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Shale Gas Reserve Potential

Detection of Staphilococcus

} Highlights {

Enhancement in Coal Mining

Plants, Boiler-Houses and Cars

Discovering Thoughts, Inventing Future

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By Olivier François Aristide Bertrand Koffi, Bernadetteehui Avo Bile, Edith Kwa-Koffi Kouassi & Abdelilah Chtaini

University Sultan Moulay Slimane

Abstract- The electrochemical detection of staphylococcus aureus bacteria by the amoxicillin modified natural phosphate (AMX-Np) is decried. The AMX-NP electrodes were used for the detection of low optical densities of staphylococcus aureus by using the cyclic voltammetry (cv) and the square waves voltammetry (swv). Some electrochemical properties, in particular the influence of the pH, the optical density of the bacterium were studied. The elaborate electrode was the subject then of an analytical application for purposes of the detection of staphylococcus aureus in the potato juice.

MotsClés: modified electrodes; SWV; CV; bacteria; electrochemical sensor.

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DETECTIONOFSTAPHILOCOCCUSAUREUSBYAMOXICILLINMODIFIEDNATURALPHOSPHATEELECTRODEANALYTICALAPPLICATIONPOTATOJUICE

Strictly as per the compliance and regulations of:

Detection of Staphilococcus Aureus by Amoxicillin Modified Natural Phosphate Electrode: Analytical Application Potato Juice

Olivier François Aristide Bertrand Koffi [α], Bernadetteehui Avo Bile [σ], Edith Kwa-Koffi Kouassi [ρ] & Abdelilah Chtaini [ω]

Abstract- The electrochemical detection of staphylococcus aureus bacteria by the amoxicillin modified natural phosphate (AMX-Np) is decried. The AMX-NP electrodes were used for the detection of low optical densities of staphylococcus aureus by using the cyclic voltammetry (cv) and the square waves voltammetry (sww). Some electrochemical properties, in particular the influence of the pH, the optical density of the bacterium were studied. The elaborate electrode was the subject then of an analytical application for purposes of the detection of staphylococcus aureus in the potato juice.

MotsClés: modified electrodes; SWV; CV; bacteria; electrochemical sensor.

I. Introduction

The gilded staphylococcus(staphylococcus aureus) is the stock of staphylococcus most frequently met in pathology human and veterinary. It shares with the bacterium Escherichia coli the unhappy privilege to be in the forefront of the germs responsible for infection nosocomial (infection contracted at the hospital) [1]. The staphylococcus aureus is pathogenic opportunist which can cause various diseases at the human ones, energy of the affections which evolve spontaneously to the cure with pathologies mortals [2].The food poisoning by the staphylococcus is characterized by a brutal appearance of nauseas, vomiting, abdominal pains, cramps and of diarrhea [2,3].

The food which facilitates the growth of *the staphylococcus* is mainly pastry makings with the cream, dairy ice creams, the food treated such as hams, the pies and rillette, and tuna and poultry, the potato salads. Cooked products contaminated after cookings (chopped meats, fish, sections of pork-butchery). Products with water content reduced (saltings, fish dried and smoked, dried milk). Cheeses, following an insufficient acidification of curd. Ovoproduits, mayonnaise, dairy products (e.g. condensed milk), creams, ices. The contaminated food has the same aspect (appearance, odor, taste) that the healthy food [4].The placement of detector of this bacterium is essential in order to prevent the risks of contamination.

A preliminary work was published on the AMX-NP characteristics as for the detection of the staphylococcus aureus [5].The objective of this work is to make an analytical application of this electrode in potato juice by using the method of the square waves voltammetry.

II. Experimental

a) Reagent

Provisions were made for oxygen removal by bubbling the solution with azotes gas for about 5 min then the solution was blanketed with azotes gas while the experiment was in progress. For reproducible results, a fresh solution was made for each experiment.

b) Instrument

Voltammetric experiments were performed using a voltalabpotentiostat (modelPGSTAT100, EcoChemie B.V., Utrecht, The Netherlands) driven by the general purpose electrochemical systems data processing software (voltalab master 4 software) run under windows 2007. The three electrode system consisted of a chemically modified carbon paste electrode as the working electrode a saturated calomel electrode (SCE) serving as reference electrode, and platinum as an auxiliary electrode

c) Electrodes

The working natural phosphate paste electrode was prepared by mixing appropriate weight of natural phosphate powder with paraffin oil. The whole cell modified natural phosphate paste was subsequently packed firmly into the electrode cavity (0.1256 cm^2) and polished to a smooth shiny finish by gently rubbing over an ordinary weighing paper. Electrical contact was established with a bar of carbon. Amoxil-modified natural phosphatepaste electrodes (AMX-NP) were prepared by immobilizing the Amoxil system by soaking the preformed natural phosphate paste electrode in a solution containing the Amoxil solution.

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d) Analytical procedure

The modified natural phosphate paste electrode was immersed in a cell containing bacteria sample to get a chemical accumulation. Meanwhile, the solution was rotated about 600 rpm at open circuit. After a desired contact time, the electrode was removed from the preconcentration cell, rinsed with DW and placed in the measurement cell containing the supporting electrolyte (1.0 mol L^{-1}NaCl). The solution was deaerated with nitrogen for 10 min. The voltammetric curve was recorded. The same procedure was carried out in sample analysis and all electrochemical experiments were carried out at room temperature. The square wave voltammograms were recorded in different bacteria concentrations using 5 mV of the pulse amplitude, step potential 50 mV and the duration time is 2 s at scan rate 1 mVs^{-1}.

III. Result and Discussion

In order to study the effect of the optical density of the bacterium on the electrode, we made the electrochemical characterization of this one by using the methods of voltammetry square waves. The electrode with natural phosphate paste modified by the amoxicillin with a concentration of 30g/L was characterized in the presence of bacteria with different density optical. In the presence of the bacteria, the electrode displays a significant increase in the density of current. This electrochemical behavior of the electrode is confirmed by the voltammetry square waves. The capacity of detection of the electrode thus increases with the increase in the bacterial load. (figure 1).
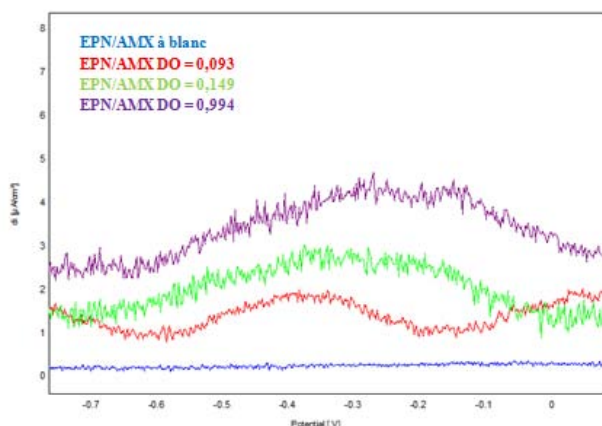
Figure 1: Superposition of the voltammogrammes with square waves of EPN/AMX ads. to white and EPN/AMX ads. (30g/l) in the presence of the bacteria with various optical densities in NaCl to 0,1 M; v = 100mV/s, of -2V with 2V; pH = 7,42

This sensor was the subject of an electrochemical characterization by the cyclic voltammetry for identifying the duration of detection of the bacterium. Within sight of the results, it arises that

after 50 cycles, corresponding to one hour duration six minutes (1.06 min), in the presence of the bacterium, the electrode displays an increase in the electroactivity (figure 2).
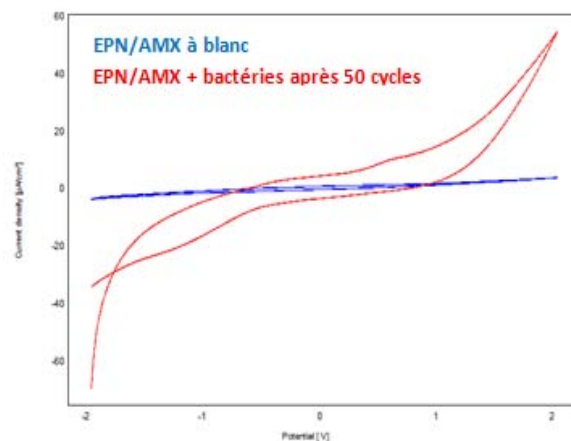
Figure 2: Comparison of the voltammogrammes cyclic of AMX-NP ads. with white and the bacteria after 50 cycles in NaCl to 0,1 M; v = 100mV/s, of -2V with 2V; pH = 7,42

A study of the influence of the pH on the electrochemical sensor in the presence of the bacteria was made. The electrode showed a good electroactivity in the presence of the bacteria in the acid media, neutral and basic. We thus compared the aforementioned voltammogrammes in order to identify the medium which is most favorable for him. The results are illustrated by (figure 3).
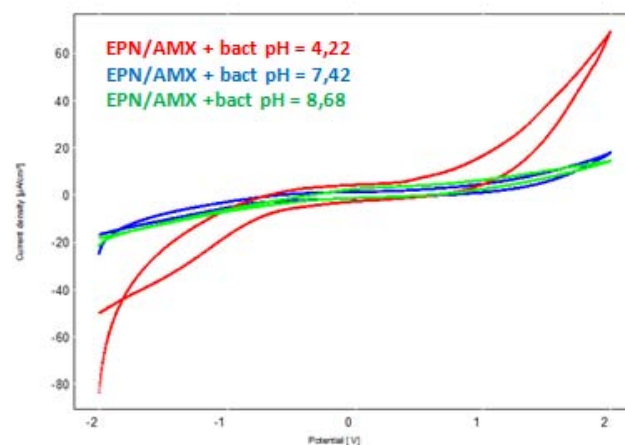
Figure 3: Superposition of the cyclic voltammo-grammes of EPN/AMX ads. to different pH in the presence of the bacteria in NaCl to 0,1 M; v = 100mV/s, of -2V with 2V

Taking into consideration these result, we can say that our electrode presents a better electro activity in acid medium, pH = 4, 22.

a)   Analytical application in the potato juice

Under the optimized conditions, the sensor (AMX-Np) was used for the detection of *staphylococcus aureus* in sample of potato juices which were the subject of no preliminary treatment. The analytical application consisted in adding various quantities of physiological water containing the bacterium in the potato juice in order to vary the optical density and we have each time made an electrochemical characterization by using the voltammetry with square waves. The seresults are presented in table 1.

Table 1: Density of current according to the optical density

DO	0	0,410	0,520	0,661	0,733	0,818	0,912	0,991
di (μA/cm^2)	1,45	1,679	1.995	1,980	2,105	2,063	2,155	2,351

Figure 4 shows the variation of the density of current according to the optical density.
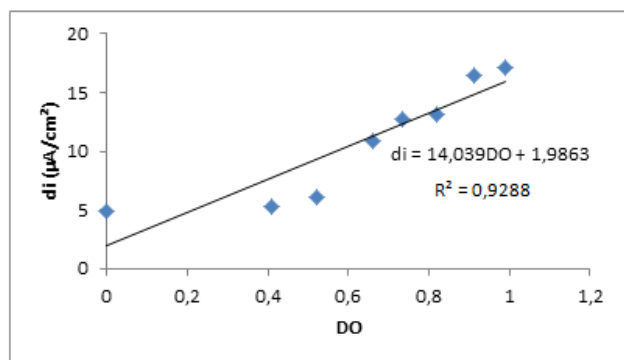
Figure 4: Density of current according to the optical density

The density of current increases with the evolution of the optical density of the bacteria, measured using a spectrophotometer. Figure 4 shows a typical linear answer, which can be expressed according to the following equation: di = 14,039DO + 1,9863.

b) Comparison of the characteristics of the electrochemical sensor(SD, LD et LQ)

Table 2:   Sensibilities of detection (SD), Limitate detection (LD) and limits of quantification (LQ) of the bacterium according to analytical mediums'

Sensor	Characteristics	Analytical mediums	
		Electrolyte support	Potato juice
AMX-NP(adsorption)	SD (μA/cm^2)	5,800.10^{-7}	6,350.10^{-9}
	LD	4,900.10^{-7}	2,218.10^{-8}
	LQ	1,635.10^{-6}	7,390.10^{-8}

Taking into consideration these result, it arises that the electrochemical sensor being studied, shows a better SD, LD and LQ in the potato juice. This result comes to confirm the effectiveness of this sensor, considering the potato juice is a hostile environment with the bacteria. Indeed the potato juice contains certain active molecules anti-bacterial in the fight against the bacteria (*the helicobacter pylori*) responsible for the ulcer of the stomach   [5].

IV.   Conclusion

The electrochemical sensor (AMX-Np) is extremely sensitive to the bacterium. The pH has an influence on the electroactivity of this electrode and the acid medium seems more favorable. Also, its duration of detection is satisfactory. The analytical study in a potato juice sample showed good results.

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Issues, Challenges and Techniques in WSN for Performance Enhancement in Underground Coal Mining

By Banda Srikanth, Dr. Hemant Kumar, & Dr. K.U.M Rao

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Abstract- Recently, technological growth has gained huge attraction and it is widely adopted in various real-time application systems/ this increasing growth has improved the communication technology by developing small and tiny sensors for information gathering and transferring by consuming less energy in real-time systems. These type of sensor systems are known as wireless sensor network which are used widely in real-time applications such as environment monitoring, traffic monitoring and bio-medical applications etc. In this work, we have focused on the coal-mine monitoring system which can provide the security for mine workers. Mine monitoring systems require an automated process to obtain the information about mine-roof and its convergence along with time which can be used for safety of miners or workers. In order deal with this, wireless sensor network based study is considered as base application.

Keywords: coal mining monitoring systems, WSN, localization, routing.

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Issues, Challenges and Techniques in WSN for Performance Enhancement in Underground Coal Mining

Banda Srikanth [a], Dr. Hemant Kumar [b], & Dr. K.U.M Rao [c]

Abstract- Recently, technological growth has gained huge attraction and it is widely adopted in various real-time application systems/ this increasing growth has improved the communication technology by developing small and tiny sensors for information gathering and transferring by consuming less energy in real-time systems. These type of sensor systems are known as wireless sensor network which are used widely in real-time applications such as environment monitoring, traffic monitoring and bio-medical applications etc. In this work, we have focused on the coal-mine monitoring system which can provide the security for mine workers. Mine monitoring systems require an automated process to obtain the information about mine-roof and its convergence along with time which can be used for safety of miners or workers. In order deal with this, wireless sensor network based study is considered as base application. This article presents various recent approaches which helps to improve the wireless communication system such as energy aware routing, wireless sensor network localization etc. A comparative study is presented based on these aspects of wireless sensor network which shows that still the performance of WSN can be improved which can be incorporated with coal-mine monitoring system.

Keywords: coal mining monitoring systems, WSN, localization, routing.

I. Introduction

Due to the problems like aeration, ventilation and chances of collapse, underground coal mining generally consists of greater threats compared to open pit mining. Nevertheless, use of heavy machineries as well as techniques which are executed for excavations purposes resulted in safety hazards in all any kind of mining. Significant changes in mining and progresses in safety level in both underground and opencast mining can be implemented, because modern mines now use numerous safety measures, training as well as education for labors along with good health and safety standards. In India, "coal" has a considerable influence on rapid industrial expansion of the country. It is considered as one of the major resource of energy.

The significance of coal in the sectors like energy is very crucial, as about 70% of power generation relies on it. On the other hand, supplementary by-products of coal, which are proven as a potential threat to people who are associated with it, and also to the environment. So, the present work makes an honest attempt in examining the severity of mining, as well as inventing real time monitoring system for detection of life threatening situation, through 'ZigBee technology'.

It is necessary to deal with non-lethal and non-dangerous environments, and also to adopt an operational working mine, air circulation systems, etc., are very critical to provide sufficient level of oxygen in case of underground mining [87]. Controlling an underground mine simply means destroying hazardous environments. For monitoring a mine's air, we are still using the conventional techniques like, consumption of canaries and also varieties of creatures to warn diggers about the harmful turn of climate. With the help of far reaching statistics obtained by monitoring system, combining ventilation monitoring system will permit a mine to insightfully establish ventilation improvements. Drastic variations, speedy deviations in ventilation systems are picked up by monitoring system. To handover the data to the surface and to supervise mines more competently, one can use new as well as innovative communication methods.

Mine monitoring techniques have become more cultured due to development of technology. But however demolitions in the underground coal mines will take place even today. A major challenge for the nation and for society is nothing but the safety concerns of coal mines. Unpredictability of the working condition and also harsh environment are the main reason for tragedies in coal mines. Hence, for safety purposes, enactment of the mine monitoring systems becomes vital. As a trend, wired network systems are used in coal mines, which has played an important role in safe production. Several unforeseen hazards are hidden with constant elaboration of exploiting area and also with depth expansion. In other words, it can be said that these issues have become blind zones.

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In addition, it is not imaginable to place dedicated cables, as it requires more time. Therefore, in order to carry out a safe production, it is crucial to build a WSNs mine monitoring systems. At the moment, Wireless sensor networks (WSNs) have got a substantial worldwide attention. A self-organizing, multi-hop and special ad-hoc network which contains huge quantity of nodes, which are organized in a wide area to monitor the occurrences of interest, is known as wireless sensor network. It can be used for many applications such as environmental, scientific, military and medical applications. WSNs primarily contain motes or sensor nodes which are accountable for identifying an occurrence and also base nodes, which are liable for handling network and gathering data from the remote nodes. Operation mechanism, scalability, sensor network topology, fault tolerance, transmission media, power consumption and hardware constraints, etc., are some of the main factors which are directly influencing the design of the sensor network.

The three foremost benefits over wired monitoring network systems are given bellow:

1. Installation is very easy in the blind areas and cables are not needed to set up the network, which decreases the cost of monitoring system. To reduce blind areas, quantity of nodes can be increased. Moreover, it provides reliable communication, as well as fulfilling the objective.
2. The remote monitoring system makes perfect sense for such scenario, due to its limited storage ability and limited computation capacity. As a result, wireless sensor network becomes suitable for scrutinizing safe production in coal mines.
3. Ideal data communication and data procurement with the high accuracy and advanced recognition of a real-time monitoring system which are designed for mine atmosphere, can be ensured by the dense nodes.

Mining atmospheres always have unseen hazards, toxins, which may create many health-related issues to people who are working in the mines, and also on the outside too. On a timely basis, these toxic gases must be detected and raise an alarm about the hazardous situations without any delay for safety of miners. Additionally, limitation of mining walls may also trigger massive harm. Therefore, endless monitoring may help reduce the risk to miners.

