for the return is very low, then it is predicted that the present value of returns/benefits could compensate the present value of the development project costs (Potts, 2002). Consequently, a point of equilibrium ascends at a rate of interest between the high rate of interest and the low rate of interest. This equilibrium rate of interest point where used to discount the development project should equate to the discounted flow of future benefits with initial development project costs. Though, it is stressed that this can be found

through the uses of trial and error rate of interest method (Sugden and Williams, 1978; Potts, 2002; Snell, 1997).

The IRR approach is such that takes accounts of the time preference of the development project, which the NPV method do not, and can be discounted or estimated without a discount rate benchmark (Potts, 2002). The IRR method is such that is capable of dealing with, and overcoming, the political difficulties in the dissimilar discounting rate used by diverse countries (Potts, 2002). Although, it may be quite easier to understood just like the NPV method, as well as does not require any necessary professionalism in it analysis procedures since the procedures is similar to the normal investment methods (Potts, 2002). Further, the IRR method where utilised, ranks development projects on the basis of most efficient resources use. Despite these advantages, it is still contested to be cumbersome to calculate, and that an alternative forgone for the resources stated are needed and must be available (Potts, 2002; Ifediora, 1993). In addition, the IRR prefers making large development project appraisal at lower rate of return as compared to small development project at higher rate of return (Selvaviayagam, 1991; Perkins, 1994). Also, the application of and the procedures involved of this method of appraisal is shown in the examples of the pragmatic analysis presented in the following sections of the study.

**Internal Rate of Return (IRR) versus Net Present Value (NPV)**

The IRR is always expressing results in percentage than in monetary terms and may lead to misunderstanding (Cuthber and Cuthbert, 2012; Brown and Kwansa, 1999). Another serious problem of IRR occurs where there is abnormal income flow, and that brings a negative income flow later in the future of the developed project, as well as may lead to producing multiple internal rates of return (Cuthbert and Cuthbert, 2012; Osborne, 2010). While it should have been only one rate of return to be used in making decision to accept or reject in development projects that are mutually exclusive. However, the NPV in its criterion assumes that the development project benefits from the cash flow analysis should be re-invested at original investment cost (Cuthbert and Cuthbert, 2012), but the IRR makes a different assumption such that it emphasis that the benefits from the development project should be re-invested to earn a return, and it should be using same IRR as with the original development project. However, it is opine that the NPV method is better than the IRR method in mutually exclusive development projects or investment appraisals (Cuthbert and Cuthbert, 2012), but, the IRR is unreliable in projects raking (Cuthbert and Cuthbert, 2012; Brown and Kwansa, 1999; Osborne, 2010; Kieruff, 2008). The assertion is based on the circumstance that IRR technique assumes that the re-investment rate should be the same to the stated rate of benefits throughout the development project years. Further, that the IRR cannot be applied when capital outlay in the development project changes at several or any time in the development project years (Potts, 2002).

The NPV technique in this situation assumes a re-investment of capital at the actual rate of return for discounting development project, and that it is related to the alternative forgone for the development project or investment (Osborne, 2010; Selvavinayagam, 1991). Practically, the IRR may seems to be a better method as compared to NPV method in mutually exclusive development projects since it helps to rank development projects according to priorities, using their internal rate of return as a measures to specify development project with highest-priority (Potts, 2002). Nonetheless, the NPV and IRR method utilisations in mutually exclusive development project analysis still prove better despite their pitfalls in appraising social development projects that their purposes and benefits are for sometimes difficult to be estimated in monetary values only (Potts, 2002).

**The Benefit Cost Ratio (CBR)**

The benefit cost ratio criterion is that method which assesses and presents to the development project investor the

ratio of the present value of the development project benefit to that of the present value of the development project costs (Potts, 2002). This is mathematically represented and calculated by the formula:

*Benefits Costs Ratio (BCR) = PVB/ PVC.*

*Where:*

*PVB = Present Value of Project B;*

*PVC = Present Value of Project C (Potts, 2002).*

The BCR method suggests that a development project should be accepted where the development project benefit cost ratio is more than a value of 1 (Potts, 2002; Ifediora, 1993). This approach under its procedures assumes that it is at this ratio that the development project is expected to generate more benefits than the costs of its development.

