

## **“Afield Survey to Evaluate the Earned Value Management (EVM) Implementation in Construction Companies in Khartoum State”**

### **By Researchers:**

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## Abstract:

Earned value management is an effective project tracking tool that links actual achievement planned time and actual cost by calculating the project performance is monitored by conducting a complete analysis of activities, the study aimed to verify the extent to which the concept of (EVM) is activated in companies and evaluate the implementation and know the extent of commitment to it as modern and advanced tool to monitoring the projects, the survey targeted project manager according to their degrees and experience in the public and private sector in the state of Khartoum were distributed to the sample then the results were collected and several then data was analyzed using the statistical analysis program (package 2019) results were reached the most important of which is that the acquired value determines the direction and future of the it also allows the administration to take the project and shows negative deviations early and shows poor performance necessary corrective actions and decisions to continue the project, also some companies are not familiar with the concept for monitoring and planning. and most modern techniques

**Key words:** Earned Value Management, Khartoum State, Construction Projects, Value Analysis, Monitoring, and Project Manager.

## Introduction:

### Project management:

It is the science concerned with planning, follow-up, management and management of resources to achieve the success of the project in the specified time and cost and the required quality, which is a key element for the development of business in all sectors, private or public.

The most project managers cannot afford to fail and not bear the consequences, so it was necessary to resort for unailing tools and the techniques aimed for monitoring and controlling such projects, therefore the United States of America and <sup>[1]</sup> other countries adopted what is known as the value management system gained

### The earned value management:-

it is an integrated approach to control and manage the elements of the project objectively and anticipate their future directions and potential risks with making corrective changes to the projects as it provides a method of what has already been accomplished within the scope of the project in a simple, easy and more flexible way, The main objective of the value gained is to conclude a negative deviation from the plan so early that the administration can make the necessary corrective decisions and allow preferences to be analyzed. It is also an evaluation of the performance of the workflow for a certain period, which determines the activity accomplished during that period, which represents the achievement rate <sup>[1]</sup>.

### The most important benefits of using the acquired value management system are:

- Gives management ability to make corrective decisions early.
- Is the only system that provides reliable data for censorship?
- Integrates the scope of work, schedule and cost based on the retail structure of the project (WBS).
- The cumulative performance cost index provides a signal for the early visit of the project budget (CPI).
- Schedule Performance Index provides a signal for early project time (SPI).
- Ease of weekly and monthly periodic reports.
- Help identify the types of problems facing the project.

. Increase the chance of delivering the project on time <sup>[6]</sup>

## Research methodology:

To study the research problem and achieve the goals descriptive analytical approach as used phenomenon as it is in reality and describes it accurately and determines the extent of its relevance to the phenomenon so it as the most appropriate tools is the questionnaire or field survey.

### Search problem:

The problems that companies face in the recent period from the late completion of the project at the time and the specified cost and frequent deviations from the basic plan of the project, most companies do not keep pace with modern concepts especially the concept of value management as modern tools of planning and monitoring and early forecasting of risks and problems.

### The importance of searching:

Earned value management is only system that provides reliable data for management and gives important indicators of cost and time measures performance and determines the type problems facing the project, it allows management to make corrective decisions and make comparisons.

### Research objectives:

- \* Study the Earned value management concepts, history, benefits, and how to apply it in the project.
- \* Evaluating the extent of activating the concept for companies in Khartoum state.
- \* Learn about the obstacles facing most companies that do not apply the concept and other modern concepts.

### Research hypotheses:

Most companies are not interested in modern methods and are continuing in traditional tools, there are a few companies that are interested implementation of earned value management are deficiencies in their activation and implementation.

### Research literature:

#### What is the value gained provides are the work of three comparisons:

#### Planned value (PV):

stick on the approved project work plan and the actual workflow of each activity according to those values, which is the calculated cost duration of the activity and, it is always calculated after the passage of 20% of the project is called Baseline or Budgeted cost work scheduled (BCWS).

