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## SPREADSHEET APPLICATION IN PROJECT PLANNING AND SCHEDULING – An essential tool for efficient application of Microsoft Project

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### ABSTRACT

*Project network planning is aimed at enhancing communication between managers and site operatives in meeting time, cost and performance objectives of a project. Today, the preparation of project networks and scheduling of resources have been simplified because of readily available project planning application soft wares. Spreadsheet offers one of the Information Communication Technology tools for the preparation of input data, which is required to be presented in quantitative terms and also the representation of resource schedules in graphical forms. This paper however explores the application of the Microsoft Excel spreadsheet in project planning, scheduling and resource control.*

### 1.0 INTRODUCTION

Developing project network plans and resource scheduling takes time for someone or group of persons to develop (Gray & Larson, 2000; Oxley & Poskitt, 1980; and Harris & Mc Caffer, 1979). Project planning, resource control and scheduling are essential requirements in the administration of construction contracts. For this reason, general application softwares have been developed in the Information and Communication Technology world which can be used to simplify its preparation, updating and monitoring.

The most popular of these application softwares is the Microsoft Project (MS Projects) which accompanies the Microsoft Office for windows. These application softwares are not custom built for construction project administration works alone; instead they are for general project management works.

In the preparation of project networks, the information collected for the Work Breakdown Struc-

ture (WBS) has to be represented in quantitative terms e.g. time requirement, gang balancing, equipment required etc to carry out an operation. This shows that a lot of input data would have to be estimated perhaps not manually. In construction works, synthetic data of time required to complete an operation have been published by the Federation of Building and Civil Engineering Employers of Nigeria, which can be readily used in calculating time required to complete an operation. Often times the construction company could determine its synthetic data of work outputs through work study.

This paper explores the use of the Microsoft Excel spreadsheet in project planning and scheduling for the preparation of input data for Microsoft Project application, resources planning and scheduling and for graphical presentation of their output The Microsoft Excel is an application package, which also accompanies the Microsoft Office. It means

that both the MS Excel and MS Project can be opened concurrently and referencing of any input data could be made by mere left clicking with a mouse to activate a hidden window.

### 2.0 MICROSOFT EXCEL SPREADSHEET

A spreadsheet is the computer equivalent of a paper ledger sheet. It contains a grid made from columns and rows, which enables easy referencing of any data fed into the spreadsheet. It is an environment that can make number manipulation easy and somewhat painless. A Microsoft Excel spreadsheet contains 65,536 rows and 256 columns (FGCU, 2005; Abdul, 2002). For easy identification of a referenced cell, the cell identification appears on the top tab. The cell corresponding to the row is also highlighted. The primary function of a spreadsheet is to help in the calculation, storage, manipulation and presentation of numbers or data. In each cell there are three basic types of data

that can be entered which include the following:

- i text (labels)
- ii number data (constants)
- iii formula (mathematical equations)

Spreadsheets have many Math functions built into them. Among the most basic operations are the standard multiply, divide, add and subtract. It is important to note that the operations follow the order of operations (just like algebra calculations BODMAS).

## 2.1 ADDRESS AND ADDRESSING TYPES IN MS EXCEL SPREADSHEET

Microsoft Excel cells are usually referenced by stating the column letter followed by the row number. The syntax therefore is "Column letter Row number". There are basically three types of addressing styles

### 2.1.1 RELATIVE REFERENCING

Calling cells by just their column and row labels such as "A1" is called **relative referencing**. When a formula contains relative referencing and it is copied from one cell to another, Excel does not create an exact copy of the formula. It will change cell addresses relative to the row and the column they are moved to. For example, if numbers in cells A1 through cell A8 are to be summed up and the sum total entered in cell A9, the formula code can be written as:

= SUM(A1:A8)

Quattro Pro: @SUM(A1:A8)

This simple addition formula like this can be copied to cell B9 by simple double clicking the reference cell with the mouse pointer displaying a moving border or dotted line on the cell. Cell B9 then displays: =SUM(B1:B8)

