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IMPACT AND RISK ANALYSIS OF AEROSPACE INFORMATION SYSTEM

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Abstract-

Aerospace Information System (AIS) is a robust integrated Computer-based system for managing the technical and commercial operations activities of an aerospace company, or aircraft fleet operator. The system can be used worldwide by large and small companies operating many types of fixed and rotary-wing aircraft. An AIS is expected to transform the relationships in the aviation organization's transactions and enhanced customers satisfaction by reducing the response time to about 10 seconds, as transactions were made easier via the use of Electronic Communications. In order to successfully implement such an application, an impact and risk analysis is necessary to provide guidance and assistance to management in planning, developing and implementing the technical infrastructure necessary to compete in today's aerospace industrial climate. This paper described an impact and risk analysis of an AIS using the techniques of payback projection, discounted cash flow, and net present value.

Keywords: AIS, Risk Analysis, Cost/Benefit Analysis

I. INTRODUCTION

No organizational-based software development should be undertaken without first establishing its impact and risk, i.e. showing its justification. The impact and risk analysis defines what is to be done, why, what are the timescales and cost involved. Once the software development is under way, its progress should be measured against the result of the analysis to make sure, for example, that the cost or timescales are not being exceeded or that the product benefits are not being eroded. The AIS Impact and Risk Analysis thus, provides the base for the Aerospace Information System Development Phases monitoring and control and, untimately, for assessing whether the software development was worth undertaking at all. Impact are changes in the way an organization like the aerospace industry thinks and acts and are worth spelling out in the software development so that the decision-makers can judge whether the proposed changes are feasible or not (Cardle *et al.*, 2008).

All large scale software development like aerospace information system development involves risk of some sort. In the AIS development, an outline of the principal risks associated with the recommended option, together with the proposed measures for either avoiding or mitigating them will raise the confidence of decision-makers that the proposal for the new system has been thought through properly. This paper described an impact and risk analysis an AIS using the techniques of payback projection, discounted cash flow, and net present value.

Section two presented the cost/benefit analysis for developing AIS, financial implications analysis of AIS design and implementation is presented in section three while sections four and five discusses the conclusions and recommendations respectively.

II. AIS DEVELOPMENT COST/BENEFIT ANALYSIS

The cost/benefit analysis of the Aerospace Information System Development presents a description of the cost of carrying out the design and implementation of the system and of the benefits that are expected to flow from it. Figure 1 indicates, costs and benefits are often presented as a 'balance' and can be tangible or intangible. The can also be incurred/enjoyed immediately or in the longer term.

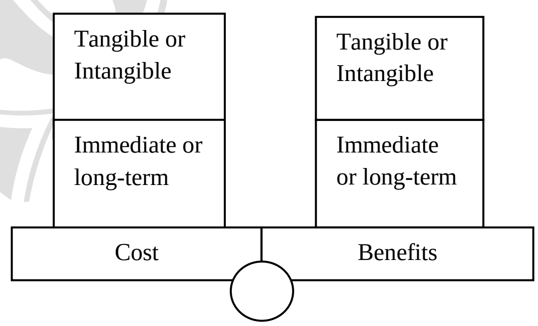

Fig 1. Cost and benefits balance

Tangible benefits can be quantified and assigned a monetary value. Intangible benefits, such as more efficient customer service or enhanced decision making can not be immediately quantified but may lead to quantifiable gains in the long run (Laudon *et al.*, 2009). Most software development projects fail due to careless treatment of intangible benefits. For example having 'better management information' will obviously be of benefit, but how much is it actually worth? It is usually better to explain what the intangible benefits are and to let the decision-makers place their own valuation on them. According to Laudon *et al.*, (2009), Aerospace Industries can invest heavily in information systems to achieve six strategic business objectives:

a. Operational excellence: Efficiency, productivity, and improved changes in business practices and management behaviour.
b. New products, services, and business models: A business model describes how a company produces, delivers, and sells a product or service to create wealth. Information systems and technologies create opportunities for products, services, and new ways to engage in business.
c. Customer and supplier intimacy: Improved communication with and service to customers raises revenues, and improved communication with suppliers lowers costs.
d. Improved decision making: Without accurate and timely information, business managers must make decisions based on forecasts, best guesses, and luck, a process that results in over and under-production of goods, raising costs, and the loss of customers.
e. Competitive advantage: Implementing effective and efficient information systems can allow a company to charge less for superior products, adding up to higher sales and profits than their competitors.
f. Survival: Information systems can also be a necessity of doing business. A necessity may be driven by industry-level changes, as in the implementation of ATMs in the retail banking industry. A necessity may also be driven by governmental regulations, such as federal or state statutes requiring a business to retain data and report specific information.