#### Earned value (EV):

it is the evaluation of the performance of the workflow for a certain period during which the activity accomplished is determined and it is the completion rate which is the basic cost of the budget in the period of the activity recorded and specified.

#### Actual value (VC):

It reflects what has been disbursed and completed as a cost and resources on the project to date and is the actual cost .recorded in the project in the actual duration of the activity (ACWP) <sup>[2]</sup>

### The history of the earned value management:

The history of earned value management dates back to the industry in the nineteenth century in the united states of America in order to measure daily productivity and compare it with the standard productivity ,the terms were used by engineers in the daily measurement ,the project and the representation of relation of activities as for the real appearance as in the 1967 American Air Force some decisions were made to use it officially in the form of binding standards especially for contractors to implementation projects <sup>l</sup>

### The relationship between project management processes and value elements gained:

It is known that the project management processes are five processes (start, planning, execution, follow-up, closure) which overlap during the life cycle of the project and the assets of the acquired value is calculated as described in the following table:

**Table (1): Project processes** <sup>[3]</sup>

Planning processes	Executing processes	Surveillance and controlling processes
1-Project Management Plan Work. 2-Work schedule. 3-Calculating project resources. 4-Budget work .	The following values are measured as inputs for the earned value system: 1/ Actual cost 2/ Earned 3/ CV, SV	Performance and achievement efficiency is measured to measure these transactions: CPI SPI ETC EAC

### How to apply and practice crisis to activate EVM:

- The following by work PMP.
- Good preparation for project structuring WBS.
- Defining responsibilities OBS.
- Identify the resources in need of each activity.
- Measuring and analyzing performance as opposed to the master plan.
- Registration the use of resources in implementation
- Recording the progress of the business.
- Analysis and forecasting of cost and table performance.
- Making periodic reports on the progress of the work and how to complete the corrective measures <sup>[3]</sup>

### Value management analysis, performance measurement and forecasting:

- At the value analysis stage, you know how to use the three acquired value elements to know the current and future status of the project, and a fourth element, the planned total value of the project, can be defined ( Budget at completion).

### The analysis is done in three things:

- Distractions.
  - scheduling deviation is used to measure percent scheduling performance.
- Cost deviation shows deviation in budget estimate.
- Accounting deviation shows deviation between planned and acquired cost.
- Total deviation is the difference between the actual accumulated costs of the WORK done BY TV.

- Time variance is a variation in the scheduled time of the work done ST.

### Indicator:

- Cost Performance Index used to see exceed or decrease.
- Scheduling performance index used to see the progress of the schedule performance.
- The overall performance index gives this indicator a clear picture of the extent to which the project is constrained by the plan developed by CSI.

### Forecasts:

. The critical ratio is used to predict that the project in danger or in good condition, but only in line with the plan <sup>[3]</sup>

### Important questions for project management to be answered by managing the value earned through the following table:

Table (2): Project Questions and Answer: <sup>[1]</sup>

Project Management Questions	The answer from the methodology
1-How can be with project time?	Time analysis/scheduling/forecasting
Is the project advanced or lagging behind the plan?	By calculating scheduling deviation
How do we know that we are effectively taking advantage of the time available in the project?	Calculates the SPI
4/ When to finish work on the project?	By calculating the completion time estimate
5/ How can we estimate the cost of the project?	Cost analysis/forecasting
6/ Is the cost of the project less or more than the budget?	Calculates CV
7/How do we know how to use our resources effectively?	CPI calculates
8/How do we use the remaining resources effectively?	TCPI Works Achievement Guide
9/what is the Potential project cost?	By calculating the EAC
10/ Will the final cost be lower or higher than the budget?	Calculates the VAC deviation
11/ What is the cost of the remaining work in the project?	Calculates the cost of the remaining works ETC

### Tools and methods :

The verity the research hypotheses the questionnaire and statistical methods were used as tool to collect and analyze data by percentage and frequency tables and validity of the statistical analysis program , the questionnaire targeted construction managers in the government and private sectors according to the educational qualification and years of experience and the special part of the loans number of more than 50copies were distributed 45 copies of which were collected for analysis and showing the result.