The Excel spreadsheet could carry out this assignment through its property known as 'relative referencing format'

### 2.1.2 ABSOLUTE REFERENCING

To prevent the change in formula as shown above, the cells must be called by **absolute referencing** and this is accompanied by placing a dollar sign "\$" within the cell addresses in the formula. Re-writing the former example, the formula in cell A9 would read:

: =SUM (\$A\$1:\$A\$8)

Quattro

Pro:

@SUM(\$A\$1:\$A\$8)

If the value in cell A9 which is the sum of A1 through A8 is copied into cell B9, both the row and the column of both cells are absolute and would not change when copied. When an absolute reference is used in a formula, Excel uses the specific cell reference that you enter regardless of where the formula is copied.

### 2.1.3 MIXED REFERENCING

Where only the row or column is fixed, the resulting addressing system is referred to as mixed referencing. For example, in the

formula:

=(A\$1+\$B2)

the row of cell A1 is fixed while the column of cell B2 is fixed.

## 3.0 EXAMPLES

### 3.1 THE CRITICAL PATH ANALYSIS EXAMPLE PROBLEM

This first example demonstrates the use of Microsoft Excel in project network planning using the Critical Path Method (CPM). The CPM is one of the several techniques used in project planning. CPM can help to figure out:

- how long a project will take to complete
- which activities along the path are critical, meaning that they have to be done on time else the whole project will take a longer time than estimated.

In everyday practice, the project network is usually represented as a graphic display of the flow and the sequence of work through the project. Certain decisions could also be made once the critical path is known, such as decision to speed up the work and what is the least costly way to speed up the project.

CPM can only be used when the activities have predecessors and successors and time or durations are allocated to each activity. The foregoing illustration will be used, with each of the activities' required predecessors and durations given. The activity on the arrow (AOA) method is used here.



Activity	Predecessor	Duration
A	None	5 months
B	A	3 months
C	A	4 months
D	A	4 months
E	B	2 months
F	B	4 months
G	C, F	2 months
H	D, G	3 months
I	E	2 months
J	I, H	4 months

The activity on the arrow diagram for this example problem is presented in the Figure 1.0 as shown below.