Wired network monitoring systems is not perfect for all forms of mining atmosphere, even though it substantially helps in improving the mine safety. For controlling and monitoring the mining atmosphere, Real-time monitoring systems can be used. Zigbee technology is perfect for real-time monitoring system, due to its numerous benefits. Hence, designing an efficient monitoring system is the major objective of this proposed work, by which several leaked mine gases

and also other features like pressure and depth etc. can be recognized at regular intervals and protective actions can be implemented consequently.
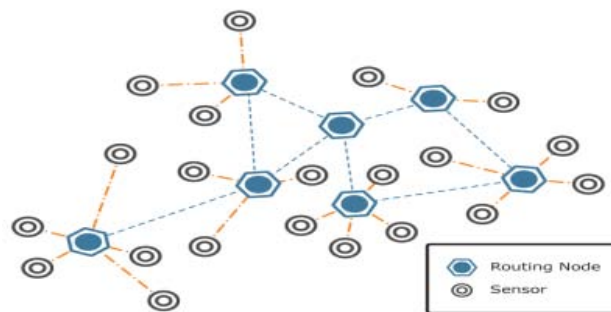
Figure 1: Wireless Sensor Network

This proposed work emphasizes on wireless sensor monitoring scheme which are designed for coal-mine monitoring system. A number of designs has been proposed for wireless monitoring system for external atmospheres. Nevertheless, it still poses a big challenge for the underground circumstances, like coal mining. Underground coal-mining systems undergo several serious problems, which might lower the monitoring power. Such problems are given below:

a) WSN Routing

Routing in the WSNs is a vital task for data diffusion. Wireless sensor networks (WSN) nodes are driven by inadequate resources of energy. Therefore, more energy utilization might result in degradation of overall lifetime of the network. Likewise, packet drop and security problems also occur in Wireless sensor networks communication system, if the links are not connected accurately, and effective routings are not applied.

i. Wireless Sensor Localization

Performance of coal-mining monitoring system can be improved by a well-organized method for Wireless sensor networks localization. Improper or inadequate data for monitoring may be resulted, if the nodes are not positioned at the precise location.

ii. Wireless Sensor Network Localization

Localization in WSNs was one of the vital modules of variety of developing solicitations together with the cyber-physical systems, military [1], Health [2], atmosphere monitoring, house and workplace automation, weather projecting[3]etc. Location based services are needed for many of above mentioned applications. The high power consumption, high price, and poor presentation of GPS within indoor environment have demanded the study on localization algorithms, even though the GPS was a direct solution to the localization problem. In recent years, the technical world has witnessed a lot of studies efforts on this subject. It

should be noted that localization is termed as determination of location of unknown node, by using the connectivity information between the unknown nodes and at other times, assistance of nodes with known point.

Latest surveys have studied the influence of the real world applications [4], movement in localization [5], "Anchor Free" and "Anchor Based" localization techniques [18], distance dimension method which is used to analyze the location of unknown nodes ("Range Based" localization algorithm) and "Range Free" localization procedure (connectivity instead of distance) [6], "Cooperative" (communication present between all nodes) and "Non-Cooperative" (communication between unknown nodes and anchor nodes) techniques, "Centralized" localization (aka network-centric positioning [7]) and also "Distributed" techniques (in which there is no vital control on determination of node's location and every node calculates its location based on the locally collected data, also termed as "self-positioning" algorithm [7]).

In this segment, localization systems/techniques in wireless sensor networks are classified into "Anchor based vs. Anchor free", "Sparse vs. Dense", "Indoor vs. Outdoor", "Static vs. Mobile", and "Cooperative vs. Non Cooperative" categories as presented in Fig. 2. And, to describe each system, based on the altered aspects like, whether they are distributed or centralized and non-cooperative or cooperative, etc., comparison tables are presented at the end of the anchor free and anchor based localization system units.
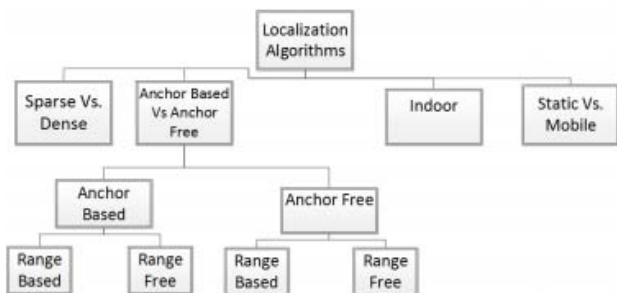
Figure 2: Typical classification of localization techniques in WSNs

Wang et al. [9] studied about WSNs localization system and also the problems related to the same. For the network operators it is noticeable that sensor node location information is very critical and therefore GPS based localization systems are used. Han et al. focused on significance of wireless sensor network localization system[10]. Meanwhile, as it offers vital provision for many location-aware procedures and applications, Localization has become the key technologies in WSNs (wireless sensor networks). Mao et al. conducted a detailed study on fixed localization in WSNs [11]by

paying attention to various aspects such as single hop, multiple hop, centralized and also distributed. The study is comparatively older and it does not deliberate on the mobility concerns of sensor network. Also, there is a scarcity of recent mechanisms in the field, as well as conversation on open problems and investigation experiments. A study was conducted by Faheem et al. [12] on data broadcasting of the mobile sink in by categorizing the data broadcasting procedures based on routing entities, mobility pattern, quantity of sinks and application type.

Dong et al. in conducted a survey on issues of mobility and also mobility conscious MAC (medium access control) practice in WSNs [13]. The authors have contemplated on diverse mobility forms and prototypes, advanced mobility valuation approaches, and also complete and relative examination of projected mobility-aware MAC procedures. The review highlights only the mobility parameters and MAC procedures of WSN, instead of the localization in WSNs. Han et al. in [14] presented a survey on localization in WSNs. The authors have considered numerous procedures which are based on the fixed and mobile nodes and on range free and range based techniques. It was published in 2013, and hence it is one of the latest surveys of the localization algorithms. But, it did not include any further investigation, nor it offers suggestions for future research enhancements.

Mesmoudi et al. undertook a detailed survey on localization procedures [15]. The procedures are principally categorized into range based and range free systems, and both are additionally categorized into hybrid schemes and full schemes. This survey grants a complete study on the procedures, but it omits the mobility issues. Gu et al. in [16] has conducted a latest study on the sink mobility management along with current research developments. But, it failed to deliver source localization, and hence arrangement and comprehensive conversation of localization procedures are not found. On the basis of these studies, a comparative investigation is made, which is shown in the table 1.

Table 1: Related WSN localization techniques

Survey paper	Main aim of study	Mobility based research	Survey coverage type	Concluding remark
Wang et al. [9]	WSN localization	No	Comprehensive	Presented latest techniques in WSN localization
Han et al. [10]	Localization	No	No	Presented anchor based WSN localization
Faheem et al. [12]	Data aggregation	Comprehensive	Yes	Presented data aggregation scheme
Mao et al. [11]	WSN localization	No	Comprehensive	Presented Static localization scheme for WSN
Dong et al. [13]	MAC protocol	Comprehensive	Comprehensive	Comparative study on MAC protocols
Tunca et al. [29]	Sink routing scheme	Comprehensive	Comprehensive	Survey on sink routing schemes
Mesmoudi et al. [15]	WSN localization	Restricted	Comprehensive	In-depth discussion on WSN localization
Han et al. [14]	Localization	Comprehensive	Comprehensive	Mobility based classification of sensor nodes
Gu et al. [16]	Sink mobility	Comprehensive	Comprehensive	Presented Sink mobility management
Ours	Routing & Localization	Comprehensive	Comprehensive	Presented localization and routing techniques for WSN

In addition, a transitory conversation is presented about numerous types of localization techniques, as shown in the figure 2.

b) Sparse and Dense WSN Localization

Two types of techniques had been introduced in the past to deal with sparse network: they are, component based localization and node based localization.

i. *Node based localization*

Sweeps' is a node based localization scheme [17] which is associated with iterative technique, known as 'trilateration'. In trilateration system, a coordinate system is defined on the basis of a major set of three nodes with the fixed location information. At every phase of algorithm, there will be the set of finitely localized nodes, in which nodes can be regulated up to a fixed set of potentials, and also a set of un-localized nodes. Huanxiang et al. [18] studied about localization and also about its benefits in WSN and localization scheme, on the basis of genetic algorithm for the mobile anchor node. Based on the distance from anchor node to unknown node, as calculated by RSSI, the algorithm pools genetic algorithm and weighted centroid method to locate the unidentified nodes.

According to Jiang et al. [19], foremost idea in the most localization algorithms of present day WSNs, is that a mobile anchor node, for instance the GPS-equipped (Global Positioning System) nodes, which shows its location information to discover unidentified nodes. In that case, one basic problem was the path planning of mobile anchor node, which must and should move along its route to lower localization blunder and to discover the unidentified nodes. Han et al [20] proposed a research study for WSN localization, based on distributed localization method and presented NDBL (node distribution-based localization) scheme. Low system-load for low-cost, simple modification and low-rate wireless sensors, are main objectives of this method.

ii. *Component based localization*

In component based technique, a factor or elements consists of a set of nodes which are termed as components. These components establish a globally inflexible structure in the distance graph. Due to the rigidity of the structure, the location of each node in an element is static. In comparison to node based localization algorithm, component based localization scheme easily detects two dimensional components. Component based localization can be categorized on the basis of the existence of internal anchor in a component.

c) Anchor based vs. Anchor Free Localization

With respect to use of location data of the known nodes, the localization based techniques are categorized as "Anchor Free" and "Anchor Based" systems. Details of these algorithms are presented in subsequent sections.

i. *Anchor based Localization*

In anchor based localization method, few nodes are known as anchors, which are embedded with a GPS

module that offers global position for these nodes. Nodes with the unidentified locations gather data from anchors to predict its locations by self-localization.

This data might point out the distance capacity or about the connectivity which distinguishes distinct two diverse subclasses of the anchor based localization: "Range free" and "Range based" localization systems. This schemes uses several algorithms such as, conversed anchor based systems [21-25]least square, [26-30] extreme likelihood assessment, [31] lateration system, [32] the multi-dimensional scaling, [33] the semi-definite encoding, [34] [56] supernatural regression, [35]fingerprinting, and [36] the Monte-Carlo localization for localization of the unidentified nodes.

a. *Range based Approaches*

Range based localization system with MDS was presented in ref. [32]. In this method, the iterative MDS and classical MDS are used to generate local maps of neighboring sensors. To compute the location of the sensors, MDS uses the pairwise distance between nodes, and iterative approach is implemented, when the spaces between the node pairs are unobtainable. Range based maximum-likelihood (ML) scheme was presented by Oˇguz-Ekim et al. recommend [33]. The primary idea of this algorithm is to create a source localization technique by building a ML valuation problem which will be followed by convex relaxation of ML by SDP.

Yaghoubi et al. [22] recommended Energy-efficient range based localization. In this method, average energy of received anchor will be presented as new decision-making parameter for the localization. Localization scheme was presented to display the correlation with power distribution of anchor nodes. Two cases are deliberated accordingly: localization presuming error free anchor nodes location, and localization which considers erroneous anchor nodes location. With the help of mathematical calculation, it is confirmed that localization correctness can be controlled by variable power provision of the anchor nodes. Simulation outcomes show that optimal power allocation outperforms equal power allocation, as confirmed by mathematical analysis of both erroneous and error free conditions. Range based localization pattern which reflects a Bayesian approach was proposed in ref. [6]. As a replacement for a conventional path loss model, this effort presents a ranging measuring scheme by means of a Bayesian model. To develop a system which requires a reduced amount of prior information, 'Empirical Bayes' methodology is used in this research. The benefit of this 'Empirical Bayes' is that it needs fewer conditional prior information. Some conditions are applied to discover Bayesian estimation more precisely. In this technique, MMSE (minimum mean square error) estimator was determined for final valuation as provisional mean.

b. *Range Free (non-range based) Approaches*

Range free localization scheme utilizes connectivity data among nodes to regulate the points of unidentified nodes. As the range based approaches need a hardware arrangement, which is both costly and complex, a range free method will be a possible solution. In this section, a recent anchor based range free localization algorithm is discussed.

Wang et al. [37] presented a range free localization system as an enhancement to conventional DV-Hop procedure. The concept of regulated neighborhood distance (RND) had been discussed in ref. [38], by means of disk communication system for localization. The notion of RND is reconsidered and restored with an effort implement RND in general propagation model. Fixing the problem of hop-distance uncertainty by computing the closeness of two neighboring nodes is one of the main purposes of the RND system. The approximation of the location of an unidentified node is estimated using Trilateration system, after the spaces from three anchors to unidentified node are computed. An area-based localization system was presented by Lasla et al. [39], in which a novel method half symmetric lens (HSL) was proposed.

Non-localizable node may determine its location in a given area by making a comparison on the received data from various anchors. In order to evaluate the performance, this technique has been compared with APIT, circular based system DRLS [40] and ROCRSSIA, by considering evaluation error and the ratio of the localizable nodes, as matching factors. Ratio of localizable nodes are termed as the proportion of nodes precisely situated at certain location in the area, and also evaluation error is termed as the difference between actual and projected distance of the node. Simonetto et al. presented a Maximum likelihood distribution localization scheme [28]. An ML based convex relaxation scheme is presented in this paper, with comprehensive explanation of its features.

With respect to above mentioned techniques, a comparative study is presented for anchor free localization algorithms, as shown in table 2.

Table 2: Anchor free localization algorithms

Algorithm	Range Measure	Range combinations	Localization method	Scalability	Node density	Cooperation	Localization accuracy	Node mobility
X. Ji et al. [32]	RSSI	MDS	Distributed	Yes	Medium	Cooperative	Medium	No
Y. Xu, [21]	RSSI	LS	Distributed	Yes	Medium	Non-Cooperative	Medium	No
Yaghoubi, et al. [22]	RSSI	LS	Distributed	Yes	Medium	Non-Cooperative	Medium	No
Oguz-Ekim et al. [33]	ToA	SDP	Central	No	Medium	Non-Cooperative	High	No
F. Bandiera [41]	RSSI	MLE	Distributed	No	Medium	Non-Cooperative	High	No
Tomic, [8]	RSSI	LS	Central	Yes	Medium	Non-Cooperative+ Cooperative	High	No
Dranka et al. [26]	Acoustic	MLE	Central	Yes	Medium	Non-Cooperative	High	No
Shen et al. [24]	ToA	LS	Central	Yes	Medium	Non-Cooperative	Medium	No
Coluccia et al. [6]	RSSI	ILS	Central	Yes	High	Non-Cooperative	Medium	No
Gepshtein et al. [34]	Connect	SR	Central	Yes	Medium	Cooperative	High	No
Yin, et al. [27]	ToA	MLE	Distributed	Yes	High	Cooperative	Medium	No
Nguyen et al [25]	NS RM	LS	Distributed	Yes	High	Cooperative	Medium	No
Salari et al [42]	RSSI+ToA	MLE	Distributed	Yes	Medium	Non-Cooperative	Medium	Yes
Wang et al [43]	Connect	Trilat	Distributed/ Central	Yes	High	Cooperative	High	No
Jean et al. [29]	ToA	IML	Distributed/ Central	Yes	Medium	Non-Cooperative	Medium	No
Lasla, et al [39]	RSSI+ connect	RA	Distributed	Yes	Medium	Non-Cooperative	High	Yes
Simonetto et al. [28]	Connect	MLE	Distributed	Yes	Medium	Cooperative	Medium	Yes
Diao,[31]	NS	Trialt	Distributed	Yes	Medium	Cooperative	High	Yes
Mourad [35]	RSSI	FP	Distributed	Yes	Low	Non-Cooperative	High	Yes
Huang et al. [36]	RSSI	MCL	Distributed	Yes	Medium	Non-Cooperative	Medium	Yes
Akba et al [44]	Connect	Multial	Central	Yes	Medium	Cooperative	Medium	Yes
Khan et al [45]	RSS + AoA	Trialt	Central	No	Medium	Non-Cooperative	High	NO

ii. *Anchor Free Localization*

Anchor-free localization techniques do not any location information of the nodes to determine the location of unidentified nodes. Such techniques have liberty on orientation and translation. On the basis of the usage of the range measurement methods, these localization techniques can be classified into two categories, range free anchor free and range based anchor free. Anchor free localization techniques do not need any complex anchor selection process. In the preceding topics, anchor free localization techniques of range free and range based types are presented.

Table 3: Anchor free localization scheme

Algorithm	Range combinations	Range Measure	Localization method	Node density	Scalability	Node mobility	Cooperation	Localization accuracy
Savarese, [46]	Triang	RSSI	Distributed	High	Yes	No	Cooperative	High
Priyantha, et al. [47]	Multilat	Acous+Connect	Distributed	Medium	Yes	No	Cooperative	Medium
Moore et al. [48]	Trilat	TDOA	Distributed	Medium	Yes	Yes	Cooperative	Medium
Shang et al. [49]	MDS	Connect	Centralized	Medium	No	No	Cooperative	Medium
Shang et al. [50]	MDS	Connect	Distributed	Medium	No	No	Cooperative	Medium
Kwon et al. [51]	Multila/MDS	Connect	Centralized	High	No	No	Cooperative	High
Kwon et al [52]	Multila/MDS	Connect	Centralized	High	Yes	No	Cooperative	Medium

II. Issues And Challenges In WSN Localization Schemes

Based on above observation, numerous researches have been carried out in WSNs to introduce and implement new algorithms for localization in WSNs. Such techniques can help reduce effects caused by inaccuracy in the distance measurements and locations of the sensor nodes. Nevertheless, few issues still require more intense study, in order to enhance the localization in the WSNs. Few of such issues are given below:

a) Efficient Energy Consumption in Wsns Localization

Typically, the sensor nodes in WSNs are equipped with restricted power source and unchangeable batteries or other energy supplies. This makes them work for a limited amount of time, before they die of energy depletion. Energy consumption is foremost design challenge in numerous WSN applications [53]. Although several researchers have presented numerous energy efficient localization scheme for WSNs, they are still not entirely powerful, and the design challenges with respect to energy consumption is still prevalent.

b) Localization in 3D WSNs

Generally, localization in WSNs focuses on determination of location of the sensor nodes in a two dimensional region. Ref. [9] suggests that, few applications require 3-dimensional distribution of node, such as survey underwater ecosystem, environment monitoring, surveillance of terrains, space monitoring and exploration, etc. Because of such complexities, the localization becomes harder, and hence more research has to be done for localization of node in three dimensional (3D) WSNs. Three dimensional (3D) localization techniques are highly complex. It is challenging for the sensor nodes to get the ranging and location measurements, because of irregular topologies and non-uniform densities. In comparison two dimensional WSNs, the three dimensional WSNs have fewer localization schemes. Limited research is available in this regard, [54].

c) Localization in Mobile Wireless Sensor Networks (MWSNs)

The WSNs have numerous challenges, among which maintenance of connectivity and boosting the lifetime of the network, are most significant. These challenges can be addressed by integrating the mobile device in WSNs [91]. Moreover, the network coverage and connectivity can be enhanced by mobility, along with better tracking capability of mobile nodes [55]. In mobile WSNs, localization is a major challenge. In traditional static WSN, the locations of sensor nodes are fixed, unlike MWSN, where the nodes tend to roam freely about the given region. Hence, they have to periodically update their location information [55]. As a result, mobility in WSNs has drawn more interest from numerous researchers. In ref. [55], the researcher has presented few proposals to enrich the location in MWSNs, as given below:

- Implementation of better distributed localization algorithms.
- Minimizing the location latency without affecting the accuracy of location.