### Reliability and Validity:

Stability means that measure gives the same results if used more than once under similar conditions.

Reliability is defined as the extent to which a questionnaire, test, observation or any measurement procedure produces the same results on repeated trials.

Validity is defined as the extent to which the instrument measures what it purports to measure. and calculate in many ways represents the easiest being the square root of the reliability coefficient

$$\text{Validity} = \sqrt{\text{Reliability}}$$

researcher calculates the reliability coefficient of the scale used in the questionnaire by alpha equation and the results as follows:

**Table (3) Reliability and Validity:**

Questionnaire	
reliability coefficient	Validity coefficient
0.85	0.725

Source: prepared by researcher, using SPSS, 2019

Notes from the results table that all reliability and validity coefficients for questionnaire is greater than (50%) and close to the one, This indicates that the questionnaire is characterized by high reliability and validity, and makes statistical .analysis acceptable

### - Percentages.

To get results as accurate as possible, has been used SPSS statistical software, which indicates a shortcut to Statistical Package for Social Sciences.

### Section 1 (General Data):

General data and personal information to match the research sample of the international qualification experience for the specialization sector working with local money or age.

\* The target of the sample included a wide range of scientific qualifications

.Most of it is bachelor and master's degrees and various specializations

the most important of it is civil engineering with experience in the field not less than 25 years and most of them in the \* education sector and the government sector with implemented projects not less than five projects and a capital not less than \$ 50,000,00. Most of the engineers do not have professional certificates number numerator holds project management certificates.

### Section tow :( Earned Value Management)

It is an effective project management department that links actual delivery with planned time, actual cost issued and cost minimized by virtually renewable activities and deviations as the following:

- 1- Is it an integrated approach to manage and control the project?
  - 2- Is it based on the principle of achievement and is it a system of control.
  - 3- Do you use the administration to make the right decisions?
  - 4- Do you infer negative deviation from the plan at a specific time and identify areas of weak administration
- Identify the new transition plan, use of computer software and Continuous team training. The best way to implement E.M.V is to develop management skills and activate it as an important project management.)
  - It is an integrated approach to control the project components and it determines the direction of the project in the future accurately and determines the direction of potential risks.
  - It determines the percentage of project direction in all activities. It is a system of control and a system that allows corrective decisions to be taken. It works to withdraw the negative deviation from a plan early. It is the most important point for the application of value management is the successful management using continuous training programs.

### Previous studies:

**Made sudsier, Idea sutra, Kieta stapes (2018)** –Evaluation of project implementation performance with earned value method: The aim of the study is to apply the value management to how performance of development of the cases study with method of result when it is reported and hat it remaining cost time required complete the project and the risks<sup>[5]</sup> .

**- Mohieddin Abdurrahman Gaily(2012)** - Management of the value gained to monitor and follow up the performance of engineering projects - Omdurman Islamic University -: The aim of the study is to apply the value gained in residential construction projects identifying a residential building in the Area of Khartoum Mujahedeen was applied to find out the status of the project and find out The reasons for the deviation in time and cost were used by Primavera and a chart was . drawn to display the results <sup>[6]</sup>

**- Mohammed Abdurrahman Abdullah Al-Khanaqi(2014)** - The possibility of applying the management of the value gained in the building in Sudan - Sudan University for Science and Technology 2014: The most important objectives are to identify the elements of the success of the project and determine the level of understanding and application of the value gained and determining its importance in analyzing and monitoring the performance The projects were a questionnaire .targeting several companies in Khartoum state <sup>[7]</sup>