The benefit cost ratio in its advantage endeavours to verify the efficiency of a development project, and it is used to compare mutually exclusive development projects analysis easier than the other previous mention appraisal methods (Potts, 2002). Though, Potts (2002) stressed that the BCR is not a reliable method for the ranking of the development projects in the built environment. Further, that under budget constraints, the BCR cannot completely address the situation, rather a further adjustable method of BCR referred to and mathematically represented as the PV/K should be used (Potts, 2002). This approach is based on dividing the present value of development project net benefits by the present value of the development project net costs. Further, Potts (2002) contended that this method utilisation should assists to measure and verify the worth of a development project under resources budget constraints in an economy. Further, the pragmatic analysis to show the operations of this method is indicated in the after that section of this paper.

However, Table 1 below indicates the summary of the decision rules applicable to each of the appraisal methods suggested by many researchers in the literature and compiled by the researcher in this study. The purpose of this was to assist in drawing conclusion to the pragmatic development project appraisal analysis results illustrated in the examples provided for each appraisal method, as well as undermutual exclusive development projects and resources budget constraints, in the subsequent section.

**Table 1: Summary of Decision Rules for the Discounted Appraisal Methods**

| Method | Acceptance | Selection under Mutual Exclusivity |
|---|---|---|
| *NPV* | *If, NPV > 0, accept.*<br>*If, NPV< 0, reject.*<br>*If, NPV = 0, no effect.* | *NPV (B)>NPV (A) & NPV (B) > 0.* |
| *IRR* | *If, IRR > trial rate, accept.*<br>*If, IRR< trial rate, reject.* | *IRR (B) > IRR (A) & IRR (B) >trial rate.* |
| *PV/K* | *If, PV/K> 1.0, accept.*<br>*If, PV/K< 1.0, reject.*<br>*If, PV/K =0, no effect* | *PV/K (B)>PV/K (A) & PV/K (B) >1.* |

(Potts, 2002; Ifediora, 1993; Ginttinger, 1982; Selvaviayagam, 1991; Perkins, 1994; Sugden and Williams, 1978; and Snell, 1997)

## THE METHODOLOGY, ANALYSIS, RESULTS AND DISCUSSIONS

### Methodology

This section demonstrates through examples, a pragmatic analysis on the various appraisal methods discussed in

the literature review of this study. This was aimed to address the study objectives of when the traditional appraisal methods cease to be appropriate to be used in development project decision making. The study utilised the conceptual and empirical methods of gathering the relevant information in the study. The conceptual approach involved the collection of electronic online journals, textbooks and visual materials so as to build the notional perspectives of the study. The empirical data was gathered through observation, experience and judgemental knowledge, and applying that gathered information to the development projects used in the study pragmatic analysis. The empirical data was at first transcribed and translated into quantitative data, and this was analysed using the Microsoft excel software packages particularly the spread sheet and with the relevant functions. This adopted approach in the study was also encouraged for and used by Keller and Warrack, (1997), Ragsdale (2001), Weida, Richardson, and Vazsonyi, (2001) and Wilson and Keating (2002) in their various works to demonstrate the basic concepts involved in development projects analysis. Further, the analysis verifies the best appraisal method to use in such a situation where there is development projects mutual exclusivity. Therefore, the following researcher's observation information where drawn based on two development projects, with one been the construction of a prefabricating company (project "A") and the other the construction of a rock crushing company (Project "B"). The information was made available by the expected donor or investor on each of the development project as fellow, and was used to buttress the advantages and disadvantages of the appraisal methods and the alternative method to overcome their pitfall in the study frame.