- Implementation of novel algorithms to extend the mobile sensing to the regions where data sensing in not safe/secure.

d) Secure Localization

One of key challenge in widely deployed WSNs, is the secure localization. Normally, the WSNs are implemented in a hostile environment. But, the localization technique is susceptible to numerous localization-specific attacks. Over the years, this topic on issues of secure localization in WSNs is gaining more interests from numerous researchers around the world. But there is still room for improvement. In ref. [56], the authors have discovered few parameters, which can contribute to secure localization process. They are given below,

- Secure localization algorithms for mobile sensor nodes
- Range-free based algorithms for Verification of localization
- Localization in un-trusted environment
- Keeping the location information of node, confidential, without hindering inter-node communication.

e) Error Propagation in Interferometric Ranging based Localization

A ranging Technique has been presented based on Radio Interferometry, for localization in WSNs [57]. The measurement can be precise in comparison to other general localization techniques, like Time of Arrival (ToA), Received Signal Strength (RSS), and Angle of Arrival (AoA). However, it turns out to be harder, as higher measurement readings are needed, and hence, this technique is restricted to smaller networks with less than 16 nodes [58].

III. WSN ROUTING

Over the previous decades, comprehensive research was conducted to resolve the issues of cooperation between sensors in information aggregation and handling, administration and coordination of the information sensing, etc.

In comparison to wired networks, due to inherent characteristics of WSN, such as wireless communication (MANET, Cellular network, etc.), routing becomes a challenging task. First, it is not sensible to generate universal addressing methods for sensor nodes, as the amounts of sensor nodes in WSN are high. This imposes the overhead of maintaining the ID of each sensor. The IP (internet protocol) will also fail to provide suitable solution to WSN applications. In case of ad hoc networks, the sensor node must be able to configure and govern themselves, without any intervention from network engineer or any other management system.

Second, compared to typical communication networks, any type of applications using sensor networks needs to transmit the collected information from multiple sources to other destinations or base stations. Third, the sensor nodes have limited resources, such as low processing power, low energy, limited storage, etc. Hence, the operation of network must be carried efficiently. Fourth, sensor nodes generally are static in most WSN application, except for few application involving mobile nodes. The application which permits random movement mobile nodes, are more arbitrary and unpredictable. They are harder to manage, as the network topology changes quite frequently. Fifth, sensor networks are application-specific, which suggest that, each different application require different design approaches. Sixth, it becomes essential to know the current location of sensor nodes. Lastly, data collection in WSN is performed using common procedure, which might result in data redundancy. The redundancy must be addressed using routing protocols to enhance network lifetime and energy saving.

a) Routing Protocols in WSN

A survey of few advanced routing protocols for WSNs are presented in this section. The routing protocols in WSNs are broadly classified into, hierarchical-based routing, flat-based routing, and location-based routing, based on the network structure. In hierarchical routing, the nodes assume various roles in the network. In flat-based routing, every node is assigned with identical functionality or roles. The location-based routing uses locations of the sensor nodes to establish routes in the network. When certain parameter of the routing protocols can be regulated for adapting to present network criteria, then they are considered as adaptive. They are adaptive to energy level of the node too. Accordingly, such protocol can be categorized into query-based, multipath-based, QoS-based, negotiation- based, and coherent-based routing algorithms, based on the protocol operation.

Apart from aforementioned categories, the protocols can also be categorized with respect to the mechanism of finding a route from source to destination. Based on this criteria, the protocols are classified into, reactive, proactive and hybrid algorithms. In reactive algorithms, the routes are established on-demand. In proactive protocols, the routes are pre-computed before they are used. In hybrid protocols, both reactive and proactive algorithms are combined for more efficient approach. In case of static sensor nodes, table-driven routing protocols are more effective than reactive protocols. In order to initiate reactive protocols, large amount of energy is needed. There is another set of routing protocols, known as cooperative protocols. In this routing protocol, the nodes forward the data to a

central node. The central nodes collect all the data and perform certain processing operation, which lower the cost of routing and energy utilization. Timing and position information are important for several protocols. A brief discussion is also made on such protocols.
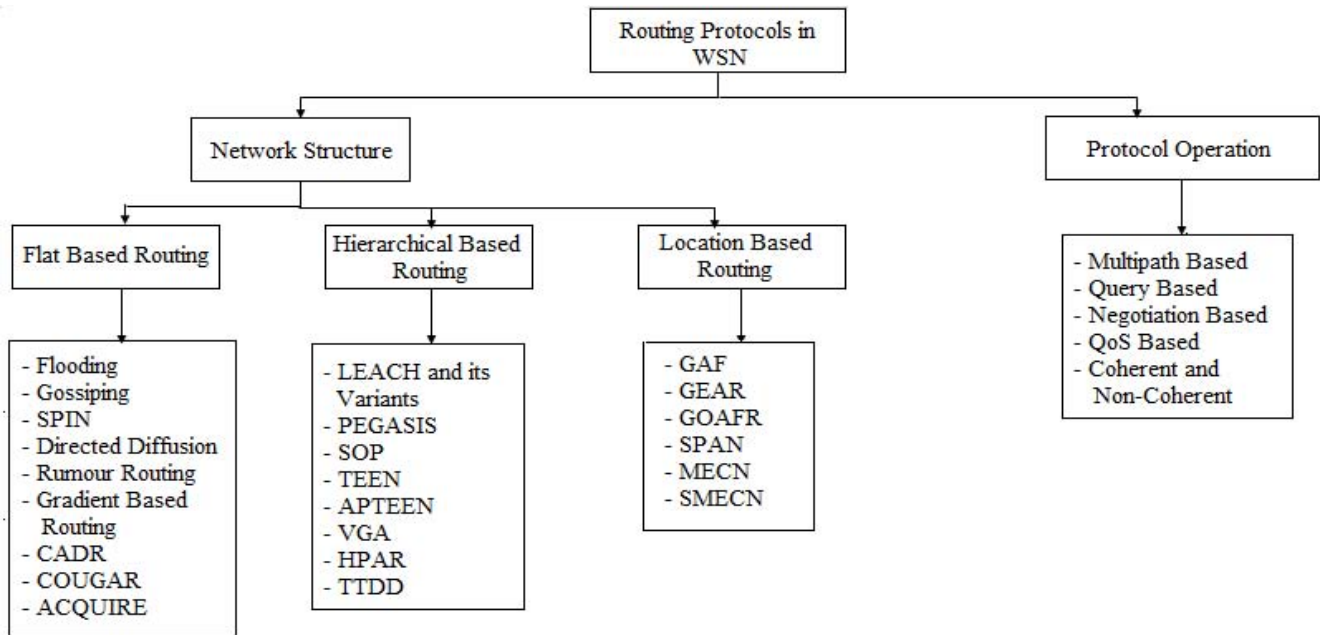
Figure 3: Classification of routing protocols

- *Flat Routing*

The multihop flat routing protocols are the first category of routing protocols. In flat networks, every node performs the same task and sensor nodes join each other to sense the environment and pick up the data. Assign a global identifier to each node is not always possible, due to large number of nodes. This resulted in data-centric routing, in which, the base station transmits the queries to particular areas and waits for data from sensors in that area. As queries are used to request for data, attribute-based naming must be used to identify the properties of data. The general classification of routing protocols is shown in figure 3.

- *Flooding and Gossiping*

The researchers presented a group of adaptive protocols in this category, namely, Gossiping and Flooding [59][103]. The data can be relayed in sensor networks using two classical methods, without any help of complex routing algorithms or topology maintenance. The image in Fig.4, depicts the concept of flooding, where each node broadcasts the packet after receiving it. The packets will be circulated to all of its neighbors. This process does not consider the capabilities of nodes. This process is will be terminated once the packet reaches its destination, or maximum number of hops for the packet is reached.
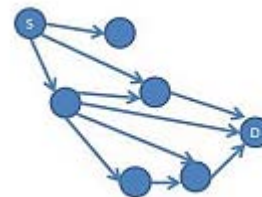
Figure 4: Flooding

Nevertheless, this protocol has few disadvantages, which are, overlap, impulsion and resource blindness. Therefore, the gossiping technique follows an entirely different approach. Rather than flooding the entire network with the data packets, the nodes transfer the packet to one of its neighboring nod only.

- *Sensor Protocols for Information via Negotiation (SPIN)*

Sensor Protocols for Information via Negotiation (SPIN) is a data centric routing protocol, which belongs to flat routing protocols [60]. It is based on negotiation model, which is used to forward the data within the WSN. This protocol solves the problems faced by flooding technique by negotiation and resource adaptation. This algorithm considers every node as a sink and transmits data to all the nodes in the network.

The SPIN works on two basic concepts [61]: Sensor nodes exchange information or brief details about the date before sending the data itself. In this way, the node can check if the data is already received or if it requires the new data packet. Such description can be exchange using meta-data of the information. Thus, redundancy can be kept under check. Every node has the ability to manage its own energy resources. This helps in energy efficient performance and extension of network lifetime. SPIN exploits three operation stages, namely ADV (Data Advertisement), REQ (Request for Data), DATA. The operation is shown in Fig 5.

Step 1: Sending ADV Message   Step 2: REQ Message Emission   Step 3: Transmission of Data Message
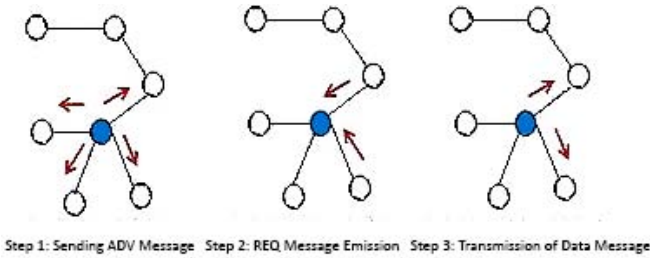
Figure 5: SPIN Protocol
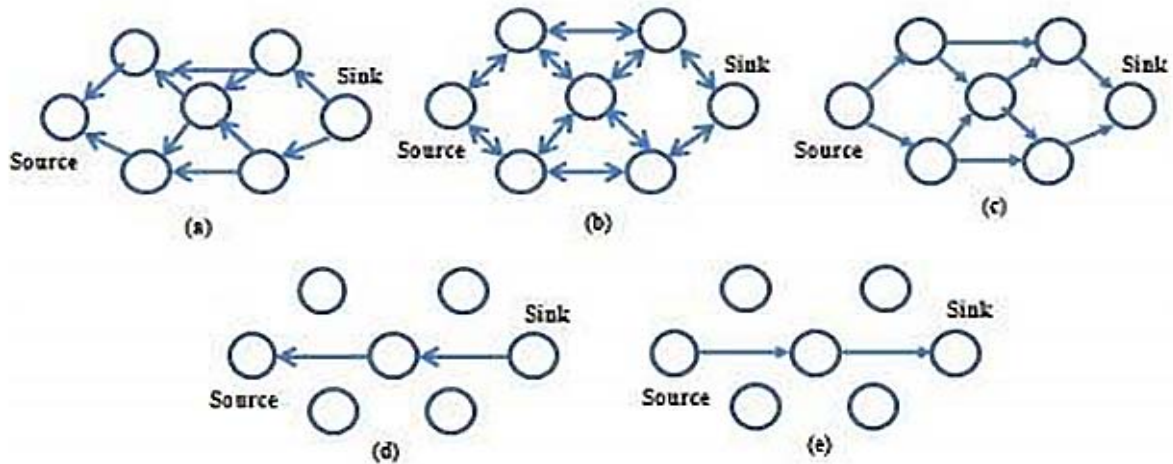
Figure 6: a- Broadcasting interest b-Establishment of gradients c- Data propagation d- Selecting and reinforcing path e- Transmitting data

- *Directed Diffusion (DD)*

Directed diffusion (DD) [61]is a well-known data aggregation model in WSNs. It was initially introduced by C. Intanagonwiwat et al. in 2000. It's a data-centric routing algorithm with data propagation schemes. Application-sensitive model uses on-demand data query and forwards data to concerned target for proper delivery. The data generated by sensor nodes are named by attribute-value pairs, such as interval, objects, geographical area, and duration. These data can be utilized for the description of the information. The process is depicted in Fig.6.

- *Rumor Routing (RR)*

Rumor Routing (RR) [62] is a type of Directed diffusion technique. It was first presented by Estrin and Braginsky in 2002. It was proposed for those networks, which did not support geographic routing. In this protocol, the packets will be transferred to nodes which have triggered an event, instead of flooding the whole network with data packets. The Rumor Routing adds the event to a table whenever an event occurs at a node. This table is known as events table. Later, the protocol creates an agent, which is nothing but a data packet with long life. It can cover a greater distance in the network. In case if a shorter path is discovered to an event, then the protocol updates the table with the new path. If a node creates a query for an event, then other nodes which are aware of the path in question, will reply to this query. If none of the nodes known the path, then the query is sent in random direction.

- *Gradient-based Routing (GBR)*

An enhanced version of Directed Diffusion was presented by Schurgers and Srivastava, in 2001, which was known as Gradient-Based Routing (GBR) [63]. This routing scheme consists of hop-count (number of hops) when the query is disseminated in the network. The essential concept of GBR is to select the shortest path with lowest hop-count to the destination. This parameter can be calculated for each node, and it is termed as height of the node. The difference between a height of a

node and its neighbor is known as gradient. The packet will be sent to the path with highest gradient. For the purpose uniform distribution of traffic in the network, traffic spreading techniques are used with GBR. When a node behaves as a relay, then multiple path will cross this node. In such situations, the concerned data will be aggregated. GBR can be used with various data spreading techniques, such as, Energy-based scheme, Stochastic Scheme and Stream-based scheme [64].

- *Cougar*

COUGAR [65] was first presented by J. Gehr and Y. Yao in 2002. It is information driven routing convention. It was designed with an intention to address the issues with large distributed database systems. The principal concept of this schemes is to present a fresh query between the sensor network and applications. This layer makes use of declarative queries to extract query processing from the network layer functions. This

includes selecting applicable sensors and use in-network data aggregation to conserve energy.

- *Active Query Forwarding in Sensor Networks (ACQUIRE)*

Dynamic Query Forwarding in Sensor Networks (ACQUIRE) [66] technique is presented by Sadagopan et al. in 2003. It is used for querying sensor nodes. This protocol considers the networks as a distributed database, just like COUGAR. This technique is appropriate for complex inquiries which are composed of few sub queries that might be addressed enroute. The main rule of ACQUIRE is to presume the query as a dynamic object, which is sent within the network seeking for a possible solution [67].

The characteristics are presented in table 4, based on the comparison of flat-based routing protocols.

Table 4: Flat-based Routing Protocols

Routing scheme	Category	Mobility	Scalability	Data aggregation	QoS	Multi-path	Power Consumption	overhead	Query	Data Delivery modeling
Flooding	Flat	Limited	No	☒	☒	✓	Excess	High	☒	☒
Gossiping	Flat	Limited	Limited	☒	☒	☒	Excess	Moderate	☒	☒
SPIN	Flat/Data centric	No	Limited	✓	☒	☒	Limited	Low	✓	Event based
Direct Diffusion	Flat/ Data centric	No	Limited	✓	☒	✓	Limited	Low	✓	Demand based
Rumor routing	Flat	Limited	Good	✓	☒	☒	Low	Low	✓	Demand based
Gradient Based routing	Flat	Limited	Limited	✓	☒	☒	Low	Low	✓	Hybrid
CADR	Flat	No	Limited	☒	☒	☒	Low	Low	✓	Continuous
COUGAR	Flat	No	Limited	✓	☒	☒	Limited	High	✓	Query based
ACQUIRE	Flat/Data centric	Limited	Limited	✓	☒	☒	Low	Low	✓	Complex query

- *Hierarchical Routing*

Cluster based routing procedures are also known as Hierarchical routing. It was initially introduced in wired networks. They were very advantageous with respect to scalability, flexibility and efficiency. Furthermore, hierarchical routing is also used in energy-efficient routing. In a hierarchical routing scheme, the data is sensed and accumulated by nodes with lower energy. The collected data is processed and sent by nodes with higher energy.

- *Location based Routing*

In Location based routing, the sensor nodes are dealt with respect to their locations. Using the strengths

of incoming signal, the distance between neighboring nodes can be easily calculated. By exchange of this data among neighbors, the relative coordinates of neighboring nodes are estimated. On the other hand, the location of nodes can be effortlessly extracted using communication between satellite and GPS modules in the nodes. Table 5 present the comparison of numerous hierarchical based routing schemes and location based routing schemes.