**- Hassam Ali and Zeina Hussein (2013)** - a field study to evaluate the performance of construction projects and the time management machine in the Euphrates region - Babylon University - Technical College Al-Musayib 2013 - the study aims mainly to find sufficient ways to exploit the optimal time for the project in the Euphrates region and know the time wastes and causes Delaying projects and how to control them and developing appropriate solutions through a case study (multi-purpose base) <sup>[8]</sup>

**- Lubna Mohammed (2010)** Application of the management of the value gained in construction projects in Sudan - Sudan University for Science and Technology -: The main goal is to apply the methodology of value gained in the rehabilitation project of the residential city in Al-Rasyras city to see the benefits of its use in the follow-up and monitoring of .performance measurement The project results showed several deviations of both cost and time <sup>[9]</sup>

**- Agata Garnigowska (2008)** Earned value method as tool for project control institute of construction faculty of civil engineering – Lublin university of technology The main goal is to apply the idea of earned value analysis and interpretation of it results in how to input the data and how to calculate that and the purpose of it and project control and implementation .of earned vale <sup>schedule [10]</sup>

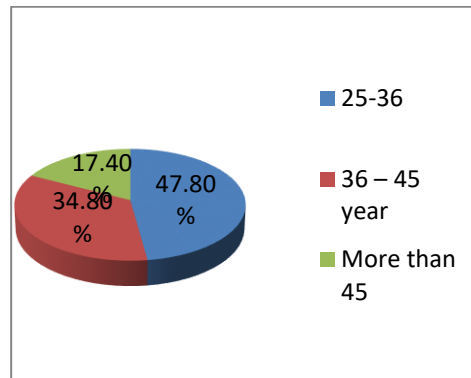
**-Thomas .F. Therdomas &Cough brought** – Integrated Cost Management System For Developing Construction Project Laugh borough University Institutional Repository 2017: The main objectives is Establishing conceptual form of the integrated cost management <sup>[11]</sup>

## Results & Discussion:

To get results as accurate as possible, has been used SPSS statistical software, which indicates a shortcut to Statistical Package for Social Sciences.

### 1- Age Group :-

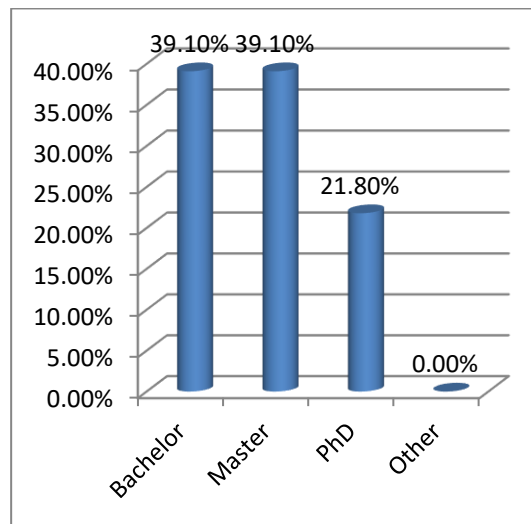
Figure (1):



From figure (1) we note that the age of most of the individuals study are (25-36 year) by (22) and with (47.8%) while the total number is (36- 45 year) by (31) and with (31%)

### 2- Qualification

Figure (2):

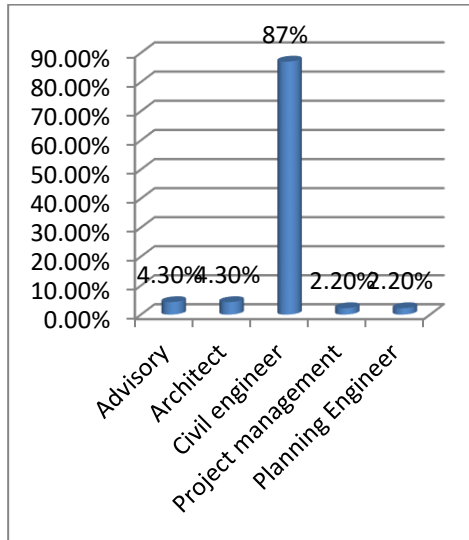


From table (4) and figure (4) we note that the Qualification of most of the individuals study are (Bachelor and Master) by (18) and with (39.1%)