**Project "A"**

*Land acquisition costs £10m, Construction costs £60m, Plant/equipment/machinery purchases £20m, Installations costs £10m, Operating cost per year £5m, while the annual benefits for the project life of 6 years are £30m, £35m, £40m, £45m, £50m, £60m and the discount rate is 15%.*

**Project "B"**

*Land acquisition cost £10m, Construction costs £60m, Plant/equipment/machinery purchases £20m, Installations costs £10m and the operating costs on annual basis is £12m. The project expected benefits for the 6years project life are £40m, £45m, £50m, £55m, £60m and £70m with same discount rate as project "A" above*

**Analysis, Results and Discussions**

The NPV method of appraisal and the results under the criteria and information supplied above are as indicate of Table 2 and 3 below.

**Table 2: Resource Cash Flow (£.00) for Development Project "A" (Prefabricating Company) @15% Discount Rate**

| **Item\Year** | | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
|---|---|---|---|---|---|---|---|---|
| Land acquisition costs | | 10 | | | | | | |
| Construction costs | | 50 | | | | | | |
| Purchases | | 20 | | | | | | |
| Installations costs | | 10 | | | | | | |
| Operating costs | | | 8 | 8 | 8 | 8 | 8 | 8 |
| Total costs | | 90 | 8 | 8 | 8 | 8 | 8 | 8 |
| Benefits | | | 30 | 35 | 40 | 45 | 50 | 60 |
| **Net Benefits** | | | **22** | **27** | **32** | **37** | **42** | **52** |
| Discount factor | 0.15 | 1 | 0.86957 | 0.7561 | 0.65752 | 0.57175 | 0.49718 | 0.43233 |
| **Present Value** | | **-90** | **19.1304** | **20.416** | **21.0405** | **21.1549** | **20.8814** | **22.481** |

**NPV=£35.10**

**Table 3: Resource Cash Flow (£.00m) for Development Project "B" (Rock Crushing Company) @ 15% Discount Rate**

| Item\Year | | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|
| Land acquisition costs | | 10 | | | | | | |
| Construction costs | | 60 | | | | | | |
| Purchases | | 20 | | | | | | |
| Installations costs | | 10 | | | | | | |
| Operating costs | | | 12 | 12 | 12 | 12 | 12 | 12 |
| Total costs | | 100 | 12 | 12 | 12 | 12 | 12 | 12 |
| Benefits | | | 40 | 45 | 50 | 55 | 60 | 70 |
| **Net Benefits** | | | **28** | **33** | **38** | **43** | **48** | **58** |
| Discount factor | 0.15 | 1 | 0.8696 | 0.756 | 0.658 | 0.5718 | 0.4972 | 0.432 |
| **Present Value** | | **-100** | **24.348** | **24.95** | **24.99** | **24.585** | **23.864** | **25.08** |

**NPV =£47.81**

The appraisal results in Table 2 and 3 above indicate that the NPV of development Project "A" was £35.10m and for that of development project "B", the NPV was £47.81m. This shows a resources difference of £12.71m surplus to development project "B" from development project "A". Therefore, based on decision rules of NPV in a mutually exclusive projects development, development project "B" (rock crushing company) should be choosing to be developed by the donor or investor since it produces higher NPV values. This is much more where it is compared to development project "A" (prefabricating company), as well as both are been discounted at same interest rate of 15%. However, it is quickly noticed from the information provided that the development costs for both projects are different, and that these results may have not revealed the true relative merits of either development projects. Therefore, to confirm are commendation to an investor and supports the decision on the development project acceptance, the NPV is further expressed as a percentage index (referred as benefitability or profitability index). According Potts (2002), the benefitability or profitability index is defined as the NPV of that project divided by its investment or development costs expressed as a percentage. This suggests that for the development projects (A and B), the benefitability or profitability index should be as appraised thus:

*Development Project "A" benefitability or Profitability index = £35.10/ -£90.00 X 100%= 39%.*