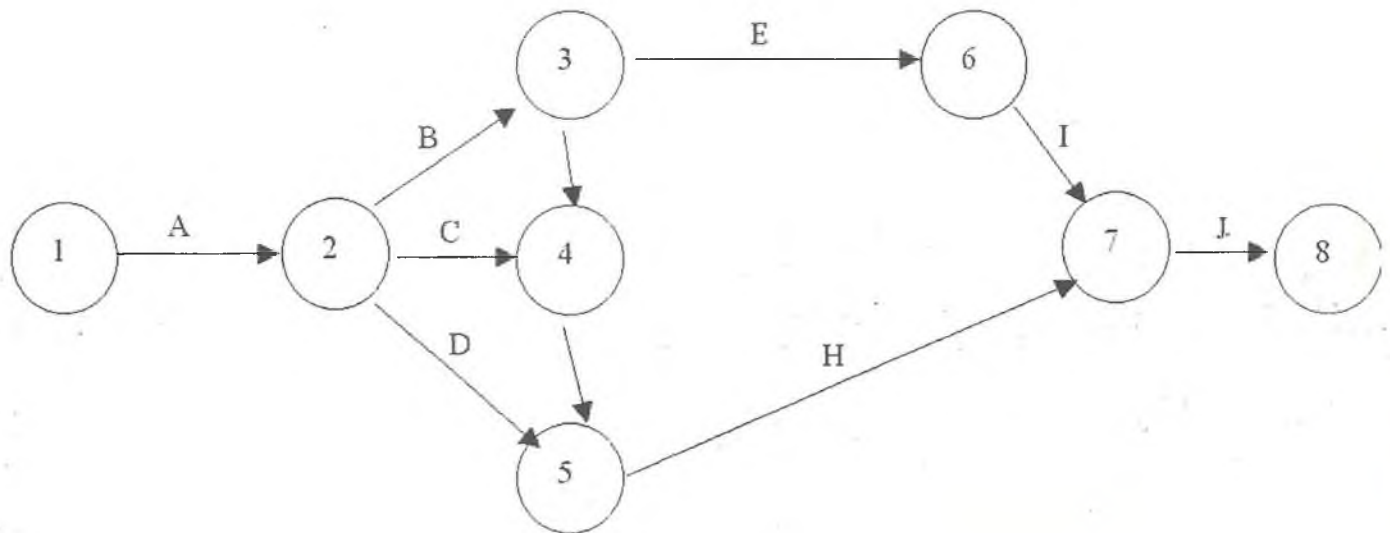
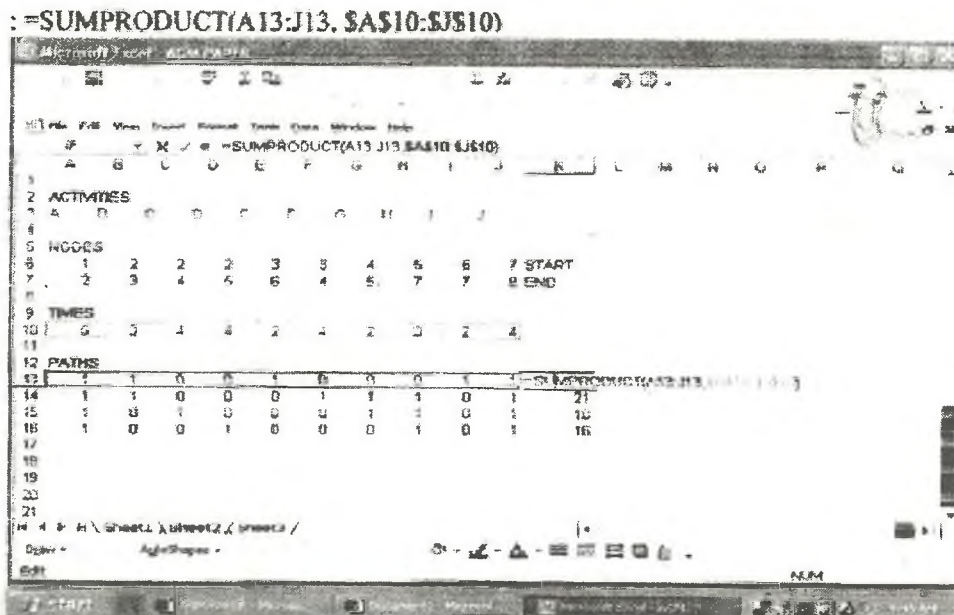


Figure 1.0 Network Diagram (AOA)



Set up the Excel spreadsheet to calculate the critical path analysis as follows:

- i) type the word "ACTIVITIES" and enter the activities A - J as shown in cell A7 through cell J7
- ii) Type the word "NODES" which represents the node numbers for each of the activities as shown in the figure and then type each activities end nodes. This should be done carefully to avoid error in the entry.
- iii) Type the word "TIMES" and enter the activity durations accordingly, iv) type the word "PATH" and enter all the possible paths. In this example, the four possible paths are: ABEFJ, ABFGHJ, ACGHJ and ADHJ represented by zeroes and 1's. Discovering the possible paths can be done by hand in the manner demonstrated here. However, Baker (2004), has provided a computer program called Pathfind which can help find and enter into the spreadsheet of all possible paths as shown on the arrow diagram. It is available through Internet connection and the browser.
- v) Calculate the path's times for all of the paths using the Excel in built math function 'sum product with the formula code: =SUMPRODUCT(A13:J13, \$A\$10:\$J\$10). This formula code can be copied and pasted to fill values in other cells.
- vi) type "MAX" in cell J17 determine the longest time by coding in cell K17 by typing =MAX(K13:K16) and the longest path is displayed in cell K17
- vii) identify the critical path by first identifying the path that takes the longest time. It is easier to see which activities are in each path by a simple conditional statement coded as:

=IF(A13=1.A\$3,"). Copy the cell in A18 and fill the other range of cells and you will the paths displayed

- vi) To determine which path is critical can also be carried out by simple conditional statement which is coded as:

IF(K13=\$K\$17,"CRITICAL",) "). The word critical will then be displayed in cell K19.