Getting reliable cost and benefits can be challenging and input from the organization's management accountants is invaluable here. Cost for elements such as new hardware or package software are usally not too difficult to obtain, but some sort of preliminary project plan may be needed for the costs of of systems development work (James Cardle et al, 2008).

III. FINANCIAL IMPLICATIONS ANALYSIS OF AIS DESIGN AND IMPLEMENTATION

Various methods are used to assess the financial implications of a system development. In the design and implementation, we outline three of the most popular methods: payback projection, discounted cash flow and internal rate of return(IRR). Payback projection is the simplest technique and is best illustrated wth the given account data and information. Here, we try to justify that installing the AIS will completely eliminate some clerical jobs. The basic facts are these:

a. The hardware will cost ₦ 12, 500, 000
b. Hardware maintenance will cost ₦ 1, 250, 000
c. The software development will cost ₦ 4, 500, 000
d. The Software maintenance will cost ₦ 500, 000
e. The system is expected to save 11 clerical posts which, with overhead costs included are worth ₦ 500, 000 each per annum (₦ 5, 500, 000 per annum overall).

The payback projection for the design and implementation of the AIS is shown in table 3.1 below.

Table 1. The payback projection

Item	Year 0	Year 1	Year 2	Year 3	Year 4
Hardware purchase	12,500,000				
Hardware maintenance	1,250,000	1,250,000	1,250,000	1,250,000	1,250,000
Software development	4,500,000				
Software maintenance	500,000	500,000	500,000	500,000	500,000
Cummulative total cost	18,750,000	20,500,000	22,250,000	24,000,000	25,750,000
Staff savings per year	5,500,000	5,500,000	5,500,000	5,500,000	5,500,000
Cummulative savings	5,500,000	11,000,000	16,500,000	22,000,000	27,500,000
Cummulative savings less cost	- 13,250,000	- 9,500,000	- 5,750,000	-2,000,000	+1,750,000

From the table it is obvious that in the first four years the costs of designing and implementing the system outweighs the savings, but from the fifth year onwards the Aerospace Information System is justified.

A. CALCULATING THE NET PRESENT VALUE OF AIS DESIGN AND IMPLEMENTATION

Net Present Value (NPV) measures the viability of a project or investment by taking into account the investments (outflow) and returns generated (inflow) from the investments. It is computed based on the sum of a series of cash flows in and out (Table 3.2). NPV takes into account the series of cash paid or received in today's value. This is different from a layman calculation of cash flows which only takes into account the Naira value of the cas h flows.

NPV is an indicator of how much value an investment or project adds to the firm. It is a central tool in discounted cash flow (DCF) analysis, and is a standard method for using the time value of money to appraise long-term projects. Used for capital budgeting, and widely throughout economics, finance, and accounting, it measures the excess or shortfall of cash flows, in present value terms, once financing charges are met. In finance, the net present value (NPV) is also known as the net present worth (NPW) of a time series of cash flows (Lin *et a.l*, 2000). In financial theory, if there is a choice between two mutually exclusive alternatives, the one yielding the higher NPV should be selected.

Table 2. Calculating NPV

If...	It means...	Then...
NPV > 0	the investment would add value to the firm	the project may be accepted
NPV < 0	the investment would subtract value from the firm	the project should be rejected
NPV = 0	the investment would neither gain nor lose value for the firm	We should be indifferent in the decision whether to accept or reject the project. This project adds no monetary value. Decision should be based on other criteria, e.g. strategic positioning or other factors not explicitly included in the calculation.

Each cash inflow/outflow is discounted back to its present value (PV). Then they are summed. Therefore NPV is the sum of all terms,

$$\frac{R_t}{(1+i)^t}$$

where

t - the time of the cash flow
i - the discount rate (the rate of return that could be earned on an investment in the financial markets with similar risk.); the opportunity cost of capital
R_t - the net cash flow (the amount of cash, inflow minus outflow) at time t. For educational purposes, R_0 is commonly placed to the left of the sum to emphasize its role as (minus) the investment.

The result of this formula if multiplied with the annual net cash in-flows and reduced by Initial Cash outlay the present value but in case where the cash flows are not equal in amount then the previous formula will be used to determine the present value of each cash flow separately. Any cash flow within 12 months will not be discounted for NPV purpose (Khan, 1993).