Table 5: Hierarchical based routing schemes and location based routing schemes

Routing scheme	Category	Scalability	Mobility	Data aggregation	Multi-path	QoS	Power Consumption	Query	overhead	Localization
LEACH[68]	Hierarchal	Yes (Good)	Fixed BS	Yes	No	No	Max	No	Yes	Yes
TEEN & APTEEN[69]	Hierarchical	Yes (Good)	Fixed BS	Yes	No	No	Max	No	No	Yes
PEGASIS[70]	Hierarchical	Yes (Good)	Fixed BS	No	No	No	Max	No	No	Yes
MECN & SMECN[71]	Hierarchical	Yes (Low)	No	No	No	No	Max	No	Yes	No
OP[72]	Hierarchical	Yes(Low)	No	No	No	No	N/A	No	No	No
HPAR[73]	Hierarchical	Yes (Good)	No	No	No	No	N/A	No	Yes	No
VGA[74]	Hierarchical	Yes (Good)	No	Yes	Yes	No	N/A	No	Yes	Yes
LAXY [75]	location	Yes(Good)	No	No	Yes	Limited	N/A	No	Yes	No
PPRP [76]	Position and location aware	Yes(limited)	No	Yes	No	No	Limited	No	Yes	No

b) Use of Wsn Systems in Underground Coal-Mining Systems

Wireless sensor networks provide efficient communication in various diverse scenarios and widely adopted for various applications. WSN is also adopted for underground coal-mining systems. In this section we discuss about application of WSN for underground communication system. Bhattacharjee et al. [77] described about WSN and presented their use for fire-detection, monitoring and prevention in underground coal-mining systems. According to this process, oxidation, coal temperature increment, oxygen absorption etc. are also monitored for early detection of fire. Qin et al. [78] used Interferometric synthetic aperture radar (InSAR) technique for underground coal mining monitoring system with the help of C-band and L-band wavelength projection. In [79] authors presented fire monitoring for coal-mining using WSN. In this work, a multi-agent model is developed where belief, desire and Intention components are considered. As discussed in previous section, WSN routing and security is also a challenging task, similarly, for underground monitoring is also face these issues. To deal with this, Shuo et al [80] presented a multi-path routing for secure data communication. In this process, residual energy and link quality parameters are considered for next hop and routing path.

Generally, underground monitoring systems use wired transmission which gets damaged during accidents and longtime deployment. This may lead to inaccurate data collection. To overcome this, wireless sensor networks play important role. However, localization of nodes in tunnels is a challenging task which can cause several issues such as energy consumption, weak connectivity, long delays, and a short lifetime. To overcome this, xia et al. [81] presented transmission power control algorithm which identifies optimal radius for communication and optimize cluster head selection process. Minhas, et al. [82] presented a combined scheme of WSN localization and event monitoring systems. In order to develop miner localization and activity monitoring low-power 3-axis MEMS accelerometer is used. Zhao et al [83] described WSN based methodology for WSN monitoring by collecting various information such as Dust Density, Temperature, Wind Speed, Gas Density and Carbonic Oxide Density. This data is transmitted to sink node for further processing.

Zhang et al. [84] discussed about coal mine monitoring system where existing Cable Monitoring System (CMS) is also discussed. For further improving the monitoring periodic inspection and interrupt service are discussed which helps for data collection, forwarding and reception. For underground

applications, cost and energy effective solution is highly demanded which can collect data efficiently and can be used for monitoring. For real-time applications, hardware modules are required for WSN monitoring for underground mines. To achieve this, in [84], authors have adapted ZigBee model due to its significant nature for this type of diverse environments. Kumar et al. [85] discussed about growth of mining industries and presented that enhanced mine productivity and worker safety can enhance the growth of mining industry. Productivity can be enhanced by varying some set of parameters and reducing the human error.

Recently, Ramesh et al. [86] presented a study for landslide monitoring using wireless sensor network. This networking system has been deployed 3 years back and has collected huge amount of data such as rainfall measure, moisture, pressure, soil properties etc. which can help to understand the situation for land slide monitoring. Sicignano et al. [88] focused on the underground WSN multimedia communication and developed a new approach for voice communication. This work is based on the multi-hop communicating protocol. This protocol helps to manage delay sensitive messages and provides better QoS. Zhou [89] discussed about wireless sensor network deployment and localization in underground coal mining First of all, a 3D type-band model is developed for node deployment where various parameters such as radio features, sensing efficiency, redundancy principles and coverage features. Li [90] et al. developed Structure-Aware Self-Adaptive WSN. This model is capable to detect activity variation which provides operating stability to the WSN. However huge amount of work has been carried out in this field of underground coal-mine monitoring with the help of wireless sensor networks but still secure and significant model need to be developed which can provide better communication quality with lesser resource utilization [91].

IV. Conclusion

Due to increasing demand of wireless communication, wireless sensor networks have gained huge attraction from researchers and industrial aspects. In this article, we have presented a comprehensive survey of wireless communication and monitoring system. Generally, performance of wireless sensor network depends on the following aspects: network localization, network routing and network lifetime. Several studies have been presented based on this assumption which focuses on network performance improvement. Comprehensive survey presented recent techniques of localization routing and network lifetime enhancement. however, due to network congestion issues still there is a need to improve the conventional approaches. Based on the working of wireless sensor networks, we would focus on the coal-mining monitoring

model for real-time applications. In order to monitor the coal-mine monitoring, a WSN based scheme will be developed which contains aforementioned stages i.e. routing, localization and energy efficient communication. Conventional routing protocols face various challenges as discussed in this article. Based on these studies, a motivation of routing protocol development is presented. Furthermore, routing protocol classification is also presented along with the advantages and drawbacks which can help to select the efficient routing protocol. Along with this, localization classification i.e. ranges based and range free approach is also discussed with comparative analysis. Hence this compete survey is focused on the performance improvement of WSN which can be utilized for coal-mine monitoring.

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Ontology Applications that used in a Various Domains in Knowledge Engineering: Survey

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Abstract- Knowledge representation and reasoning are important component in knowledge engineering. In most information systems knowledge capture and then processed using different method like classified and compute ...etc. One of the methods for a processing knowledge is Ontology. Ontology is an organized means of representing the knowledge detailed to the domain of interest. This survey focused to get a clear understanding of what Ontology?. And how to building Ontology in various domains Like intelligent system –Elearning – software engineering and discuss new approaches for ontology in a various domains in knowledge representations . And tools that used in building ontology for example, (UML) Unified Modeling Language this is an associated languages to build ontology.

Keywords: knowledge engineering, ontology, knowledge representations, UML.

GJRE-J Classification: FOR Code: 091599

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Strictly as per the compliance and regulations of:

Ontology Applications that used in a Various Domains in Knowledge Engineering: Survey

Abdalmoneim Mohammed [α] & Mohammed Khair [σ]

Abstract- Knowledge representation and reasoning are important component in knowledge engineering. In most information systems knowledge capture and then processed using different method like classified and compute ...etc. One of the methods for a processing knowledge is Ontology. Ontology is an organized means of representing the knowledge detailed to the domain of interest. This survey focused to get a clear understanding of what Ontology? . And how to building Ontology in various domains Like intelligent system – Elearning – software engineering and discuss new approaches for ontology in a various domains in knowledge representations . And tools that used in building ontology for example, (UML) Unified Modeling Language this is an associated languages to build ontology.

Keywords: knowledge engineering, ontology, knowledge representations, UML.

I. Introduction

Applications of Ontology are ubiquitous in this world. And use for almost applications that uses for decision making and for solutions, diagnosing, interpreting, and predicting results. There are some definitions of ontology in field of computer science and environment of WWW (world wide web). Ontology is an explicit specification of a conceptualization and semantic meaning. Ontology is known to provide syntactic and semantic meanings of concepts in a concerned domain using different techniques, one of them being OWL (Ontology Web Language). In computer science Ontology researchers agree that capturing domain knowledge is the most important task to build large, powerful and complex artificial intelligence system. And also Ontology is a way to confine knowledge in a machine-understandable form. It yields and used tools for building ontology in various domains of knowledge representation and software engineering. This survey about how to used ontology in a various domains and how to build or create new method or approaches that is used for extracting knowledge for a decision making. And then show tools and software that used for ontology. This survey organized in five sections section one include brief introduction about the ontology. Section two related works in different domains

that used ontology. Section three Table of comparison that contains six related work and show some of limitations. Section four Discussion and section five conclusion and recommendation.

II. Related Work

This section will discuss some issues related to ontology. Starting with the descriptions for ontology in a various domains. And survey about how to uses ontology applications in knowledge representations . And then go through some of applications for uses ontology in knowledge representations.

1) Rashmi S R and R Krishnan. [1] were get a clear understanding of what Ontology? And uses in various domains. And covers the reported approaches to gather and represent knowledge using Ontology and tools that supported and associated languages for build ontology. And discussed the usage of ontology for domain knowledge capture and reasoning in the area of intelligent systems.

Then conclude in two research issues:

To build Domain Ontology for the area of discourse. To try out different reasoning techniques such as causal in intelligent system. S. R they gave four questions were asked and three steps of methodologies are: How do you use Ontology in Knowledge Representation? How do you use Ontology for reasoning / inferencing? How do you build Ontology? What are the Applications of Domain Ontology?

Methodologies conducted in 3 steps as given:

Background Preparation. Setting of Survey Objectives. Conduction of the Survey.

2) Karmen Klarin and Stipo. [2] Deals with ontology elements modeling in design and evaluation procedure and Ontology elements such as rules, constraints and axioms and correlation between ontology elements and investigated the correlation between static elements like concepts and dynamic elements like queries and analyzed evaluation procedure Competency questions (CQs) as a technique for gathering information about ontology elements. And analyzed ontology engineering conceptualization based on two well-known

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methodologies are Ushold & Gruninger (U&G) methodology Case (study in education domain).

3) Tatiana V. Avdeenko, Natalia V. Pustovalova [3] presents a knowledge - based approach to requirements engineering process. This approach used when creating system requirements-correctness, completeness, consistency, unambiguity and proposed hyper model based on ontology frame and production rules. And can be used for testing traceability, completeness and consistency properties of the requirements specification. And then used **UML** (Unified Modeling Language) object oriented analysis for modeling and annotation the process. And **Protégé** software is free and open-source supported frame-based Ontology.

4) Jiayao Gao, Buyang Cao, Hongfei Fan. [4] Contribute to the novel approach for storing Points Of Interest (POIs) data by using ontology. And capable of building unified data structures and integrated data as well as providing a unified query approach. And design POIs in ontology model to demonstrate the integration of data and structures of classes and descriptions and used Protégé **software** for design ontology.

5) Supavas Sitthithanasakul and Noppon Choosri. [5] Proposed new method to create the ontology applied in software requirements engineering process(SREP) in requirement elicitation, requirement analysis, requirement specification, requirement validation. Although there are already many methodologies to create the ontology, some of them are difficult to understand and apply by other people. And we have presented the ontology information extraction form this form creates for (SREP). And generate the ontology component. This form separates into four parts. Each part used different type of ontology component and considered a guideline to build ontology systematically using UML.

6) Nina Stancheva Stancheva and Asya Stoyanova-Doycheva. [6] Presents test environment that is intended to support E-learning in software engineering education and contains two elements named Questioner and Operatives to support automatic generation and assessment of the test questions by using ontology. These operatives are implemented as intelligent agents that use structured educational content an ontology in the Unified Modeling Language domain to generate and assess different types of test questions using ontology as a knowledge base with the current UML ontology version. It is possible to create questions like true false, multiple choices, multiple responses, select text, drag objects, match items.

7) Suma T, Kumara swamy Y S. [7] Proposed Ontology Extraction engine on the fuzzy rules and define the information and extracts based on fuzzy rules and self-clustering techniques for email classification and use the similarity and match the words. in case a word is not found to match the similarity with existing cluster than a new cluster is formed for that word and also conducted experimental result shows that classification and fuzzy rule set against ontology creation with better efficiency by using values of mean and deviation. Methodologies that used are analytical for email processing and extraction of fuzzy rules.

8) Maedeh Mosharraf and Fattaneh Taghiyareh. [8] presents an automatic approach to enrich E-Learning domain in specific ontology based on two method the integration of graph and clustering techniques in addition external knowledge resources like WordNet and Wikipedia . And generated ontology as integration used model education activities. and showed experimental results that in the case of simple words the dictionary of WrodNet can add acceptable connections to the ontology. methodologies and tools that used Wikipedia and WordNet tool to specify the application domain and semantic features of the input terms.

9) ABADI Asmae, SEKKAT Souhail, ZEMMOURI El Moukhtar, BENAZZA. [9] Hussein Propose a new approach for production and informatics system based on ontology and the concept of agent in software engineering to automate the development of a new product. And achievement of the interoperability requirements and informatics system using UML language and also modeled strategy of the system during the development of a new product.

10) Janejira Somchart, Patitta Suksomboon Garcia and Pattara Aiyarak. [10] use N-Gram technology. NGram technology was used to increase channels and efficiency in the query. Also used ontology technique to analyze, classify, and display information according to the need of stakeholders by classifying the stakeholders into Classes and Sub-classes from 4 to 7 and showed the results through an Android-based smart phone application and measure the satisfaction of stakeholders. The result prove satisfied (mean = 4.65, standard deviation = 0.657) and then use the methodology and tool (UML) to build ontology and analysis for information. (case study) in Prince of Songkla University.

Table of Comparison

Investigator	Research	Finding	Limitations
Rashmi S R and R Krishnan	Domain Ontologies and their use in Building Intelligent Systems: A Comprehensive Survey	Two research issues:- 1- build Domain Ontology for the area of discourse 2- diffrenet reasoning techniques in intelligent system.	focus on survey and there is no example for build ontology.
Tatiana V.Avdeenko, Natalia	The Ontology-Based Approach to Support the Requirements Engineering Process	New approach for requirement engineering process and hyper model based on ontology frame	There is no example for testing the requirement engineering.
Supavas Sitthithanasakul and Noppon Choosri	Application of Software Requirement Engineering for Ontology Construction.	New method to create ontology for software requirement engineering process(SRE P)	Creative method but in a four component there is no integration to validate the requirement s and compare between requirement analysis and requirement specificatio n.
Karmen Klarin and Stipo	Modeling information resources and application using ontological engineering	Technique for gathering information about ontology elements. based on two methodologie s are Ushold & Gruninger (U&G)	There is no extracting the result in test.
Jiayao Gao, Buyang Cao, Hongfei Fan	Point of Interest Data Storage using Ontology.	Novel approach for storing Points Of Interest (POIs) data by using ontology.	Types of queries and types of data type is different
Suma T, Kumara	Email classification	proposed Ontology	Similarity is complex
Swamy Y S	using adaptive ontologies Learning	Extraction engine on the fuzzy rules	when replaced the word

III. Discussion

Ontology applications are large domains so you must select and determine the requirements for ontology design and used for other domains. There several challenges in ontology design and methodologies when we use and build ontology for specified problem one of them interoperability and integrating. In this survey all of the related work uses or build ontology in one domain While the interoperability issue is an open for research.

IV. Conclusion

This paper review several topic about ontology applications that uses in different domains in knowledge representation in E-learning, expert system, and how to select the tool for ontology analysis and software we use to build ontology or propose new method to build a systematic approach for ontology and modeling and extracting knowledge for decision making.

V. Recommendations

Through this survey I recommend for this points Integrating models for ontology to fit for all application in specific domain. Reuse the ontology model to adapt any action when the application is changing. New approaches to help the modelers to use a suited framework to design the ontology. Interoperability and matching are a challenge is open research issues in ontology processes.

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Assessment of Participation of Quantity Surveyors in Oil and Gas Projects in Nigeria

By Odesanya Busayo Kehinde & Ebhohimen Tolulope Ehijel

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Abstract- The study appraised the participation of Quantity s Surveyors in the execution process of oil and gas projects and established the roles quantity surveyors play in such projects. The study also considered factors that affects the participation of quantity surveyors in oil and gas projects and adopted snowballing sampling techniques to survey quantity surveyors practicing in oil and gas firms, oil servicing firms and consultancy firms, using structured questionnaires to collect data. The data collected were analysed using percentiles and mean score item. The study revealed that quantity surveyors are involved in oil and gas projects, but on the average. As earlier said, the research identified four prevalent factors like Lack of Technical Knowledge/Skills with a mean item score of 3.93, Educational Curriculum in Tertiary Institutions with a mean item score of 3.89, Government Policies/Nigerian Content Development Act with a mean item score of 3.76 and Inter-Professional Rivalries with a mean of 3.67.

Keywords: cost engineer, cost estimator, engineering, quantity surveyor, oil and gas.

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Assessment of Participation of Quantity Surveyors in Oil and Gas Projects in Nigeria

Odesanya Busayo Kehinde [α] & Ebhohimen Tolulope Ehijel [σ]

Abstract- The study appraised the participation of Quantity s Surveyors in the execution process of oil and gas projects and established the roles quantity surveyors play in such projects. The study also considered factors that affects the participation of quantity surveyors in oil and gas projects and adopted snowballing sampling techniques to survey quantity surveyors practicing in oil and gas firms, oil servicing firms and consultancy firms, using structured questionnaires to collect data. The data collected were analysed using percentiles and mean score item. The study revealed that quantity surveyors are involved in oil and gas projects, but on the average. As earlier said, the research identified four prevalent factors like Lack of Technical Knowledge/Skills with a mean item score of 3.93, Educational Curriculum in Tertiary Institutions with a mean item score of 3.89, Government Policies/Nigerian Content Development Act with a mean item score of 3.76 and Inter-Professional Rivalries with a mean of 3.67. The study recommended that the Nigerian Content Monitoring Board must ensure that the provisions for local professional services in the "Act" are obeyed strictly. Also, quantity surveyors must ensure they understand the provisions applicable to their involvement in oil and gas projects. It also recommended that the educational curriculum at tertiary institutions be revised so as to widen the scope of knowledge. It further suggested that quantity surveyors should be encouraged to be registered by International Cost Engineering Council [ICEC], and any associated professional body. Lastly, regulatory bodies or enforcement agencies could be established in order to and constrain every expert in the oil and gas sector to his or her profession, as well as organise expository seminars, launch books, journals, and other official publication so as to foster the awareness of the benefits of having quantity surveyors in such projects to every stakeholder/shareholder (including the Governments and oil and gas parastatals) involved in oil and gas projects.

Keywords: cost engineer, cost estimator, engineering, quantity surveyor, oil and gas.