### 3- Specialization:-

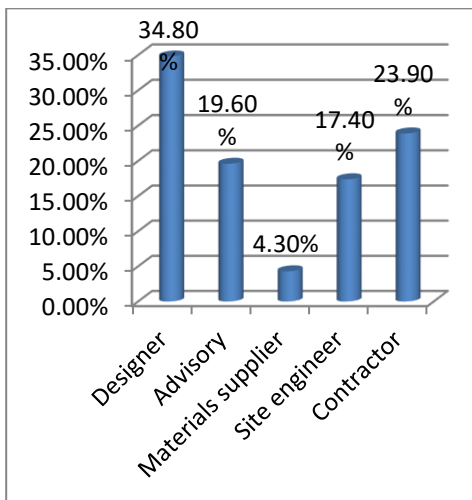
Figure (3)



From table (5) and figure (5) we note that the Specialization of most of the individuals study are (Civil engineer) by (40)and with (87%)

### 4- Classification:-

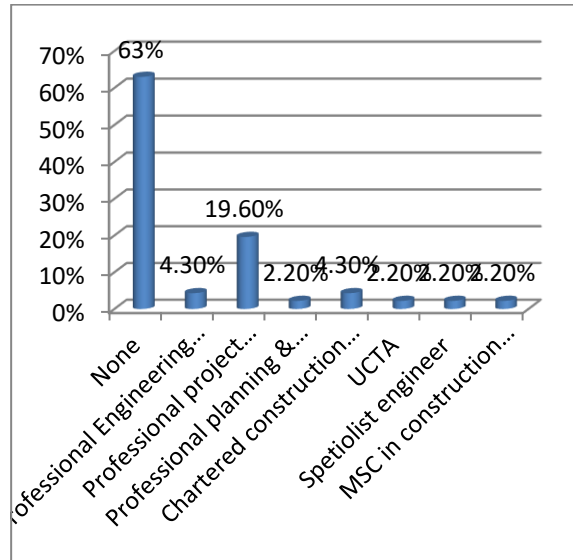
Figure (4):



From figure (4) we note that the Classification of most of the individuals study are (Designer) by (16)and with (34.8%) .

**5- Profession certificated:-**

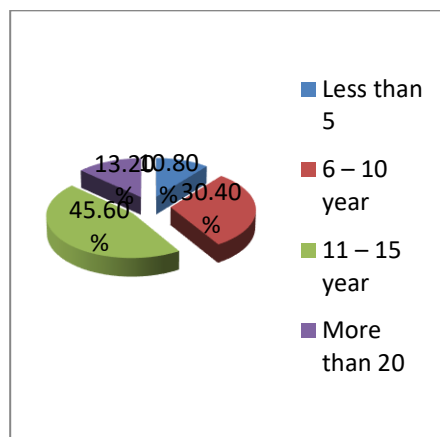
**Figure (5):**



From figure (5) we note that the Which of the following profession certificated do you have of most of the individuals study are (None) by (29)and with (63%)