*Development Project "B" benefitability or Profitability index = £47.81/ -£100.00 X 100%= 47.8%.*

Utilising this method as a further step in the pragmatic appraisal analysis in the NPV appraisal method, the findings confirm that development project ''B'' still proves better where it is compared to development project ''A'', and hence, it should be accepted to be embarked upon by the donor or investor in this situation. The IRR under the criterions and information provided in the two development projects earlier stated, the results of the appraisals are as indicate of Table 4 and 5 below. Also, because the IRR depends on trial rates so as to find the exact rate of interest, the 15% used in the previous analysis for development project "A" with NPV £35.10M was adopted here, where as different trial rates of interests (29% and 30%) are further applied to development project "A" and "B" respectively.

**Table 4: Resource Cash Flow (£0.00m) for Development Project "A" (Fabricating Company) @29% Trail Rate**

| Items/Years | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Land Acquisition Costs | 10 | | | | | | |
| Construction Cost | 50 | | | | | | |
| Purchases | 20 | | | | | | |
| Installations Costs | 10 | | | 8 | | | |
| Operating Costs | | 8 | 8 | | 8 | 8 | 8 |

**Table 4: Contd.,**

| **Total Costs** | **90** | **8** | **8** | **8** | **8** | **8** | **8** |
|---|---|---|---|---|---|---|---|
| Benefits | | 30 | 35 | 40 | 45 | 50 | 60 |
| **Net Benefits** | **-90** | **22** | **27** | **32** | **37** | **42** | **52** |
| Discounted Factor @ 0.29 | 1 | 0.7752 | 0.6009 | 0.4658 | 0.3611 | 0.2799 | 0.217 |
| **Present Value** | **-90** | **17.054** | **16.225** | **14.907** | **13.361** | **11.757** | **11.284** |

**NPV = -#5.4M**

The NPV at 29% trails rate in the development project "A", and as it is related to the IRR decision rules (in Table 1) for mutually exclusive development projects, the findings indicate that this rate of interest is too high since it verifies a negative NPV value of -£5.41M. It therefore suggests that the IRR lies between the two trail interest rates of 15% and 29%. Hence, to actually verify or estimate the IRR for development project "A", the IRR estimation formula, which isas stated thus, was applied to the development project "A".

$$IRR = r^1 + \left(\frac{((r^2 - r^1)*NPV1)}{(NPV1 - NPV2)}\right) x\ 100\%$$

*Where:*

$r^1$ = *the lowest trying rate of interest;*

$r^2$ = *the highest trying rate of interest;*

*NPV1* = *the NPV at the lowest trying rate of interest;*

*NPV2* = *the NPV at the highest trying rate of interest* (Potts, 2002).

Therefore, substituting the figures from Table 4 above into the IRR estimation formula, the results indicate that the IRR for the development project "A" (prefabricating company) or investment was 27%. The case of development project "B", the NPV at trial rate of 15% is £47.81m and equally adopted here while the trail interest rate of 30% is applied as to obtain the NPV2 value for development project "B", and as indicate of Table 5 below.

**Table 5: Resource Cash Flow (£.00m) for Development Project 'B' (Crushing Company) @ 30% Trail Rate**

| **Item\Year** | | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
|---|---|---|---|---|---|---|---|---|
| Land acquisition costs | | 10 | | | | | | |
| Construction costs | | 60 | | | | | | |
| Purchases | | 20 | | | | | | |
| Installations costs | | 10 | | | | | | |
| Operating costs | | | 12 | 12 | 12 | 12 | 12 | 12 |
| **Total Costs** | | **100** | **12** | **12** | **12** | **12** | **12** | **12** |
| Benefits | | | 40 | 45 | 50 | 55 | 60 | 70 |
| **Net Benefits** | | **-100** | **28** | **33** | **38** | **43** | **48** | **58** |
| Discount factor | 0.3 | 1 | 0.769231 | 0.59172 | 0.4551661 | 0.350128 | 0.269329 | 0.2071762 |
| **Present Value** | | **-100** | **21.53846** | **19.5266** | **17.296313** | **15.0555** | **12.9278** | **12.01622** |