I. Introduction

Out of the leading industries in Nigeria, the oil and gas over the years has proven to be the most contributing and determining factor of Nigeria's economy (Centre for Energy Economics [CEE], 2006; Odularu, 2008). Recent studies (Klynveld Peat Marwick Goerdeler [KPMG] 2014); Owusu-Manu, 2011) divides the sector into: upstream sector which is characterized by exploration and production of crude oil and gas; downstream sector (midstream inclusive) which involves transmission and conveyance, distributing and marketing, refining, liquefied natural gas; and services sector which includes exploration support services, drilling services, downstream services, wireline services, refinery maintenance etc. Adepetun (2013), opined that the petroleum sector accounts for more than 95% of export earnings and more than 75% of Nigerian Federal Government revenue. Likewise, the Nigerian economy depends upon the Petroleum Industry, with the contribution to National Revenue exceeding 90% (Onyeador, 2011).

Studies by (Jagboro and Dada, 2012; Rabie and Riad, 2011) defined the traditionally quantity surveyor to be a professional concerned with the contracts and costs on construction projects, and that they control construction costs by accurate measurement of the work required. In their study, they also ascertained that these methods involve activities which may include value management, tendering, valuation, change control, claims management and cost estimation. Jagboro (1991) therefore asserted that the quantity surveying profession was at start known for expertise in building work however, an increasing evolution of the profession into new areas including engineering, contract management, and project management. In addition, Mohammad and Price (2014), in their study also pointed out the fact that procurement is also a major aspect of contract management which happens to be capital intensive. Mogbo (1998), further stressed that quantity surveying is said to be an applied science but which has its root in construction Economics and Management, which is applicable in Engineering: Civil, Electrical, Mechanical, Process, Petroleum etc).

Previous studies (Circa, 2012; Said, Shafiel, and Omran, 2010; Nkado, 2002) has shown that there has been a huge development in the number of services a quantity surveyor can render. Some of which are; investment appraisal, advice on cost limits and budgets, whole life costing, value management, risk analysis, insolvency services, cost engineering services, subcontract administration, technical auditing, planning and supervision, valuation for insurance purposes, project management, facilities management, administering maintenance programmes, advice on

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contractual disputes, planning supervisor, employers' agent, programme management, cost modelling, and sustainability advisor (Seleey, 1993).

Moreover, the findings by the Association for the Advancement of Cost Engineering International [AACEI] (2007) reported the relationship between the Cost Engineer and a Quantity Surveyor. While Engineers are responsible for functional and physical creation (design) in term of dimensional element of structures e.g. road and bridge. However, seeing beyond the functional and physical dimension, less tangle dimensions of money, time and other resources invested (collectively referred to as Costs), someone need to estimate the cost, determine activities time to build it, continually monitor and control ,assess the progress in relation with time and money expended to ensure clients objectives. However, the engineering skills and knowledge require for cost dimension in construction are quite different. From that difference, the skills of a cost engineer is born.

Holmes and Joyce (1993) defines competency as action, behaviour or outcome which a person should be able to demonstrate, or the ability to transfer skills and knowledge to new sector. Moreover, Onyeador (2011) opined Knowledge which entails the technical, economic/financial, commercial, organizational, and political aspects of the sector to be key to effective participation of quantity surveyors in the Nigerian oil and gas projects. Opawole, Awodele, Babatunde and Awodele (2012) concluded in their study that the training of quantity surveyors will help them handle the measurement of civil engineering works. Previous researches suggested that Quantity Surveyors need to possess a full understanding of the overall life cycle of exploration and production (upstream) down to refining (downstream) to project life cycles and activities performed at each stage of the life cycle. A multi-disciplinary knowledge of other related professional disciplines is much required, since the quantity surveyor occupies a central role of interacting with other members of the design and construction/engineering team (Hassal, Dunlop and Lewis, 1996; Nkado, 2000).

Although, the Federal Government of Nigeria by the enactment of the Nigerian Content Development Act in April, 2010 has given rise to the hope of the involvement of the quantity surveying practice in the oil and gas projects, (Ojo and Eyitope, 2011), it is left to the quantity surveyor has a professional to possess some pre-qualification skills. Heum, Quale, Karlsen, Kragha and Osahon, (2003) highlighted certain promising areas where opportunities exist in the industry which are to include: fabrication and construction; well construction and completion; modification, maintenance and operations; transportation; control systems and ICT; design and engineering; and consultancy.

II. Previous Studies

a) Quantity Surveyors and the Oil and Gas Industry

Olanrewaju, Anavhe and Abdul-Aziz (2014), noted that "Quantity Surveying is universal and is carried out under different names, such as building economist, cost consultant, management consultant, cost economist, project consultant, and commercial manager". Also, the diversification has been said to have robbed the profession of an identity (Olanrewaju and Anavhe, 2008) unlike other allied profession where an engineer remains an engineer or where an architect remains an architect.

Defining the role of a Quantity Surveyor, "the Quantity Surveyor is the expert who is concerned with financial integrity, contractual matters, procurement, and delivering value for the clients' money invested" (Olanrewaju, Anavhe and Abdul-Aziz, 2014, para. 1). The services that the Quantity Surveyors currently provide have shifted from the 'downstream' to 'upstream'. The dynamism of quantity surveying enables it to venture into other areas like facility management, value management, knowledge management, risk management, arbitration, maintenance management, centre management, system management, and project management. Moreover, Quantity Surveyors are adaptable creatures capable of reinventing themselves according to the demands of the modern progressive clients (Cartlidge, 2003). Talking about the present roles that the Quantity Surveyors perform today, they have diversified into industries including petrochemical, manufacturing, automobile, mining, telecommunication, shipping, transport, and agriculture. The major impetus for this diversification is the changing requirements of the stakeholders. In addition, The Nigerian Institute of Quantity Surveyors (NIQS), the professional body that regulates the activities of the Quantity Surveyors in Nigeria was established in 1969 by some UK trained Nigerians. Since the late 90s, the Nigerian Institute of Quantity Surveyors (NIQS) is now a member of the International Cost Engineering Council (ICEC).

b) Quantity Surveyors Roles as Cost Engineer in the Oil and Gas Industry

Findings made by Jagboro (1991), reveals that the Quantity Surveying profession was only known for building work, but now it has digressed into new areas like Engineering, Contract Management, and Project Management. With this, the Researchers, Ojo and Eyitope (2011) therefore took time to see the dependency of Oil and Gas Industry on the Quantity Surveying Profession as touching the cost aspect. So therefore, this review will be to see the similarities between the skill competitiveness and the practice of Cost Engineer and Quantity Surveying with a view to provoke opportunity for Nigerian Quantity Surveying particularly in the oil and gas.

The Cost Engineering skill was defined from the Advancement of Cost Engineering International [AACEI] (2007), as skills that empowers a person who estimate the cost, determine activities time to build it, continually monitor and control, assess thee progress in relation with time and money to ensure client's objective. There were clients that showed the comparison of the skills of a Cost Engineer and a Quantity Surveying. It was therefore stated by the International Cost Engineering Council [ICEC] (1996, 2002), that Quantity Surveying is more related to building design and construction, while Cost Engineering relates more to Engineering projects.

The major difference is that the two bodies responds to different professional bodies and have different modes in taking professional qualification. In its publication, AACEI (2007) stated least years allowed becoming a Quantity Surveying and Cost Engineer. For a Cost Engineer to be certified, it requires at least 8years of post-graduation of which four (4) must be a degree/HND in law, business administration, information technology, accounting etc. Also, the Quantity Surveying, just 36months industrial experience and a degree/HND level will make a Cost Engineer.

A step to creating opportunities for Quantity Surveyors by the Government is the enactment of the Nigerian Content Development Act, April 2010. Under Clause 15, 28 and 42, NIQS has the chance to creating opportunities for its members in order to compliment the few in the industry working as Contract Engineer, Project Control Engineer, Proposal and Estimating Engineer, Planning Engineer etc

c) *Educational Curriculum for Administration of Engineering Projects*

Quantity Surveying profession was at start known for expertise in building work. There is, however, an increasing evolution of the profession into new fields including engineering. For this evolution to be worthwhile in Nigeria, there is the need to understand the major aspects under which engineering constructions are administered, and the scope of Quantity Surveyors' education and training in Nigeria (Jagboro, 1991).

The researcher opined that Quantity Surveyors services are fully appreciated when it comes to engineering projects unlike Nigeria where their involvement is fully appreciated for building engineering constructions but at seemingly low level in engineering projects. Some previous works attributed this to professional rivalries while some are of the opinion that the present education/training of Quantity Surveyors in Nigeria has not led to adequate qualitative competence of the quantity surveyors due to the embryonic state of the discipline.

As a discipline, Quantity Surveying is said to be concerned with detailed calculation and measurement of both materials and labour required for construction activities including building, and engineering project, reveals a multi-disciplinary nature. Jagboro emphasized the link between the Nigerian educational curriculum and the administrative aspect of the profession in handling Engineering projects. However, Seleey (1993) is of the opinion that sound knowledge and expertise of project design and cost solution to physical and geological problems are the required proficiency for administering civil engineering projects. Quantity Surveyors' education as an applied science which is in effect a construction economics and management oriented that covers various areas of construction sciences (engineering: civil, electrical, product and chemical, among others), pure and applied economics, finance, accounting, politics, sociology, government administration and law; the study identified quantity surveyors' training to be interdisciplinary covering about 80% of course required providing financial administration required for all forms of constructions. (Mogbo, 1998).

Jagboro (1991) opined that the educational training of quantity surveyors in Nigeria has brought about nothing but inadequate quantitative competence of the professionals which is as a result of the embryonic state of the discipline is also seconded by Mogbo (1998) who advocated for an overhauling to the quantity surveyors syllabi in the Nigerian tertiary institutions to respond to all engineering projects. Contrary to aforementioned opinions, Ajanlekoko (2003), emphasized the recognition of the curriculum of quantity surveying programme by the international assessment that quantity surveyors in Nigeria possess requisite skills, education and training to ensure value for money in all construction works. Adebola (2002) who asserted that the present level of education and training of Quantity Surveyors in Nigeria is adequate for that required for all forms of engineering projects. However, Awodele (2003) believes that lack of adequate training is not a serious factor that influences the involvement of Quantity Surveyors in civil engineering works in Nigeria.

The research methodology of the study involved a review of the Higher Diploma and Degree syllabi of the Polytechnics and Universities of the Nigerian education system respectively. The syllabi were obtained from the polytechnic and universities in the south western Nigeria where quantity surveying are studied at both undergraduate and postgraduate levels. In a publications, Seeley (1993) argued that the skill requirements for the execution of civil engineering projects are sound knowledge and expertise of engineering construction including proficiency in proffering design solution to physical and geological problems; and proficiency in cost appraisal.

Civil engineering as defined by the Curriculum and Course Specification for Nigerian University system (2005) is the discipline involved in the

planning, design, construction and operation of physical facilities essential to modern life and community living. It also defines the discipline to be involved in financial probity in the conception, planning, and execution of development projects (all forms of engineering infrastructure); as well as a discipline that requires adequate training in feasibility studies of capital projects, cost modelling, contract documentation and procurement, contract administration and management, project management consultancy, information technology, facility management, arbitration, ands fire insurance assessment.

From the discussion of findings, a sample was drawn from the curriculum specification of the Nigerian University commission and the National Board of Technical Education for degree courses in quantity surveying and civil engineering . The result reveals a greater correlation of civil engineers education and training to 'design and construction' and a greater correlation of Quantity Surveyors education and training to 'cost appraisal and management of civil and other engineering projects. These services constitute the major components of the cost appraisal and financial administration of engineering projects. The research shows a low correlation between the curriculum and course specification of quantity surveying in the Nigerian education system and 'Design and Construction' of civil engineering constructions. Quantity Surveyors are not expected to design and construct civil engineering infrastructure but to show adequate understanding of the design and construction with the aim of being able to communicate and interpret for the purpose of the cost management services. The results, however, agree with Seeley (1993) that while cost appraisal forms a substantial part of the education and training of Quantity Surveyors, it represents only a part of the education and training of civil engineers.

The researcher concluded that revealing that the study the education and training of quantity surveyors in Nigeria provides adequate skill requirement for providing services requiring measurement of civil engineering works as well as services requiring evaluation of civil engineering works and financial management with about 51.2% and 52.2% of the curriculum and course content of University and Polytechnic respectively satisfying directly the requirement of cost appraisal and administration of the financial aspects of civil engineering and other engineering projects. In was therefore suggested that there should be a continuous overhauling of the curriculum and course content of quantity surveying in the Nigerian higher education system.

III. RESEARCH METHODOLOGY

The study was carried out by carrying out a survey which will give an overview of the numerical level of participating Quantity Surveyors in oil and gas projects. As a result of this, this research was carried out by acquiring primary and secondary data which was used to analyze the research questions. The primary data was collected systematically with the use of questionnaire while the secondary data was gotten from journals of related literatures. The study was done through questionnaires distribution to seek the view of Quantity Surveyors which were self-administered. The research population was characterised of Nigerian Quantity Surveyors/Cost Engineers practicing in oil and gas companies and quantity surveying firms who have executed oil and gas projects. These members were chosen based on the fact that the professionals have the required knowledge (i.e. experience) for the analysis for the research questions.

Non-Probabilistic sampling technique was used, i.e. Snowball sampling technique. The reason behind the employment of this type of sampling technique is because of the peculiarity of the study i.e. it might not be easy to access the Quantity Surveyors that are involved in the execution of oil and gas projects.

Analysis of data collected is quantitative in nature. The first section which contains the Demographic Information of the Respondents was analysed using the Percentile. While the second, third and fourth sections which are to identify the roles Quantity Surveyors play in oil and gas projects; to assess the level of involvement of Quantity Surveyors in such projects; to identify the factors affecting the participation of Quantity Surveyors in oil and gas projects respectively, was analysed using the Mean Item Score (MIS). The mean item score formula is given by:

$$\frac{5N5 + 4N4 + 3N3 + 2N2 + 1N.}{n}$$

Using 5 (five) point LIKERT SCALE which corresponds to:
"5" = very high.
"4" = high.
"3" = average.
"2" = low.
"1" = very low.

Where N = number of respondents to a particular scale
n = total number of respondents.

And

$$\frac{5 + 4 + 3 + 2 + 1}{5} = 3 \text{ (i.e. positive decision)}$$

Decision Rule

Any mean score below 3.00 is considered a negative decision, while any mean score from 3.00 and above was considered a positive decision.

IV. DATA PRESENTATION AND ANALYSIS

Fifty Questionnaires were administered among Quantity Surveyors who practices in upstream sector companies, downstream sector companies, oil and gas servicing firms and quantity surveying firms, of which only a total of 45 questionnaires were recovered successfully.

Table 4.1 reveals the Type of Employment of the Respondents in their respective companies and firms in Lagos State. A total of 37 Quantity Surveyors amounting to 82.2% are full time staffs, while a total of 5 Quantity Surveyors amounting to 11.1% works as Temporary staffs i.e. Ad-hoc staffs, and 3 Quantity Surveyors amounting to 6.7% are part time staffs i.e. Casual staffs.

Table 4.2 shows the Quantification of the Respondents; 22 Quantity Surveyors amounting to 48.9% are Members of NIQS; 12 Quantity Surveyors amounting to 26.7% are Probationers; while 8 Quantity Surveyors amounting to 17.8% happened to be Graduates and; 3 Quantity Surveyors amounting to 6.7% were fellows of NIQS.

Table 4.3 reveals the Type of Employing Company who are involved in Oil and Gas projects; 15 Quantity Surveyors amounting to 33.3% are staffs in Quantity Surveying Consultancy Firms; while 11 Quantity Surveyors amounting to 24.4% works in the Companies of Downstream Sector; while 11 Quantity Surveyors amounting to 24.4% are recruited to Oil Servicing Firms; and 8 Quantity Surveyors amounting to 17.8% are staffs in Companies in the Upstream Sector.

Table 4.4 shows the Years of Working Experience of the Respondents; 16 Quantity Surveyors are having a working experience between the range 6-10years; while 12 Quantity Surveyors are having a working experience between the range 11-15years; also 9 Quantity Surveyors are having a working experience between the range 1-5years; 6 Quantity Surveyors are having a working experience range of 16-20years and lastly; only 2 Quantity Surveyors are having a working experience between the range 21-25years.

Table 4.5 reveals the number of Oil and Gas projects the respondents has been involved in; 35 Quantity Surveyors have been involved in projects between the range 1-9; while 9 Quantity Surveyors have been involved in more than 9 projects. However, one of the questionnaires administered, one was left void.

Table 1: Type of Employment

Type of Employment	Frequency	Percent
Full time	37	82.2
Temporary(daily)	5	11.1
Part time	3	6.7
Total	45	100.0

Table 2: Qualification of Respondent

Qualification	Frequency	Percent
MNIQS	22	48.9
PROBATIONER	12	26.7
GRADUATE	8	17.8
FNIQS	3	6.7
Total	45	100.0

Table 3: Type of Employing Company

Employer	Frequency	Percent
QS Consulting Firm	15	33.3
Downstream	11	24.4
Oil Servicing Firm	11	24.4
Upstream	8	17.8
Total	45	100.0

Table 4: Years of Working Experience

Years of Working Experience	Frequency
6-10	16
11-15	12
1-5	9
16-20	6
21-25	2
Total	45

Table 5: Number of Oil and Gas Project Executed

Projects	Frequency
1-9	35
Above 9	9
Total	44
Void	1
Total	45

Table 6: Roles of Quantity Surveyors in Oil and GasProjects

Roles of Quantity Surveyors in Oil and Gas projects	Mean	Rank
Cost Estimator	4.62	1
Cost Engineer	4.30	2
Contract Manager	4.16	3
Procurement Planning Manager	4.11	4
Cost Planning Manager	4.11	4
Total Cost Manager	4.11	4
Budgeting Manager	3.76	7
Asset and Facility Manager	3.67	8
Value Analysis and Engineering Manager	3.67	8
Planning Manager	3.64	10
Assessment Manager	3.60	11
Investment Feasibility Manager	3.53	12
Project Implementation and Performance Manager	3.49	13
Arbitrator	3.33	14
Resource Manager	3.22	15
Risk Manager	3.20	16
Technical Auditor	2.93	17
Supply and Distribution Manager	2.84	18
Health, Safety and Environment Manager	2.24	19

Table 6 shows the roles the Quantity Surveyors plays in the execution of Oil and Gas projects; The roles that were ranked high includes: Cost Estimator with a mean of 4.62; Cost Engineer has a mean score of 4.30; Contract Manager with a mean score of 4.16; while the role of Procurement Manager, Cost Planning, Total Cost Manager were ranked on the same level with their mean scores of 4.11. On the other hand, the roles that were ranked least includes: Technical Auditor with a mean score of 2.93; Supply and Distribution Manager with a mean score of 2.84; and lastly, Health, Safety and Environment Manager with a mean score of 2.24 making it the lowest ranked. Although, in this section, two questionnaires were invalid i.e. Cost Engineer and Procurement Planning.