**6- Experience (years) :-**

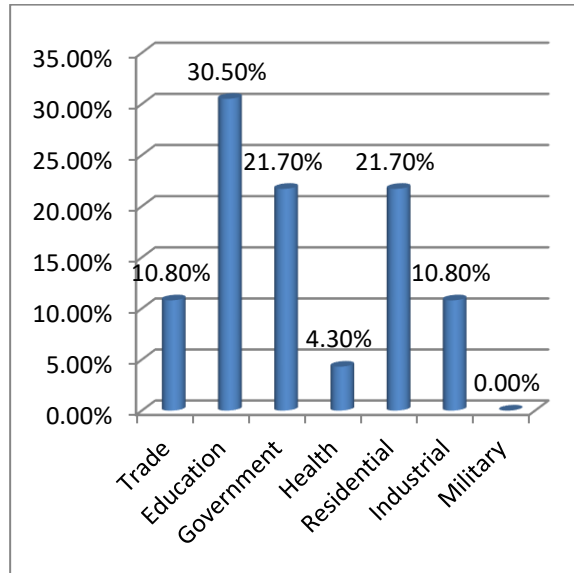
**Figure (6):**



From figure (6) we note that the Experience of most of the individuals study are (11 - 15 year) by (21)and with (45.6%)

**7- Sectors of interest to the institution:-**

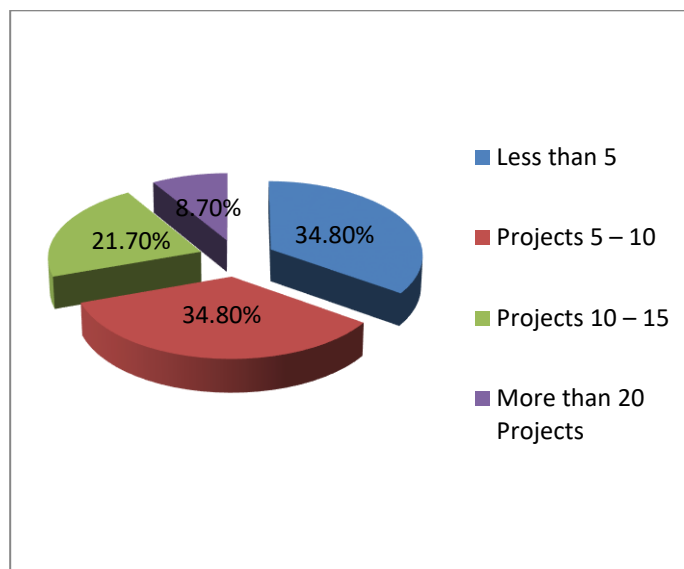
**Figure (7):**



From figure (7) we note that the Sectors of interest to the institution in which you work of most of the individuals study are (Education) by (14) and with (30.5%)

**8- Projects Implemented during the last Years**

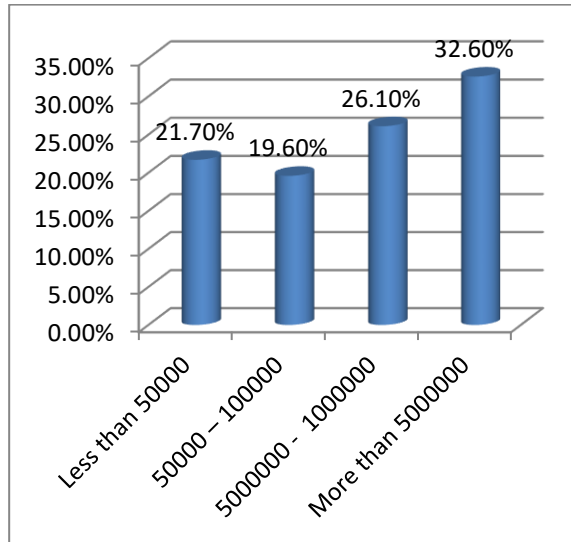
**Figure (8):**



From figure (8) we note that the Projects Implemented during the last Years of most of the individuals study are (Less than 5 and Projects 5 - 10 ) by (16) and with (34.8%)

### 9- The Company's Capital (USD)

Figure (9):