For a project involving a large number of activities, this procedure can get the task done more quickly. For more procedure on implementing 'costs and crash costs' in project planning and scheduling, see Baker (2004).

### 3.2 CASH FLOW FORECASTING EXAMPLE PROBLEM

This second example demonstrates the use of Microsoft Excel spreadsheet in cash flow forecasting. A cash flow essentially represents the transfer of money into or out of the company. It could also be described as a statement of expected cash receipt and payment projected over the contract period. The input requirements of a cash flow forecasting system includes the following:

- i) the contract period
- ii) The measurement and certification interval
- iii) The payment delay between the certification and contractor receiving cash
- iv) the retention conditions and retention payment arrangements
- v) the project costs broken down into labour, plant and materials
- vi) the delay between incurring a cost liability (labour, plant and materials) and meeting the liability
- vii) the graph of value versus time, value being the money the contractor will eventually receive for doing the job.
- viii) the graph of cost versus time, cost being the contractor's cost liability arising from labour, plant, materials and subcontractors and other cost headings as necessary
- ix) the head office outgoings and the time of their occurrence
- x) the head office incomings and their time of occurrence.

Items 1 - 4 are readily available, item 5 can be estimated while item 6 can readily be supplied by the purchasing department. Items 7 & 8 are a little more difficult to estimate manually but could be calculated more easily by the use of Microsoft Excel spreadsheet. In practice, deriving the graph of value

the value of each activity and sum up the value in each time period cumulatively. The graph of cash flow profile could also be drawn from the cash flow forecast table.

This example is curled from Harris and McCaffer(1979) as shown in Table 6. It demonstrates the visual representation of spreadsheet output on a two dimensional graph. However, the estimation of all the values of inputs in items 1 - 12 is not shown. They are usually obtained in the cumulative cost estimate usually presented in bar chart form. Item 13 is obtained by coding in cell C17 as: =C10+C12+C14+C16 and Item 14 is obtained by coding in cell