Quantity Surveyors' Level of Participation in Oil and Gas Projects.

Table 7: Level of Participation of Quantity Surveyors in Oil and Gas Projects

Level of Participation	Frequency	Percent
Average	23	51.1
Low	11	24.4
High	9	20.0
Very High	1	2.2
Very low	1	2.2
Total	45	100.0

Table 7 shows the respondents' opinion on the level of Quantity Surveyors in Oil and Gas projects; 23 Quantity Surveyors which makes up 51.1% opined that the Quantity Surveyors' level of participation in oil and gas projects is on the Average, while 11 Quantity Surveyors which makes up 24.4% were of the opinion that the Quantity surveyors' level of participation in oil and gas projects is low, also 9 Quantity Surveyors with 20.0% were of the opinion that the Quantity Surveyors' level of participation in oil and gas projects is high, just a (1) Quantity Surveyor which makes up 2.2% opined that the Quantity Surveyors' level of participation in oil and gas projects is very high and lastly, a (1) Quantity Surveyor which makes up 2.2% opined that the Quantity Surveyors' level of participation in oil and gas projects is very low.

Table 8: Oil and Gas Projects' Dependency on the Participation of Quantity Surveyors

Dependency of Oil and Gas Projects' delivery	Frequency	Percent
Average	19	42.2
High	14	31.1
Low	6	13.3
Very High	5	11.1
Very low	1	2.2
Total	45	100.0

Table 8 shows the respondents' opinion on the Dependency of the participation of Quantity Surveyors for Oil and Gas projects delivery: 19 Quantity Surveyors (42.2%) were of the opinion that the dependency is on an average; while, 14 Quantity Surveyors (31.1%) were

opined that the dependency is high; 6 Quantity Surveyors (13.3%) claimed that the dependency is low; while 19 Quantity Surveyors (11.1%) were of the opinion that the dependency is very high; and lastly, 1 Quantity Surveyor (2.2%) opined that the dependency is very low.

Table 9: Level of Participation of Quantity Surveyors

Roles of Quantity Surveyors	Mean	Rank
Cost Estimator	4.33	1
Cost Engineer	4.13	2
Total Cost Manager	3.89	3
Procurement Planning Manager	3.77	4
Contract Manager	3.67	5
Risk Manager	3.47	6
Cost Planning Manager	3.36	7
Value Analysis and Engineering Manager	3.33	8
Budgeting Manager	3.29	9
Resource Manager	3.29	9
Asset and Facility Manager	3.24	11
Project Implementation and Performance Manager	3.13	12
Planning Manager	3.13	13
Assessment Manager	3.02	14
Investment Feasibility Manager	2.98	15
Arbitrator	2.93	16
Technical Auditor	2.87	17
Supply and Distribution Manager	2.80	18
Health, Safety and Environment Manager	2.13	19

Table 9 shows the Respondent's Perception on the Level of Participation of Quantity Surveyors in the Execution of Oil and Gas Projects based on roles they perform in such projects: From the analysis, their response depicts that the level at which the Quantity Surveyors participates as Cost Engineers is the most ranked with a mean score of 4.33; while as Cost Engineers are ranked with a mean score of 4.13; while a mean score of 3.89 for Quantity Surveyors participating as Total Cost Managers; Procurement Planning Managers with a mean score of 3.77; and Contract Managers with a mean score of 3.67; Contrarily, the roles ranked lowest were: Investment Feasibility Managers with a mean score of 2.98; Arbitrators with a mean score of 2.93; Technical Auditor with a mean score of 2.87; Supply and Distribution Managers with a mean score of 2.80; and, Health, Safety and Environment Managers ranked the lowest with a mean score of 2.13.

Factors Affecting the Participation of Quantity Surveyor in Oil and Gas Projects

Table 10: Factors Affecting the Participation of Quantity Surveyors

Factors	Mean	Rank
Lack of Technical Knowledge/Skills	3.93	1
Educational Curriculum in Tertiary Institutions	3.89	2
Government Policies/Nigerian Content Development Act	3.76	3
Inter-Professional Rivalries	3.67	4
Corruption/Politics played amongst Stakeholders	2.56	5

Table 10 shows the Respondent's ranking on the Factors that could affect the Level of Participation of Quantity Surveyors in the Execution of Oil and Gas Projects; based on the analysis, Lack of Technical Knowledge/Skills was ranked the highest with a mean score of 3.93; with Educational Curriculum in Tertiary Institutions ranked second with a mean of 3.89; Government Policies/Nigerian Content Development Act with a mean score of 3.76; Inter-Professional Rivalry with a mean of 3.67; while Corruption/Politics played amongst Stakeholders was ranked lowest with a mean score 2.56.

V. Discussion of Findings

The study is characterized with respondents working in Lagos State, comprising of 37 Quantity Surveyors (82.2%) who are full time employed, 5 Quantity Surveyors (11.1%) who are Temporary staffs i.e. Adhoc workers and 3 Quantity Surveyors (6.7%) who are part time staffs i.e. Casual Workers, in their workplaces. 22 Quantity Surveyors (48.9%) are Members of NIQS, 12 Quantity Surveyors (26.7%) are Probationers, while 8 Quantity surveyors (17.8%) are Graduates and, 3 Quantity Surveyors (6.7%) are Fellows of NIQS. 15 Quantity Surveyors (33.3%) are staffs in Quantity Surveying Consultancy Firms, 11 Quantity Surveyors (24.4%) are staffs in Quantity Surveying Consultancy Firms, same as Oil Servicing Firms, and 8 Quantity Surveyors (17.8%) are staffs in Quantity Surveying Consultancy Firms. 35 Quantity Surveyors have been involved in less than 10 projects, 9 Quantity Surveyors have been involved in more than 9 projects. 16 Quantity Surveyors have spent 6-10years as working experience, 12 Quantity Surveyors have spent between 11-15years as working experience, 9 Quantity Surveyors have spent between 1-5years as working experience, 6 Quantity Surveyors have spent between 16-20years as working experience, 2 Quantity Surveyors have spent between 21-25years as working experience. The above analysis shows that a larger chunk of the respondents, Quantity Surveyors who work full time in Quantity Surveying Consultancy Firms which are members of NIQS body having spent 6-10years in experience, who have been involved in less than 10 projects.

From the analysis, it is clear that the response from the respondent pertaining roles of Quantity Surveyors in oil and gas projects are positive except three which are: Health, Safety and Environment Manager; Technical Auditor and; Supply and Distribution Manager . The analysis proves that the Quantity Surveyors' roles in projects are majorly Cost Estimator which was ranked high and, secondly; Cost Engineer.

Onyeador (2011) opined that Cost engineering which is the main function of the Quantity Surveyor that intends to participate in Oil and Gas projects is quite different from Quantity Surveying as a profession. The major difference between the two is that the Quantity Surveyor works mainly in the building Construction while the Cost Engineer tilts towards Engineering Projects. Also, Ajator (2014) submits that costing of oil and gas projects present great opportunities for the Quantity Surveying consultants as is the case in advanced countries where cost engineers perform this role.

According to Jagboro (1991), the Quantity Surveyor profession was said to be into mainly building, but as the profession increased in evolution, in new areas which include Engineering, Contract Management, Project Management etc. "Interestingly, Quantity Surveying practice is gaining more relevance in Asset Management, Project Management, Taxation, Law, Insurance, Banking and Manufacturing – especially oil and gas" (Yakub, 2005). The analysis shows that the level of participation of Quantity Surveyors in oil and gas projects is on the average. With this, it will be impossible to disprove the afore-reviewed literatures which submit that the participation of Quantity Surveyors in oil and gas projects is on the increase. Nevertheless, the analysis shows the opinion of the respondents on the level of involvement, using the roles the Quantity Surveyors have been playing in past projects. Their responses show that there has been a high involvement of Quantity Surveyors playing the roles of Cost estimators and secondly, cost engineers. Conversely, the study shows that the level of participation of Quantity Surveyors playing the roles of Investment Feasibility Manager, Arbitrator Technical Auditor and Supply and Distribution Manager is on a low scale.

The respondent also expressed their opinion on the delivery of oil and gas projects' dependency on the participation of Quantity Surveyors. The analysis shows that the dependency of oil and gas projects' delivery on the participation of Quantity Surveyors is on the average. The research identified five causative factors that could affect the participation of Quantity Surveyors in oil and gas projects, but four factors are prevalent which are: Lack of Technical Knowledge/Skills, Educational Curriculum in Tertiary Institutions, Government Policies/Nigerian Content Development Act and, Inter-Professional Rivalries.

Results from the findings revealed that Lack of Technical Knowledge/ Skills is the most prevalent factor affecting the participation of Quantity Surveyors. This finding agrees with Onyeador (2011) which affirms that Knowledge which ranges from technical general knowledge to technical detailed knowledge is the first criteria to effective participation of Quantity Surveyors in the oil and gas project. Quantity Surveyors have to understand the overall Lifecycle of exploration and production to refining of the Oil and Gas industry.

Another factor that affects the participation of Quantity Surveyors in such projects is the Educational Curriculum in Tertiary Institutions. This is supported by Jagboro (1991) who opined that the educational training of quantity surveyors in Nigeria has brought about nothing but inadequate quantitative competence of the professionals which is as a result of the embryonic state of the discipline; and by Mogbo (1998) who advocated for an overhauling to the quantity surveyors syllabi in the Nigerian tertiary institutions to respond to all engineering projects. This disproves the assertion Ajanlekoko (2003), who emphasized the recognition of the curriculum of quantity surveying programme by the international assessment that quantity surveyors in Nigeria already possess requisite skills, education and training to ensure value for money in all construction works. Likewise, Adebola (2002) asserted that the present level of education and training of Quantity Surveyors in Nigeria is adequate for that required for all forms of engineering projects.

Government Policies/Nigerian Content Development Act has been discovered to be the next prevalent factor. The result shows that the Act could either favour or disfavour the profession's involvement in oil and gas projects. According to PIB publication, the Nigerian Local Content Development Act requires that professional services including legal, financial and insurance services be provided solely by Nigerian firms. Since Quantity surveyors provides financial services in construction and engineering projects (Mogbo, 1998), the profession is not left out.

Lastly, Inter-Professional Rivalries has been researched to be another prevalent factor affecting the participation of Quantity surveyors in oil and gas projects. Rivalries among the professionals in the construction industry refer to the degree of which professionals in the construction industry respond to competitive moves of other professionals in the industry (Olanrewaju 2011). This assertion correlates with this research, such that, has there are rivalries of Professionals in construction projects, likewise oil and gas projects.

VI. Conclusion

The findings show that the level at which Quantity Surveyors participates in oil and gas projects is on an average level. It also shows that most Quantity Surveyors currently practicing in such projects are playing the roles of Cost Estimator and Cost Engineer. Conversely, the level of participation of Quantity Surveyors as Investment Feasibility Manager, Arbitrator, Technical Auditor, Supply and Distribution Manager and, Health, Safety and Environment Manager is low. It was also revealed that level of dependency on the services the Quantity Surveyors render to the success of oil and gas project is on the average. The research hypothesized five factors that affect the participation of Quantity Surveyors in oil and gas projects of which four was deduced to be more prevalent. These factors are; Lack of Technical Knowledge/Skills which is the most prevalent; Educational Curriculum in Tertiary Institutions; Government Policies/Nigerian Content Development Act and Inter-Professional Rivalries.

VII. Recommendations

In the light of this foregoing conclusion drawn from the findings, it is deemed fit that some strategies and realistic recommendations that if properly implemented would alleviate some of the problems facing the participation of Quantity Surveyors in oil and gas projects. These recommendations include;

1. Nigerian Content Monitoring Board which was created by the Government so as to monitor the achievement of local content in the oil and gas industry, should begin/continue to ensure that the provisions for local professional services in the Act are adhered strictly, and any defaulters are brought to book. Also, Quantity Surveyors should ensure they understand the provisions applicable to their involvement in oil and gas projects.
2. The educational curriculum at Tertiary institution should be revised as the scope of the profession increases. Measurement, estimating, procurement, management, etc. of heavy engineering projects and oil and gas components should be incorporated in the curriculum.
3. Also, Quantity Surveyors should be encouraged to be registered by International Cost Engineering Council [ICEC], and any associated professional bodies, so that the necessary skills and knowledge to participate in oil and gas projects can be acquired.
4. Regulatory bodies or enforcement agencies should be established in order to constrain every expert involved in the execution of oil and gas projects to his or her profession. Also, expository seminars, launch books, journals, and other official publication should be encouraged so as to make every

stakeholder/shareholder (including the Governments and Oil and Gas Parastatals) involved in oil and gas projects aware about the benefits of having Quantity Surveyors in such projects.

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Shale Gas Reserve Potential in the Sedentary Basins of Malaysia and South-East Asia Region

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Abstract- Shale gas, which is mostly methane, can be found in any sedimentary basins. The depositional setting directly controls key factors in shale gas, such asorganic geochemistry, organic richness, and rock composition. Shale gas reservoir type is a source rock that has retained gas production potential. Produced gas comes from adsorbed gas in the organic matter and free gas trapped in the pores of the organic matter and in the organic portions of the matrix.

The main objective of this study is to discuss the potential of shale gas reserves in Malaysia and South East Asia sedimentary basins. Shale can actually be a game changer in South East Asia and mainly for Malaysia, China, India, Pakistan, Indonesia and Thailand. Malaysia, located within Southeast Asia, has two distinct parts. The western half contains the Peninsular Malaysia, and the eastern half includes the states of Sarawak and Sabah.

Keywords: sedimentary basins, shale gas reserves, south asia region, global shale reserves.

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SHALEGASRESERVEPOTENTIALINTHESEDENTARYBASINSOFMALAYSIAANDSOUTHEASTASIAREGION

Strictly as per the compliance and regulations of:

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A. El-Sakka[α], G.M. Hamada[σ], E. Padmanabhan[ρ] & A.M. Salim[ω]

Abstract- Shale gas, which is mostly methane, can be found in any sedimentary basins. The depositional setting directly controls key factors in shale gas, such asorganic geochemistry, organic richness, and rock composition. Shale gas reservoir type is a source rock that has retained gas production potential. Produced gas comes from adsorbed gas in the organic matter and free gas trapped in the pores of the organic matter and in the organic portions of the matrix.

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Keywords: sedimentary basins, shale gas reserves, south asia region, global shale reserves.

I. Introduction

In the last decade and more, shale gas resources have emerged as a viable energy source. The development of these shales changed the traditional approach geologists had been following-that of the sequence of gas first being generated in the source rock, followed by its migration into the reservoir rock in which it is trapped. The shale layer acts as both source and reservoir rock in gas reservoir, there is no need for migration and since the permeability is near zero, it forms its own seal. Large amount of gas is generated in shale layers by sedimentation of organic matter. It is

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important for development of shale gas reservoirs to locate such layers where gas can be generated and accumulated in a sedimentary basin as well as the sweet spot with shale gas deposits. To accomplish this, the tectonics of shale sedimentary basins have to be analyzed, along with the sedimentary environment and sequence stratigraphy. As different shale gas reservoirs have different properties, it is imperative to study them before any exploration plan is put in place.

Shale gas consists of 70-90% methane, it is often called unconventional natural gas and is taken from different rock layers than traditional gas. shale gas exploration and exploitation is governed by many factors such as the areal extent of shale layer, thickness, total organiccarbon content, kerogen type, maturity, mineralogy, brittleness verses ductility etc. integrated studies of geological, geochemical, geophysical, petrophysical, geo mechanical can help evaluating all these factors to identify the sweet spots for shale gas exploration and exploitation. The shale itself has very low permeability and, without employing fracturing technology, production well flow rates would be minimal, (Satinder et al, 2012 and Hamada, 2017).

The main method of shale gas production is hydraulic fracturing, which requires a tremendous amount of water. Every shale gas well needs millions of gallons of water. The hydraulic fracturing process shoots out a mixture of water and chemicals at high pressure to extract the gas, inevitably requiring large amounts of water. Thus, the most important issue in developing shale gas in SE ASIA developing the technology to minimize water usage. In summary, it can be stated that the potential for shale gas as a source of energy in Southeast Asia appears to be good. However, more work needs to be carried out to ascertain the exact capacity of this gas in each country mentioned earlier.

For a shale gas reservoir to become a successful shale gas play, the following characteristics need to be considered: organic richness (TOC), maturation, thickness, gas in place, permeability, mineralogy, brittleness and pore pressure. An optimum combination of these factors leads to favorable productivity. Geophysical methods can help in characterizing the shale gas resource plays. However, the methodology adopted is in general quite different from methodologies applied to conventional reservoirs. In addition, the characterization of each shale reservoir could require particular types of tools and approaches

to well understand the sedimentation conditions and the petrrophysical properties to meet the growing challenges and expectations of shale gas resources.

Exploration and production activity started in Southeast Asia in the beginning of the last century. Shale gas resources are widely spread across the globe, there is great interest in the economic potential for developing shale gas more widely. The main objective of this study is to discuss the potential of shale gas reserves in Malaysia and South-East Asia sedimentary basins. Shale can be a game changer in South East Asia and mainly for Malaysia, China, India, Pakistan, Indonesia and Thailand. All these countries are big importers of crude oil and shale has the potential to drastically reduce the huge import bills of these nations. However, Southeast Asia has strengthened its important role in the global energy market, due to the growing economies in the region.

II. Malaysia Basins And Shale Gas Potential

Malaysia is in rapid economic growth while oil and gas is expected to play an important role in the economy towards the year 2020, when the country is expected to be fully industrialized.