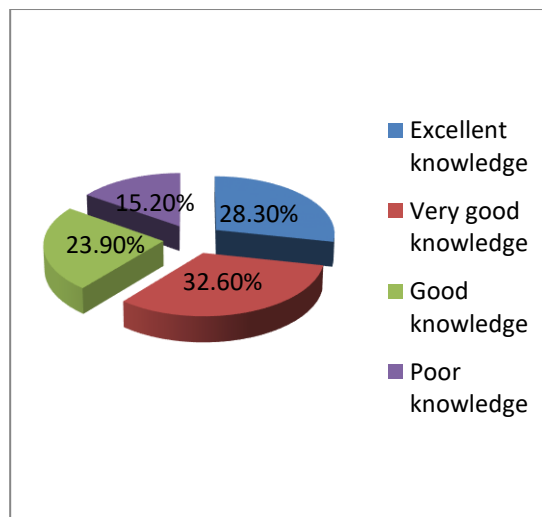


From table (11) and figure (11) we note that the Company's Capital (USD) of most of the individuals study are (More than 5000000) by (15) and with (32.6%)

### Section tow: Earned Value Management

\*- Assessment of knowledge of Earned value management:-

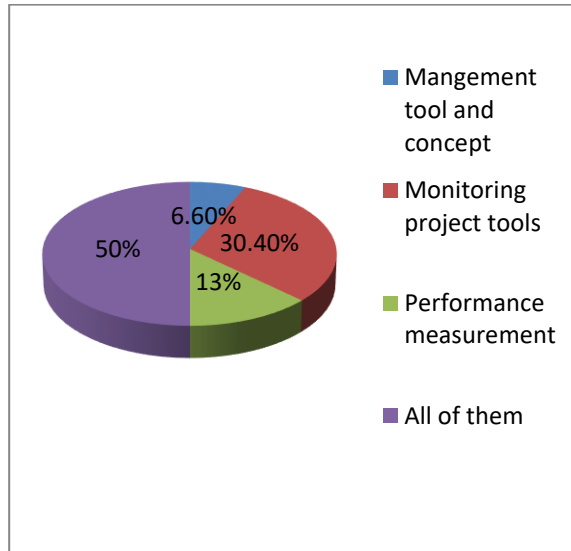
Figure (10):



From figure (10) we note that the What is your assessment of your knowledge of Earned value management of most of the individuals study are (Very good knowledge) by (15)and with (32.6%)

**\* The EVM is considered as the construction project:**

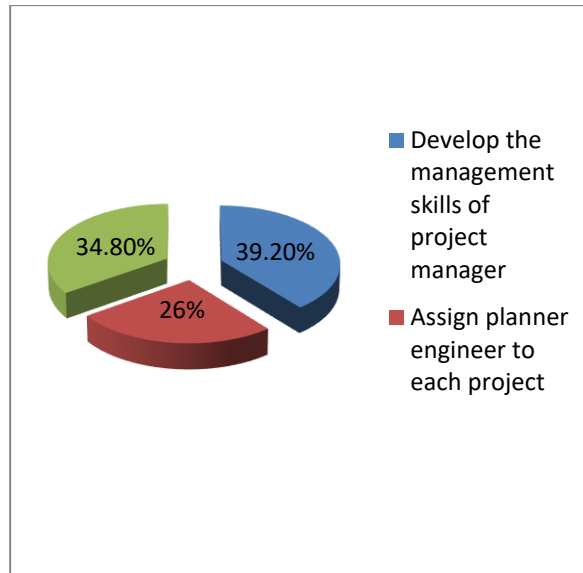
**Figure (11):**



From figure (11) we note that the Through your experience the EVM is considered as the construction project of most of the individuals study are (All of them) by (23)and with (50%)

**\*The best ways to apply EVM in construction project:**

**Figure (12):**



From figure (11) we note that the In your opinion what is the best ways to apply EVM in construction project of most of the individuals study are (Develop the management skills of project manager) by (18)and with (39.2%)

Table (4): Chi-square test results:

N o.	Phrases	Frequency and percentages%				
		Strongly agree	Agree	uncertain	Disagree	Strongly disagree
1	The acquired value management approach provides an integrated approach to controlling project elements	12 26%	24 52.3%	10 21.7%	0 0.0%	0 0.0%
2	Acquired residual management provides and determines the direction of the future project and accurately identifies potential risks	6 13%	26 56.6%	12 26.1%	2 4.3%	0 0.0%
3	Value acquired principle is based on the possibility of determining the percentage of monthly achievement of all activities	4 8.7%	26 56.6%	13 28.1%	3 6.6%	0 0.0%
4	The acquired value management system is the only system of control	2 4.3%	12 26.1%	11 23.8%	19 41.5%	2 4.3%
5	The acquired value system allows the project management to take corrective decisions	6 13%	25 54.4%	13 28.3%	2 4.3%	0 0.0%
6	The primary objective of managing the acquired value is to draw a negative deviation from the plan at an early date	7 15.2%	23 50%	12 26.1%	4 8.7%	0 0.0%
7	The most important points for successful management application acquired is good communication plan and the use of software And continuous training of the working group	12 26.1%	25 54.4%	9 19.8%	0 0.0%	0 0.0%
8	The most important points of management of acquired value are Major the areas of poor performance	3 6.6%	24 52.1%	17 37%	2 4.3%	0 0.0%

Source: prepared by researcher, using SPSS, 2019

**\*From the table above:**

To find out the opinion of the sample members on the concept of value management :

A majority of 52.3% agreed that the earned value approach is an integrated way to control the project.

Also agreed with ratio of 56% that is accurately sets the direction of the project in the future and sets the direction for poetics risks, the sample members at percentage of 56.6% agreed that it determined the achievement for all activities, almost did not agreed that the value management is only system for monitoring, most of sample agreed that it allows the administration to take correction decisions at aerate of 54.4%

### - Conclusion:

- The Earned Value Analysis is used to control both cost and time and knowing how far we are from the schedule and the budget plan.
- Earned Value helps to make decisions to control the variance that happened in projects.

The most important result were reached through field survey and statistical analysis that the earned value management determines the direction of the projects future and shows negative deviations very early and gives the opportunity to make decisions quickly and correctly and found that most companies are not aware of this modern concept and are not applied to this system , and there is weakness and lack of commitment by companies that applied the concept in specific project , due to the state s lack of interest in modern concepts weak oversight of companies, lack of specialized training courses and each management education by the states media. It's highly recommended for companies in Khartoum to apply the concept of Earned Value Analysis and Management to get more efficiency result in both cost and time.

Try to apply Earned Value in a large number of projects with limited resources for one company.

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### ملخص الدراسة:

- ادارة القيمة المكتسبة هي اداة فعالة لمتابعة المشاريع وهي تربط بين الانجاز الفعلي والزمن المخطط له والتكلفة الفعلية عن طريق حساب الانحرافات وبها تتم الرقابة على المشروع باجراء تحليل متكامل للانشطة , هدفت الدراسة الي التحقق من مدى تفعيل القيمة المكتسبة في الشركات وتقييم عملية التطبيق ومعرفة مدى الالتزام بها كاداة حديثة ومتطورة للرقابة, استهدف المسح الميداني مدراء المشاريع حسب درجاتهم العلمية وخبراتهم المختلفة في القطاعين العام والخاص في ولاية الخرطوم ثم توزيعه على العينة وجمع معلومات وحصر النتائج ثم تحليل البيانات باستخدام برنامج التحليل الاحصائي SPSS (حزمة 2019) وتم التوصل لعدة نتائج كان اهمها ان ادارة القيمة المكتسبة تحدد اتجاه مستقبل المشروع وتظهر الانحرافات السلبية في وقت مبكر وتظهر ضعف الاداء كما تتيح للادارة اتخاذ الاجراءات والقرارات التصحيحية اللازمة لاستمرار المشروع , كما اظهرت النتائج ان بعض الشركات على غير دراية بالمفهوم واغلب التقنيات المتطورة والحديثة للرقابة والتخطيط.