**NPV = -£1.64M**

Table 5 analysis and results at the 30% trial discount rate, reveal that the NPV was -£1.64m, and this further indicates that the applied discount rate to the development project was too high. But, it suggests that the IRR should fall within the two trial discount rates of 15% and 30%. Therefore, the IRR estimation formula is applied with the various figures (data) substitution, and the findings reveal that the IRR at this discounted rate for development project "B" (rock crushing company) was approximately 29%.

However, the IRR estimation through the estimation formula above has some marginal error since it assumes a linear relationship between the two NPV values (Potts, 2002), as well as overestimation of the IRR may always be the case. Therefore, it is imperative to overcome this error so that development project decision taking with the estimated IRR should not adversely affect the project benefits.

This, Potts (2002) suggests that adopting the use of spreadsheet of the Microsoft Excel software packages. As well as, adopting the Guess interest rate in the appraisals should reduces the level these errors and the cumbersome of the estimation formula. This is demonstrated in the study pragmatic appraisal analysis, and as it is shown of table 6 and 7 for assurance and verification on the development project "A" and "B".

**Table 6: Resource Cash Flow (£.00m) for Development Project "A" @ 15% under Guess Discount Rate**

| **Item\Year** | | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
|---|---|---|---|---|---|---|---|---|
| Land acquisition costs | | 10 | | | | | | |
| Construction costs | | 50 | | | | | | |
| Purchases | | 20 | | | | | | |
| Installations costs | | 10 | | | 8 | | | |
| Operating costs | | | 8 | 8 | | 8 | 8 | 8 |
| **Total costs** | | **90** | **8** | **8** | **8** | **8** | **8** | **8** |
| Benefits | | | 30 | 35 | 40 | 45 | 50 | 60 |
| **Net Benefits** | | **-90** | **22** | **27** | **32** | **37** | **42** | **52** |
| Discount factor | 0.15 | 1 | 0.8696 | 0.7561 | 0.6575 | 0.5718 | 0.4972 | 0.4323 |
| **Present Value** | | **-90** | **19.13** | **20.416** | **21.041** | **21.155** | **20.881** | **22.481** |

**NPV = £35.10; GUESS Rate = 20%; IRR = 27%**

**Table 7: Resource Cash Flow (£.00m) for Development Project "B" @15% under Guess Rate**

| **Item\Year** | | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
|---|---|---|---|---|---|---|---|---|
| Land acquisition costs | | 10 | | | | | | |
| Construction costs | | 60 | | | | | | |
| Purchases | | 20 | | | | | | |
| Installations costs | | 10 | | | | | | |
| Operating costs | | | 12 | 12 | 12 | 12 | 12 | 12 |
| **Total costs** | | **100** | **12** | **12** | **12** | **12** | **12** | **12** |
| Benefits | | | 40 | 45 | 50 | 55 | 60 | 70 |
| **Net Benefits** | | **-100** | **28** | **33** | **38** | **43** | **48** | **58** |
| Discount factor | 0.15 | 1 | 0.8696 | 0.756 | 0.658 | 0.5718 | 0.4972 | 0.432 |
| **Present Value** | | **-100** | **24.348** | **24.95** | **24.99** | **24.585** | **23.864** | **25.08** |

**NPV = £47.81; GUESS Rate = 20%; IRR = 29%**

Table 6 and 7 results confirm by the Guess discount rate, as well as under the mutually exclusive development projects or investment criterion that development project "B" (rock crush company) should be accepted or selected since its reveal a better and higher IRR of 29% as compared to development project "A" (prefabricating company) with 27% IRR.