Malaysia is the world's third-largest exporter of liquefied natural gas, and the second-largest oil and natural gas producer in the Southeast Asia. Malaysian sedimentary basins are major areas for potential oil and gas reservoirs as they contain many faults and natural traps, which collects and accumulate hydrocarbons under its impermeable layer. Six major Tertiary sedimentary basins are present in Malaysia: the Malay, Penyu, Sarawak, Sabah, Sandakan and a portion of Tarakan basins (Fig. 1) (EIA, 2013). Of these basins, only in Sarawak and Sabah basins have been proven to contain significant Shale gas accumulations that have been discovered. The six basins are grouped into three main regions: Peninsular basin, Sarawak & Sabah basin. Sarawak and Sabah basins area have been identified as a potential for unconventional play but in the early stage of exploration and no drilled wells to test the play. East Malaysia of sabah and Sarwak is a huge area totaling almost 200,000 sq km making up approximately 60 % of the Malaysia land mass. Based on preliminary resource assessment, Malaysia has an estimated hydrocarbon initial in place of 8.8 Tcf shale gas resources. (PETRONAS, 2016). The development of unconventional gas resources especially shale gasis still under study.
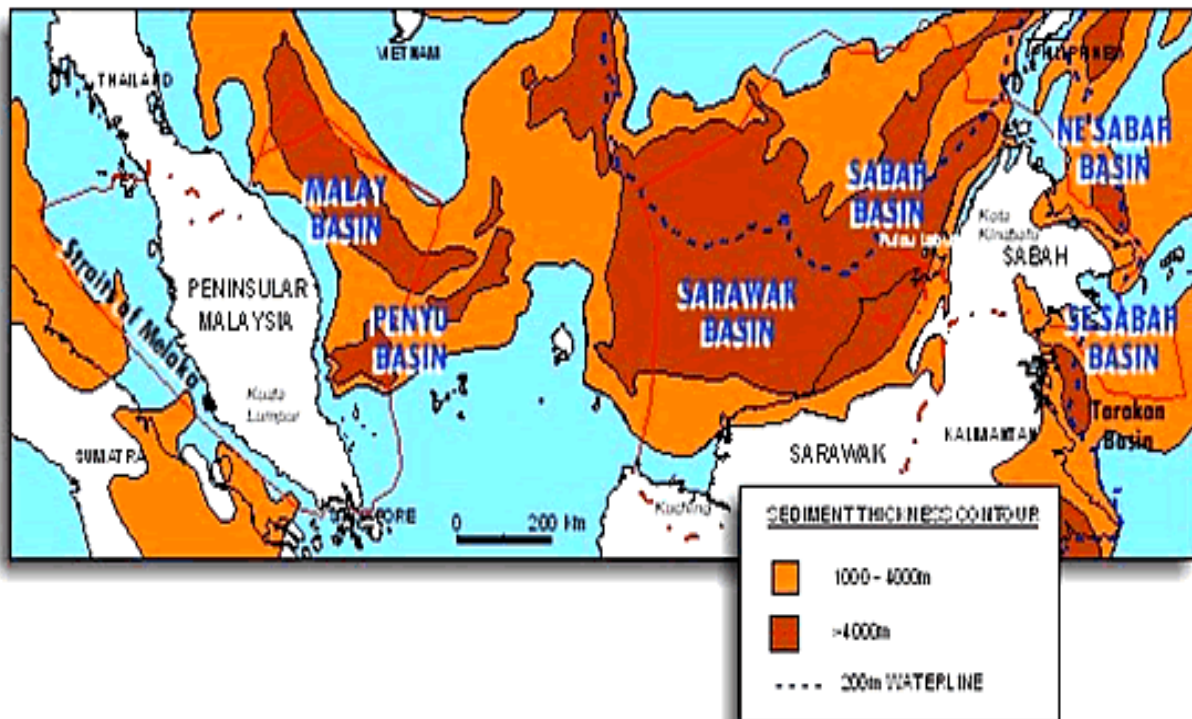
Figure 1: Sedimentary Basins in Malaysia (CCOP, 2010)

a) Sarawak

In Sarawak, the oldest formations date back to 300 million years. These ancient rocks form part of the West Borneo Basement which is the exposed part of Sundaland in Southwest Borneo, thus related to continental South-East Asia. The Basement is built up of Paleozoic and Mesozoic rocks. Most of Sarawak is underlain by younger Tertiary sedimentary rocks

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underlain by younger Tertiary sedimentary rocks especially the region northeast of the Lupar river. SETAP-SHALE Lithology Description (Inner neritic clay-shale & silty clay Occasionally interbedded with ss, calcareous ss & moderate thick limestone) with SR Potential (Poor-Fair Organic matter. NYALAU Lithology Description (Hard and semi to unconsolidated sandstone, massive, heterolithic coal seam, paleosol and thick mudstone (probably shelf and marginal marine mudstone) with TOC:78% Oil & gas. The

stratigraphic subdivision of the Tertiary sequence in Sarawak is based on sedimentary cycles, the cycles have been identified based on eight separate geological regions , namely the West Baram Delta, Balingian, Central Luconia, Tinjar, Tatau, West Luconia and SW Luconia and SW Sarawak Provinces as shown in (fig.2,3) (1994). The sedimentary succession on the Sarawak Basin shelf is more than 12 km thick. SIBUTI formation Lithology Description (shale, siltstone interbedded, limestone.)

Figure 2: Onshore Formation central Sarawak, (Petronas,2015)

b) *Sabah Basins*

The Sabah Basin have three major basins, which located in NW Sabah, is mainly offshore while the other two basins cover some areas in the N.E. and S.E. of onshore Sabah. The Sabah Basin contains 12-km thick Neogene sediments that were deposited within the deep marine and progradational shelf slope environment.

Figure 3: Location map of Sarawak and Sabah basins (IEA,1994)

c) Peninsular Basin

Peninsular Malaysia region have four main basins, The Malay Basin and the Penyu Basin are located offshore to the east of the peninsula. Other two basins, namely the Central Sumatra Basin and the North Sumatra Basin lie to the west of the peninsula and are mostly offshore with a small portion lying onshore. The Malay Basin contains about 12-km thick Neogene sediments that were deposited within the non-marine to shallow marine environment. In the Penyu Basin, oil has been discovered on horst blocks of Oligocene synrift play consisting of fluvial sandstones reservoirs.

III. China Potential And Major Shale Gas Prospects

China is the third country gaining shale gas discovery in the world after the United States and Canada. China has a huge shale gas resources. According to some estimates, it is the world's largest reserve. China possesses 31.6 trillion cubic meters (1,115 trillion cubic feet) of technically recoverable shale gas resources(EIA, 2013).

For geographical distribution, target areas can be divided into four regions (Fig 4): South (Sichuan Basin, Jianghan Basin and Chuxiong Basin), North (Ordos Basin, Bohai Bay Basin, Songliao Basin), Northwest (Tarim Basin and Qaidam Basin), and Qinghai-Tibet (Qiangtang Basin).

Most of the shale gas is in the South (46.8 percent) and Northwest (43 percent) regions (Zhang, 2010a), primarily in Sichuan, Tarim, and Ordos basins. The North (8.9 percent) and Qinghai-Tibet (1.3 percent) regions only account for 10.2 percent of the total shale gas resources. Formations include marine shale, continental shale and transitional facies (Guan and Niu, 2005).
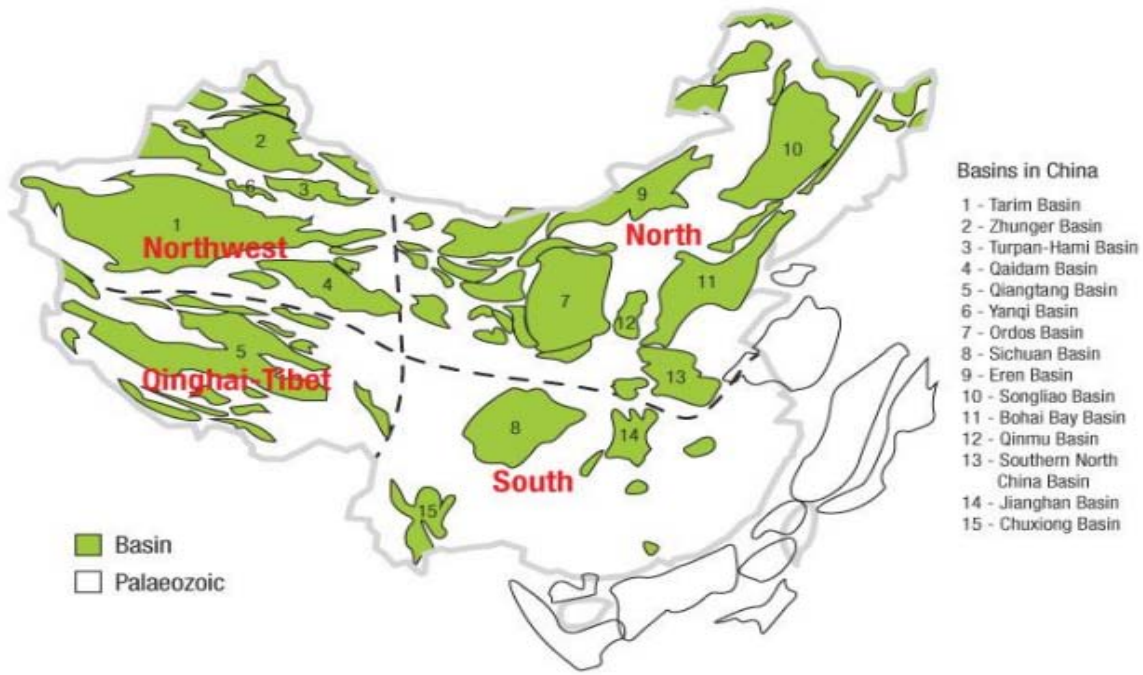
Figure 4: Basins in China (Wang and Wang, 2011)

The estimated amount of technically recoverable gas in two China shale basins shown in **Fig. 5,** Tarim and Sichuan, rank the country among the world's richest. The EIA study estimated that the Sichuan and Tarim basins hold 1,275 Tcf of technically recoverable gas, assuming that about 25% of the gas can be produced.

The Sichuan and Tarim Basins are two large organic rich shale plays, and other five less prospective basins are the Songliao, Bohai, Ordos, Tuha and Jungar Basins. The Sichuan Basin is considered as the most promising basin to develop shale gas in short term, because of its well-developed gas pipeline network and mature gas market.
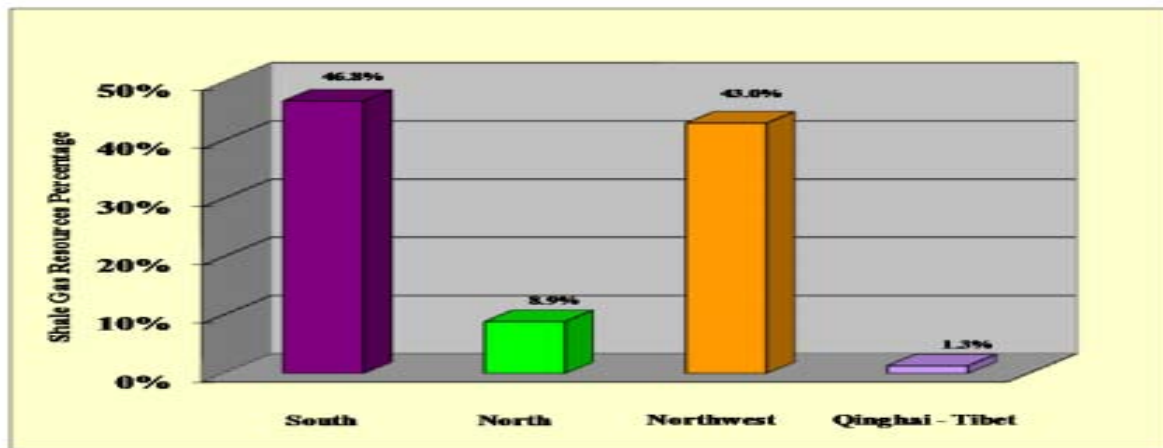
Figure 5: Shale Geographic Distribution in China (Zhang, 2010)
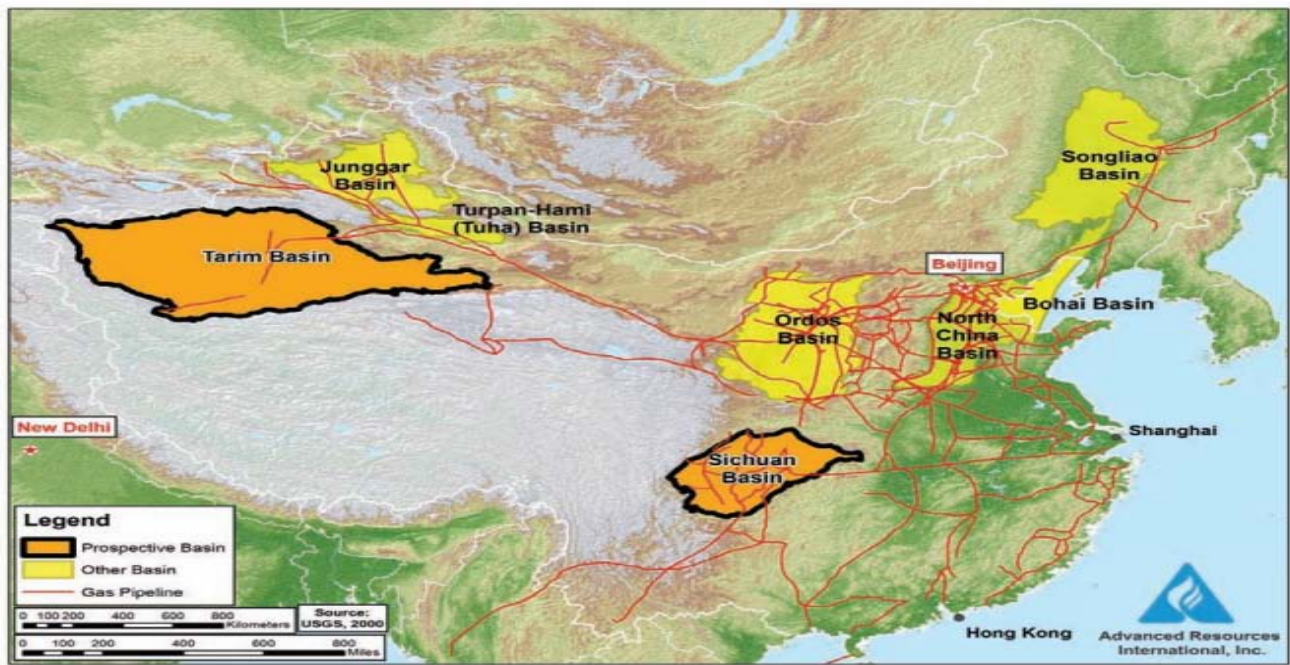
Figure 6: China shale gas Prospective basins, Tarim and Sichuan & gas pipeline (ARI, 2013)

China is facing with many challenges in shale gas exploration and development. Firstly, shale formations are not homogenous. The depth of shale reservoirs in China is normally from 3000 to 4000 meters, which is deeper than in the USA. Second, China has more complicated reservoir characteristics and Limited water resource makes shale gas development more difficult. The major Chinese petroleum companies have shown great interest in shale gas development. The geologic features of large gas fields in China, including forming conditions, distribution regularity, main controlling factors, reservoir lithology and geologic ages, gas geneses and sources, traps and gas accumulation. China has an estimated 1,115 Tcf of risked, technically recoverable shale gas, mainly in marine- and lacustrine-deposited source rock shales of the Sichuan (626 Tcf), Tarim (216 Tcf).

a) Sichuan Basin

Sichuan Basin is one of the richest shale gas basins in China. Shale exploration activity in China has been focused on the Sichuan Basin, which contains marine-deposited, dry-gas mature source rock shales that resemble commercially productive shales. The Sichuan Basin covers a large 190,000-km2 area in south central China. The basin currently produces about 1.5 Bcf/d of natural gas from conventional and low-permeability sandstones and carbonates within the Triassic Xujiahe and Feixianguan formations, from complex structural-stratigraphic traps (mainly faulted anticlines) that are distributed across the basin. Sichuan Basin is the Changning- Weiyuan area, which is found to be high in thermal evolution degree (Ro: 2.0%-

4.0%), porosity (3.0%–4.8%), gas concentration (2.82–3.28 m3/t) and the burial depth is relatively moderate (1500–4500 m). (Zou C. D., 2010) The EIA shale report assessment said the shale formations in the Sichuan shale are, on average, around 11,000 ft. deep. Sichuan basins technically recoverable resources which are 17. 716 trillion of cubic meters. (Xin-gang, 2015). Some available data on this basin are are summarized in Table1.

Table 1: Identified Shale Gas Formation in Sichuan Basin

System	Series	Formation	Depth	Formation thickness (m)	Shale Thickness (m)	Area ($10^3 km^2$)	Shale Gas Resource ($10^{12} m^3$)
Triassic	upper	Xujiahe	1,870-5,000	1,800-5,100	500-1,860	14-16.5	8.4-33.5
Silurian	lower	Longmaxi	2,300-4,100	200-800	50-500	128.2	4-12.4
Ordovician	upper	Wufengzu	2,300-4,500		2-40	147.3	0.52
Cambria	lower	Qiongzhusi	2,700-3,600	50-500	74-400	184.5	7.14-14.6
Sinian	upper	Doushantuo		25-70	10-40		

The Sichuan Basin, primary focus for shale gas, has multiple shale targets but also significant geologic challenges, such as numerous faults, often steep dips, high tectonic stress, slow drilling in hard formations, and high H2S and CO2 in places. Table-1 data provides good control of shale thickness, depth, structural geology, thermal maturity, and organic content.

The Sichuan basin has four tectonic zones: the Northwest Depression, Central Uplift, and the East and South Fold Belts. The Central Uplift, characterized by relatively simple structure and comparatively few faults, appears to be the most attractive region for shale gas development. In contrast, the East and South Fold Belts are structurally more complex, with numerous closely spaced folds and faults.

The four-main organic-rich shale targets in the Sichuan Basin are the Lower Cambrian Qiongzhusi, Lower Silurian Longmaxi, Lower Permian Qixia, and the Upper Permian Longtan formations. (Figure 3). Most important is the Lower Silurian Longmaxi Formation, which contains an average 300 m of organically rich, black, graptolitic-bearing, siliceous to cherty shale. TOC is mostly low to moderate, reaching 4% and consisting mainly of Type II kerogen (Liu et al., 2011). Thermal maturity ishigh and increases with depth, ranging from dry gas prone to over mature (Ro 2.4% to 3.6%).