Thus, the disconted rate flow (DCF) is technique that addresses the time value of money and this produces the NPV for the project(software design amd implementation). The NPV take into account the interest forgone by investing in the project; in other words it reflects what else could have been done with the money. Applying this method to the financial implications of AIS Design and Implementation will make the financial analysis clearer. Assuming we have to pay 20% interest rate for the money being used on the project, the net cash flows for the design and implementation of AIS are as follows (Table 3.3):

Table 3. Calculating time-value of monetary investment

Year 0	-13,250,000	
Year 1	+ 3,750,000	(i.e 20% of 18,750,000)
Year 2	+ 3,750,000	(i.e 20% of 18,750,000)
Year 3	+ 3,750,000	(i.e 20% of 18,750,000)
Year 4	+ 3,750,000	(i.e 20% of 18,750,000)

The NPV calculation uses tables of discount factors, which depend upon the interest rates currently being used. An NPV calculated using variable discount rates (if they are known for the duration of the investment) better reflects the real situation than one calculated from a constant discount rate for the entire investment duration (Baker, 2000). The present value (PV) can be calculated for each year (Table 4):

Table 4. DCF/NPV calculations

Year	**Cash flow**	**Present value**
T=0	$\frac{-13,250,000}{(1+0.2)^0}$	- ₦ 13,250,000.00
T=1	$\frac{3,750,000}{(1+0.2)^1}$	₦ 3,123,750.00
T=2	$\frac{3,750,000}{(1+0.2)^2}$	₦ 2,602,500.00
T=3	$\frac{3,750,000}{(1+0.2)^3}$	₦ 2,171,250.00
T=4	$\frac{3,750,000}{(1+0.2)^4}$	₦ 1,807,500.00

The sum of all these present values is the net present value, which equals - ₦3,545,000.00. The general convention as tabulated earlier is that a project is justified if it produces a positive NPV. On this basis, the Design and Implementation of AIS cannot be recommended. The result is different from our simple payback calculation in table 3.1 above and vividly illustrates why DCF and NPV calculations are desirable. In our simple payback projection, it appeared the design and implementation of AIS is cost-effective and cost-justified, albeit we had to wait five years for a positive result. But the NPV calculation indicates otherwise. The result of the NPV calculation does rather depend on the period over which it is made; if the DCF and NPV had been calculated over eight years instead of five, it would have shown a positive NPV of ₦1,046,250.00. However, five years is a typical period over which an investment must be justified.

We further applied a Sensitivity analysis to the DCF and NPV calculations to observe the effect of using different discount rates. Using a discount rate of 15% in the above calculations of table 3.4 produces a net present value of – ₦2,540,000.00 and a discount rate of 10% produces an NPV of

- ₦1,366,250.00. So, it appears that the negative financial result of the Design and Implementation of AIS is relatively insensitive to rather large changes in interest rates. Ideally, the Design and Implementation of AIS was not justified soley on grounds of cost. For instance, installing an expensive software for radiotherapy in a hospital, would be justified in terms of the improvements in patients care that could be made with it. Similarly, the Design and Implementation of AIS is justified by intangible benefits stated earlier. However, the DCF and NPV calculations enable the decision-makers to see the true financial costs of their decisions.

B. USING THE INTERNAL RATE OF RETURN (IRR)

Laudon et al (2009) defined IRR as the rate of return or profit that an investment is expected to earn, taking into account the time value of money. IRR is discounted (interest) rate that will equate the present value of the project's furture cash flow to the initial cost of project. One tries different discount rates until an NPV of zero is achieved. Applying the rule to table 3.4 above the IRR is 5.136 percent. All other things being equal, a software development with IRR of 10% would be better than one with 5%. The major problem with IRR is that it does not consider the sheer size of competting projects. Based on this, most decision-makers aggree that DCF/NPV is the better measure to use.

IV. CONCLUSION

The impact and risk analysis of a software development is essential before the software design and implementation is undertaken as it will define the scope of the project in broad terms and establish what are the cost and benefits of undertaking it. Ideally, the software project manager should be involved in the impact and risk analysis, as well as have significant input to it. The analysis provides the baseline against which possible changes to the scope or direction of the software development can be evaluated and decided on. Information technology investments must be thought of in terms of a firm's overall information system. This research explains and illustrates that in any software development project, the analysis stage documenting, designing and costing technical requirements for the needs of decision-makers - is vital to the success of the project. The core implementation have taken into account the needs of both the managerial and end-user.

V. RECOMMENDATIONS

The full benefits of the project will not be fully experienced or achieved until the system becomes executive and has a period of stability, for at least a whole year. Once the system has become stable and users have had time to adjust to new working practices the benefits of lower cost will become visible. The sustainability of Aerospace information systems (AIS) during the post-implementation period needs to be looked into. There is a lack of clear understanding about the strategic needs and requirements for sustaining the effectiveness of large-scale information systems after a period of relative stability following initial implementation. Sustainability and management of AIS is therefore a very important research dimension that needs to be explored to maximise the benefits of an expensive information system investment such as AIS.

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