Demonstrating whether the traditional appraisal methods of: NPV; IRR; and BCR; were appropriate to use in mutually exclusive development project, as well as where there are resources budget constraints, and what approach should be appropriate instead. A further pragmatic appraisal analysis was carried out, while at the same time adopting the information provided in the earlier mentioned development projects (A and B). But, in a mutually exclusive investments or development projects**,** the decision to accept a development project out of several alternatives using the NPV, IRR, and

CBR criterion may lead to conflicting recommendations (Cuthbert and Cuthbert, 2012; Potts, 2002). Further, it is also contended that other issue may suggests that the NPV and the IRR are subjected to error, and making decision by investor or donor based on the findings of their analyses alone should create un-necessary recommendation to development project acceptance or rejection (Potts, 2002).

This is more particular to where there are "*resources budget constraints"* (Potts, 2002). In this circumstance, the NPV and IRR may cease to be appropriate as methods to use in the analysis of mutually exclusive development projects, as well as because of the major reliance of NPV and IRR in measuring development project benefits in monetary terms than social benefits (Potts, 2002; Gittinger, 1982). Although, in the earlier appraisal analysis, both NPV and IRR approach confirms development project 'B' as a better option than development project 'A'.

But, supposing a donor or investor is faced with three possible development projects alternatives and had no sufficient resources to undertake all, the decision rule might not be based on one with the highest NPV or IRR. Rather, the decision on which development project (s) to embark upon could be firmed on the available funds, and where two out of the three projects could be embarked under the budgeted fund plus a surplus. In this case and its situation, the NPV and IRR would not be an appropriate criterion for decision to development project (s) acceptance or rejection. Hence, another technique of "*capital rationing*" might be more appropriate (Potts, 2002), and this is also more particular to social development projects provided by government or Non-Governmental Organisations (NGOs).

The pragmatic analyses to illustrate the above scenarios, the following information/data are obtained of three development projects alternative and they are mutually exclusive to each other.

> *If for example, a development project "A" have the development project costs of £3,000M; operating costs of £1000M per year starting in year one; working capital of £600M and revenue at £1800M per year. Another development Project "B" has investment costs of £2,000M, operating costs of £500M annually; working capital of £200M and yearly revenue of £1300M. While development project "C" has investment costs £1,800M; operating cost of £700M annually; working capital of £200M and annual revenue of £1300M. Assuming that the development projects life is 10 years and the discount rate to be applied is 8% to all the development projects. The issues here is ranking these development projects by utilising the NPV, IRR, PV/K criterion on each development project, as well as determining the development project (s) that should be undertaken with a budget constraints of £5, 400M.*

The summaries of the results of the analysis in the above circumstance are as indicates of Table 8 and 9 below.

**Table 8: Summary of the Mutually Exclusive Development Projects (A, B, C) and their Raking before Budget Constraints**

| Development Projects | NPV | IRR | PV/K | Ranking |
|---|---|---|---|---|
| **A** | £1, 953.34 | 18.54% | 0.65 | 3 |
| **B** | £3, 168.07 | 34% | 1.58 | 1 |
| **C** | £2, 118.68 | 28% | 1.18 | 2 |

From the analysis in Table 8, it indicates that development project "B" should be accepted and undertaking by the investor since it has a higher NPV of £3168.07M as compared to the other development projects (A, C). Also, the IRR was 34% higher than the test discounted rate of 8% applied, and the PV/K is more than the value of 1 (1.56). But, under resources budget constraints of £5,400M, the techniques of *"capital rationing"* becomes more appropriate to apply in

mutually exclusive development project appraisals such as analysed in Table 9. This gives the investor the opportunity to undertake more than a development project rather than using the NPV and IRR results revealed in their method utilisation, and as also stated in their decision rules for project development acceptance or rejection in mutually exclusive development projects. It also provides the best approach and opportunity for maximum utilisation and allocation of the available resources within the development projects alternatives to the donor or investor in the economy.