C18as: =C6+C7-C17

The cumulative cash flow profile is drawn as shown in Table 2

Table 2.0

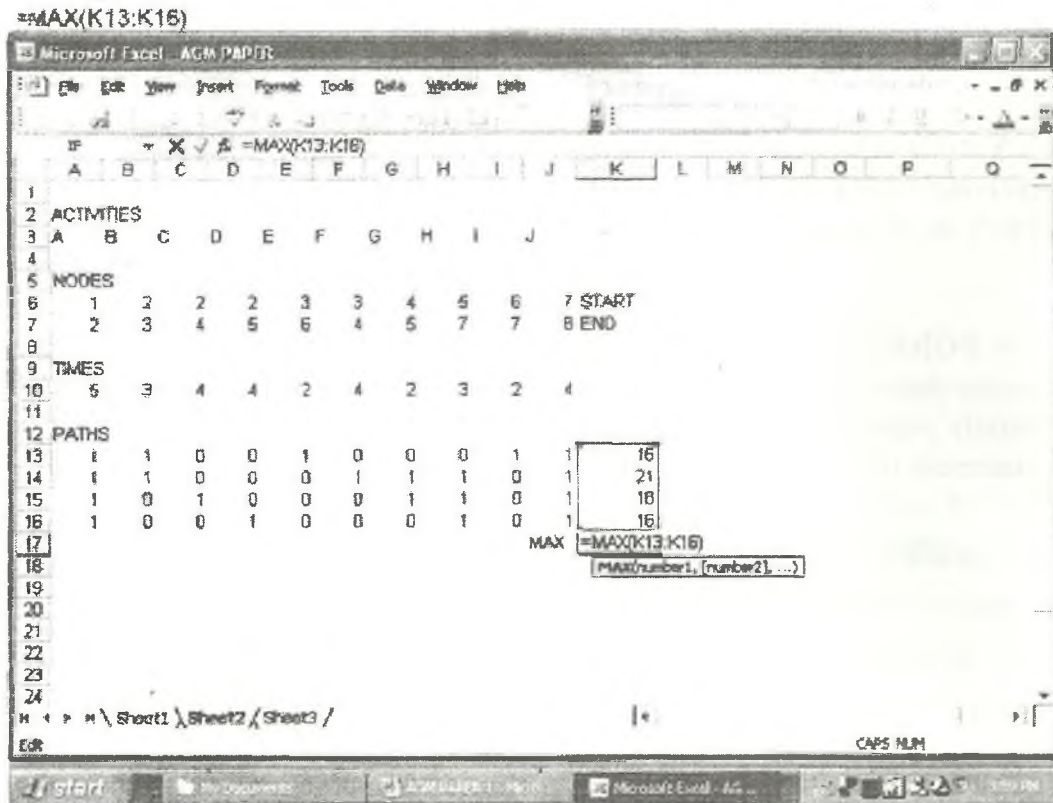




Table 3.0

1											
2	ACTIVITIES										
3	A	B	C	D	E	F	G	H	I	J	
4											
5	NODES										
6	1	2	3	4	5	6	7	8	9	10	START
7	2	3	4	5	6	7	8	9	10	11	END
8											
9	TIMES										
10	5	3	4	4	2	4	2	3	2	4	
11											
12	PATHS										
13	1	1	0	0	1	0	0	0	1	1	16
14	1	1	0	0	0	0	1	1	1	0	21
15	1	0	1	0	0	0	1	1	0	1	16
16	1	0	0	1	0	0	0	1	0	1	16
17											MAX 21
18	A	B			E	F	G	H	I	J	
19	A	B								J	
20	A	B	C							H	
21	A			D						H	

Table 4.0

IF(K13=\$K\$17,"CRITICAL","").