**Table 9: Summary of the Mutually Exclusive Development Projects (A, B, C) and their Raking under Budget Constraints of £5, 400M**

| Development Projects | Investment Costs | NPV | IRR | PV/K | Ranking Based on Capital Rationing |
|---|---|---|---|---|---|
| A | £3,000 | £1, 953.34 | 18.54% | 0.65 | A + B = 3rd |
| B | £2,000 | £3, 168.07 | 34% | 1.56 | B + C = 1st |
| C | £1800 | £2, 118.68 | 28% | 1.18 | C + A = 2nd |

***Option 1:*** *Development projects (B+ C), with total NPV £4, 072.72, IRR value 46% and balance of £1,600;*

***Option 2:*** *Development projects (C+ A), with total NPV £5,121.43, IRR value 52.54 and balance of £600;*

***Option 3:*** *Development projects (A + B), with total NPV £5,286.75, IRR value 62% and balance of £400.*

Table 9 findings indicate that three different ranking options appears amongst the development projects such as: development projects (B + C) was ranked 1st; development projects(C+A) was ranked 2nd; and development projects (A + B) was ranked 3rd. But, in Table 8 above, only development project "B" was ranked 1st, while development project "C" was ranked 2ndand that of development project "A" ranked 3rdand these last two development cannot be accepted based on NPV and IRR decision rules.

The findings further show that within the resources budget constraints, option 1 reveals that two development project should be under taken while making a surplus of £1600M. These development projects has a total NPV of £4,072.02 and IRR of 46.54% which is greater than the NPV of project B if selected on the basis of NPV and IRR criterion alone. Again, option 2 reveals that development projects (C + A) can be embarked within the budget constraints resources, but would only make a surplus of £600M lower to the previous option 1. Though, the combined NPV and IRR are greater than that in option 1, but the surplus is more than twice. Therefore, this situation should not utilise the NPV, IRR and BCR criterions in development projects decision making rather the capital rationing approach should be better and appropriate to apply in mutually exclusive development projects alternatives for development projects acceptance or rejection (Potts, 2002).

## CONCLUSIONS AND RECOMMENDATIONS

The paper demonstrate through conceptual review and pragmatic analysis that the traditional appraisal methods significance and utilisation in the appraisals of mutually exclusive development projects should not be overemphasised since there is a circumstance that they cease to be appropriate to be applied in the analysis of mutually exclusive development projects in an economy. Though, the study in using the pragmatic examination, have further illustrated the strengths and weaknesses of: NPV; IRR; and BCR; in appraisals of development projects. It is over this process that the investor or donor should be provided with the opportunities to understand the expected development project benefits or returns. Further, it is also over this information provided in their analysis procedures and results that the investor or donor should make an informed recommendation and decision on whether a development project(s) is/are worth undertaken.

The study in its additional exploration and investigation have established that the NPV and IRR is immersed in only determining the monetary worth of a development project, and not interested in the social benefits of the development projects to the built environment.

The NPV, IRR and BCR methods has also been conventional to cease to be the best methods in a mutual exclusive development project where there is/are resources budget constraints, and that the best techniques to use in such circumstance is the "*capital rationing"* practice. This technique determines and confirms that more than a development project should be developed or undertaken within specified budget constraints. Rather than only embarking upon a development project for which the: NPV; IRR; and BCR; advocates for in their analyses and findings, and in their decision rules to accept or reject a development project in mutually exclusive development project alternatives. It is also in this method that the available resources are rationed in such ways that two or more mutually exclusive development project alternatives should receive the decision by the investor or donor to develop, as well as making reasonable surplus that should be re-invested in another development projects or investment with sufficient benefits or returns sustained. The reflection of this study should be to provide and promote a more understanding, knowledge and best practice to development projects investors, practitioners, government, decision makers and agencies in the project management of mutually exclusive development projects alternatives in the social, political, environmental and economic system. This study further should promote the awareness to relevant stakeholders that the benefits in undertaken more than a development project in circumstances of resources constraints are what should not be allowed to be detracted in their goals and objective for economic growth and development of a country or countries.

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