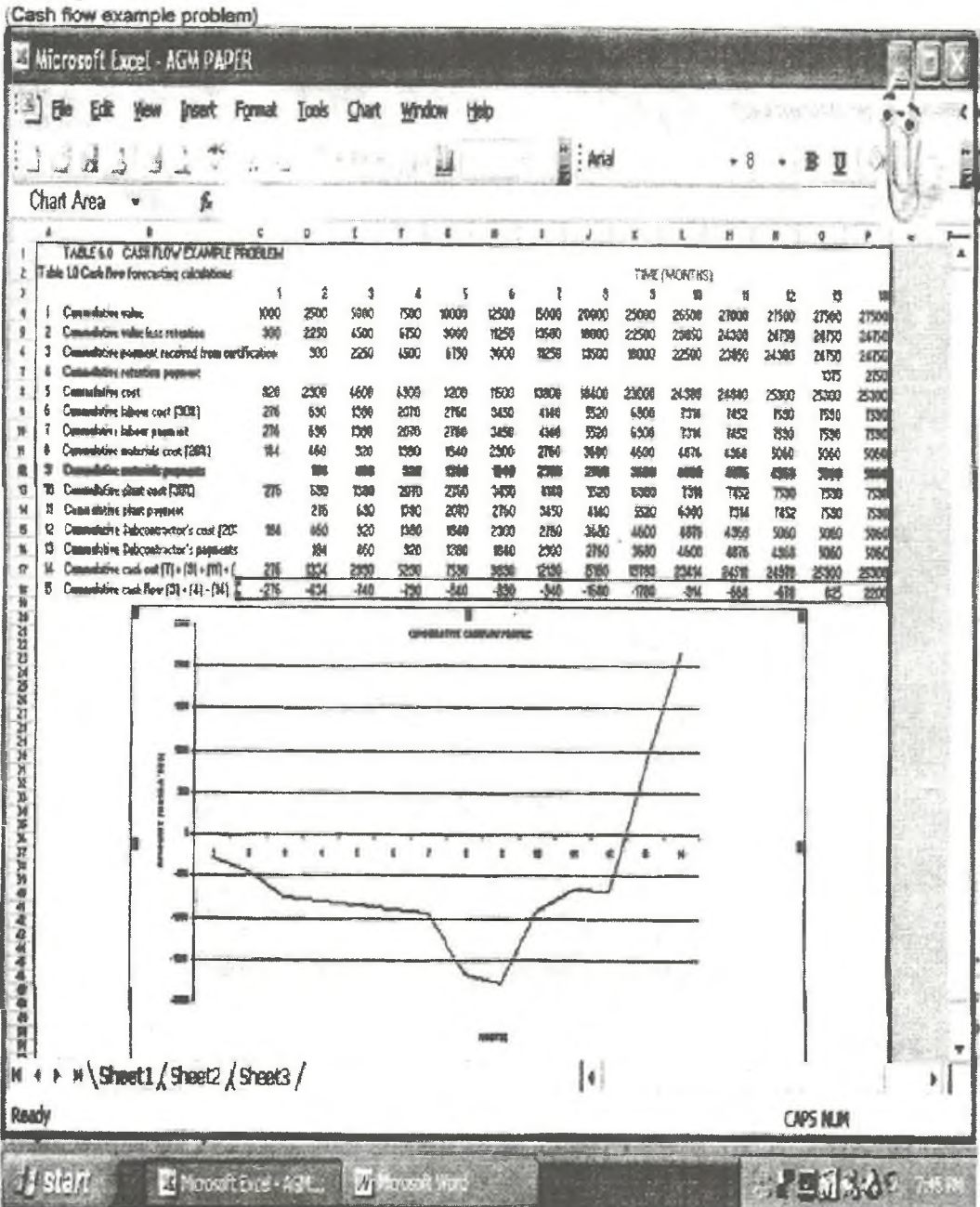
1											
2	ACTIVITIES										
3	A	B	C	D	E	F	G	H	I	J	
4											
5	NODES										
6	1	2	3	4	5	6	7	8	9	10	START
7	2	3	4	5	6	7	8	9	10	11	END
8											
9	TIMES										
10	5	3	4	4	2	4	2	3	2	4	
11											
12	PATHS										
13	1	1	0	0	1	0	0	0	1	1	16
14	1	1	0	0	0	0	1	1	1	0	21
15	1	0	1	0	0	0	1	1	0	1	16
16	1	0	0	1	0	0	0	1	0	1	16
17											MAX 21
18	A	B			E	F	G	H	I	J	CRITICAL
19	A	B								J	CRITICAL
20	A	B	C							H	
21	A			D						H	

Table 5.0

(Final result of the example)

1											
2	ACTIVITIES										
3	A	B	C	D	E	F	G	H	I	J	
4											
5	NODES										
6	1	2	3	4	5	6	7	8	9	10	START
7	2	3	4	5	6	7	8	9	10	11	END
8											
9	TIMES										
10	5	3	4	4	2	4	2	3	2	4	
11											
12	PATHS										
13	1	1	0	0	1	0	0	0	1	1	16
14	1	1	0	0	0	0	1	1	1	0	21
15	1	0	1	0	0	0	1	1	0	1	16
16	1	0	0	1	0	0	0	1	0	1	16
17											MAX 21
18	A	B			E	F	G	H	I	J	CRITICAL
19	A	B								J	CRITICAL
20	A	B	C							H	
21	A			D						H	

Table 6.0





#### **4.0 CONCLUSION**

The foregoing discussion with the examples problems shows that spreadsheet is an indispensable application software in project planning and scheduling, resource control etc. It enhances the computational capability of the project manager without any risk of error particularly when working with a very large set of data once he is well acquainted with MS Excel's referencing styles. Its use would also enhance easy inputs of data requirement when using the MS Projects application software. The line of balance method of project planning for repetitive projects which MS Projects cannot handle can conveniently be handled using spreadsheet.

#### **5.0 REFERENCES**

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