Another shale gas target in the Sichuan Basin is the Cambrian Qiongzhusi Formation. Even though deeper than the Longmaxi and mostly screened out by the 5-km depth, the Qiongzhusi contains high-quality source rocks that provide stacked shale resource potential. The formation was deposited under shallow marine continental shelf conditions and has an overall thickness of 250 to 600m.

Table 2: Stratigraphy of Source Rock Shale Targets in the Sichuan Basin

ERA	PERIOD	EPOCH	FORMATION	AGE (Ma)	THICKNESS (m)
CENOZOIC	QUATERNARY			0 – 3	0 – 380
	TERTIARY	Upper		3 – 25	0 – 300
		Lower		25 – 80	0 – 800
MESOZOIC	CRETACEOUS			80 – 140	0 – 2000
	JURASSIC	Upper	Penglaizhen	140 – 195	650 – 1400
		Middle	Suining		340 – 500
			Shaximao		600 – 2800
		Middle-Lower	Ziliujing		200 – 900
	TRIASSIC	Upper	Xujiahe	195 – 205	250 – 3000
		Middle	Leikoupo		
		Lower	Jialingjiang	205 – 230	900 – 1700
			Feixianguan		
PALEOZOIC	PERMIAN	Upper	Changxing	230 – 270	200 – 500
			Longtan		
		Lower	Maokou		200 – 500
			Qixia-Liangshan		
	CARBONIFEROUS	Mississippian	Huanglong	270 – 320	0 – 500
	SILURIAN	Upper		320 – 570	0 – 1500
		Lower	Longmaxi		
	ORDOVICIAN				0 – 600
	CAMBRIAN	Upper	Xixiangchi		0 – 2500
		Middle	Yuxiansi		
		Lower	Qiongzhusi		
PROTEROZOIC	SINIAN	Upper	Dengying	570 – 850	200 – 1100
			Doushantuo		
		Lower			0 – 400
	PRE-SINIAN			850	

b) Tarim Basin

The Tarim Basin, located in the Xinjiang Autonomous Region, is China's largest onshore sedimentary basin (600,000 km2, the Tarim Basin produces 260,000 B/D of oil and 1.6 Bcfd of natural gas from conventional reservoirs, which were sourced mainly by organic-rich Cambrian and Ordovician shales. Figure 7 shows the structural elements of the Tarim Basin, and Prospective of shale gas.

The Tarim Basin is sub-divided by fault and fold systems into a series of seven distinct structural zones, comprising three uplifts and four depressions. (Xiao et al., 2000) Petroleum source rocks are found in the Cambrian, Ordovician, Carboniferous Triassic, Cretaceous, and Tertiary, Figure8 shows which the marine deposited black shales of Cambrian and particularly Ordovician age are considered the most important source rocks in the basin. (Cai et al., 2009)Tarim and the Northern China area are marine deposits often have high organic matter content and Ro value of 1.1%–2.5%. the organic matter is mostly II–III type kerogen. while those in the Tarim average 13,500 ft. deep. (Rassenfoss, Jul 2012).

By 2020, China's annual shale gas production will be expected to reach 300×10^8 m3. No shale leasing or drilling have beenreported, probably because of this basin's remoteness and extreme depth of the shale. (Zou C., 2010).
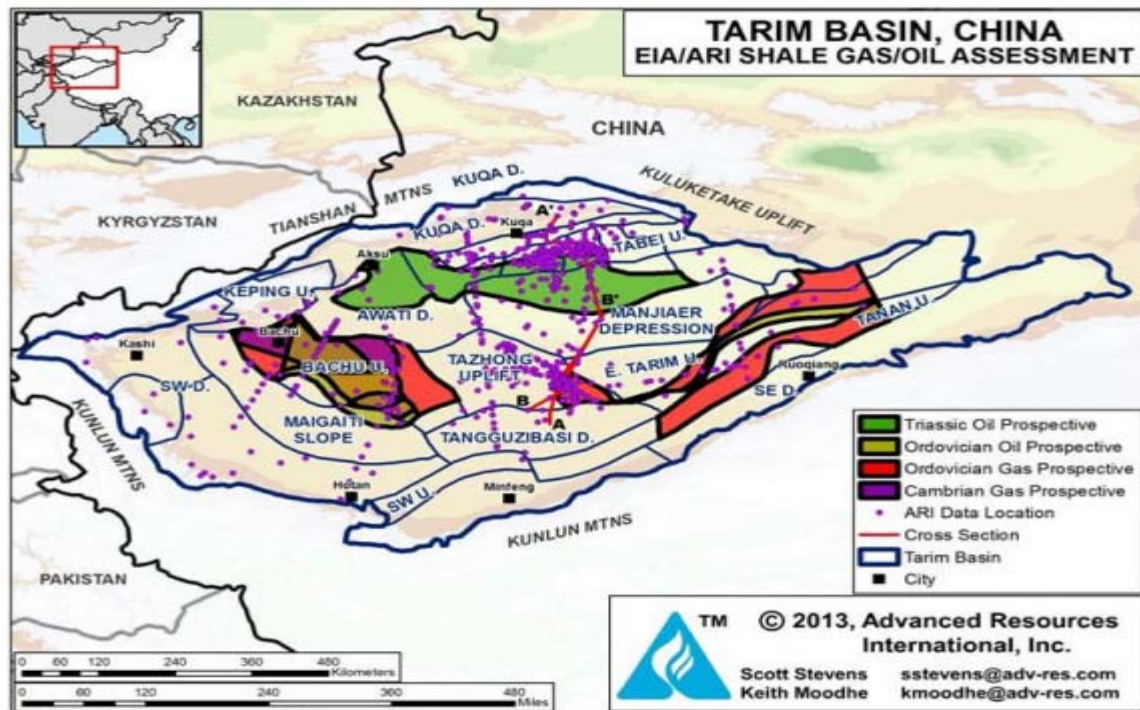
Figure 7: Shale Prospective Areas in the Tarim Basin (ARI, 2013)

ERA	PERIOD	EPOCH	FORMATION	AGE (Ma)	THICKNESS (m)
CENOZOIC	QUATERNARY	Q			
	TERTIARY	N₂ₐ			
		N₁w			
		Eh			
MESOZOIC	CRETACEOUS	K₂y			
		K₁y			
	JURASSIC	J₃k			
		J₂t			
		J₂y			
		J1k			
	TRIASSIC				
PALEOZOIC	PERMIAN	Upper	Shazjing	290	0 - 780
			Aqiaqun		
		Middle-Lower	Aqiaqun		
	CARBONIFEROUS	Upper-Middle	Xiaohaizi	290 - 355	0 - 691
		Lower	Kalashayi		
			Bachu		
	DEVONIAN			355 - 405	0 - 241
	SILURIAN	Upper		405 - 439	0 - 517
		Middle			
		Lower			
	ORDOVICIAN	Upper	Hetuao (O₁₋₂)	439 - 459	0 - 300 org-rich
		Middle	Yijianfan (O₂)	459 - 478	0 - 150 org-rich
		Lower	Lianglitage (O₃)	478 - 505	0 - 50 org-rich
	CAMBRIAN	Upper	Qiulitage	505 - 600	2918
		Middle	Awatage		125
		Lower	Xiaoerbulake		74
PROTEROZOIC	SINIAN			600+	200 - 1100

Figure 8: Stratigraphy of the Tarim Basin, Highlighting Prospective Cambrian, Ordovician, Carboniferous, Triassic, Cretaceous, and Tertiary Source Rocks

IV. India Shale Gas Potential

Natural gas is rapidly substituting fuel to suffice the growing energy requirement of today's world. As the consumption of natural gas is increasing rapidly, it is essential to identify and develop the available energy resources. India has the huge prospects of unconventional shale gas resources. Commercial exploration of these shale gas resources can effectively make the global natural gas curve more elastic.

There is a sizeable deposit of shale formations in several sedimentary basins of India with different total organic (TOC) content and maturity history. The Cambay, Krishna-Godavari, Cauvery and Damodar valley are the four major basins of shale gas reservoirs as indicated by considerable thickness of shales; sufficient TOC (2 to 6 wt%) content; and good thermal maturity with vitrinite reflectance of more than 1.0. (Ind., 2014). The reservoir properties and resource potential (290 TCF) of shale gas, estimated by ARI, are shown in Table-3.

According to ARI (American Research Institute), shale gas reserves would be anywhere between 600 Tcf to 2000 Tcf and technically recoverable shale gas resource is estimated as 63 Tcf in spread over many sedimentary basins India. Most of Indian basins especially the Cambay, Krishna-Godavari, Cauvery and Damodar Valley have good prospects of shale gas (Fig.9). Several other basins such as the Vindhyan, Upper Assam, Pranhita-Godavari and Rajasthan, though show thermal immaturity, contain measurable thickness of shale with good TOC content.
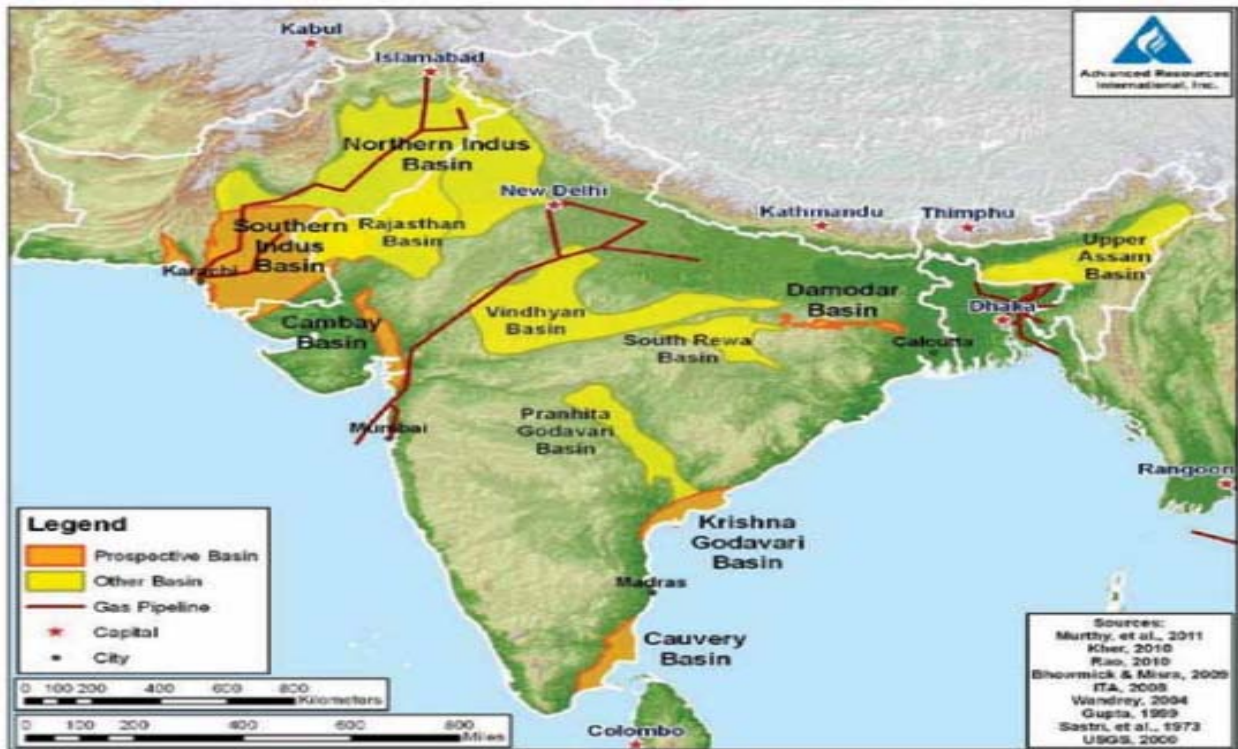
Figure 9: Shale gas basins of India (US EIA 2011)

a) Cambay Basin

Thick Cambay Shale has been the main hydrocarbon source rock in the Cambay basin. The basin covers total area of about 53,500 sq. km. It is bounded on its eastern and western sides by basin-margin faults. The Cambay basin contains five distinct fault blocks (Fig.10) from north to south: (1) Sanchor Patan; (2) Mehsana-Ahmedabad; (3) Tarapur; (4) Broach; and (5) Narmada. These blocks are characterized by local lows, some of which appear to have sufficient thermal maturity for shale gas.ARI estimates a risked gas in-place for the Cambay Black Shale of approximately 20 Tcf of which may be technically recoverable.

b) Krishna Godavari Basin

It is located on the east coast of India; land part covers an area of 15000 sq. km and the offshore part covers an area of 25,000 sq. km. Shale in the Krishna Godavari Basin is limited to the four grabens (sub-basins) where the thermal maturity is sufficiently high for wet to dry gas generation. (Mahto, 2014) Estimated risked shale gas in place is of 136 Tcf, with a risked technically recoverable resource of 27 Tcf.

c) Cauvery Basin

The Cauvery basin covers an area (25,000 sq.km) and shallow offshore areas (30,000 sq. km). The basin contains a thick interval of organic rich source rocks in Lower Cretaceous Andimadam and Sattapadi shale formations. The oldest rocks in the Cauvery Basin are the shallow marine, late Jurassic sediments and early Cretaceous deposits. Average resource around 43 Tcf of risked shale gas in-place is estimated of which 9 Tcf is considered technically recoverable.

d) Damodar Valley Basin

The Damodar Valley Basin is part of a group of basins collectively named as Gondwanas. (Pradhan, 2015) The Gondwanas, comprising the Satpura, Pranhita-Godavari, Son-Mahanadi and Damodar Basins. In this basin around 33 Tcf of risked shale gas in-place is estimated of which 7 Tcf is considered technically recoverable.

e) Southern Indus Basin

The Southern Indus Basin is in southern Pakistan adjacent to the border with India. Southern Indus Basin has five commercial oil discoveries and one gas discovery in the conventional Cretaceous-age and three gas discoveries and one gas condensate discovery in shallower formations. Moreover, with the help of this technology the well can drain shale gas resources from a geographical area that is much larger than a single vertical well within the same shale formation.

Table 3: Shale gas reservoir properties and resource potential of India. (ARI and US EIA 2011)

	Basin/Gross Area		Cambay basin (20,000 mi²)	Damodar Valley basin (1,410 mi²)	Krishna-Godavari basin (7,800mi²)	Cauvery basin (9,100 mi²)
Basic data	Shale Formation		Cambay Shale	Barren Measure	Kommugudem Shale	Andimadam Formation
	Geological Age		Upper Cretaceous/ Tertiary	Permian-Triassic	Permian	Cretaceous
Physical Extent	Prospective Area(mi²)		940	1,080	4,340	1,005
	Thickness (ft)	Interval	1,600-4,900	0-2,100	3,100-3,500	600-1,200
		Organic Rich	1,500	1,050	1,000	800
		Net	500	368	300	400
	Depth (ft)	Interval	11,500-16,400	3,280-6,560	6,200-13,900	7,000-13,000
		Average	13,000	4,920	11,500	10,000
Reservoir properties	Reservoir Pressure		Moderately Overpressured	Moderately Overpressured	Normal	Normal
	Average TOC (wt. %)		3.0%	4.5%	6.0%	2.0%
	Clay Content		Medium	High	High	High
Resource	GIP Concentration(BCF/mi²)		231	123	156	143
	Risked GIP (TCF)		78	33	136	43
	Risked recoverable(TCF)		20	7	27	9
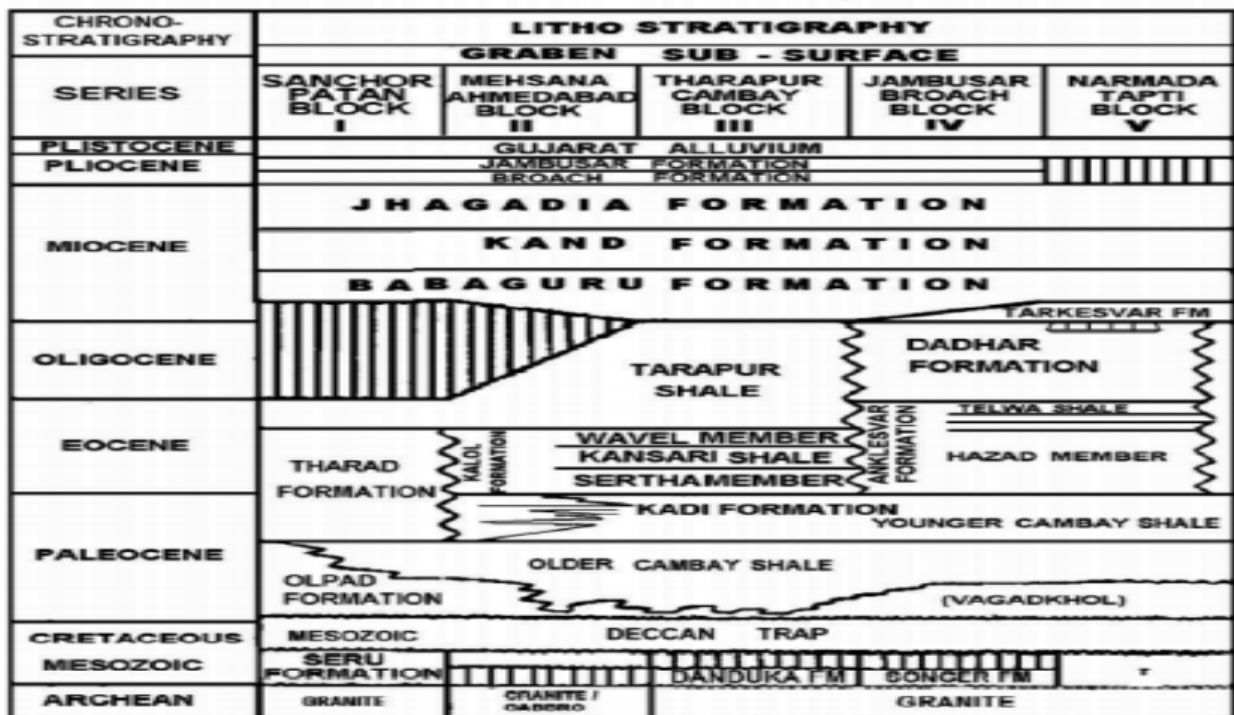
Figure 10: General stratigraphic column of the Cambay Basin (Sivan et al., 2008)

India has vast resources of shale gas and it is mainly untapped due to strict government policies, lack of new technologies & technical expertise and lack of interest from the industry. But, it is essential to explore and exploit the shale gas due to growing energy needs in the country. The Cambay, Krishna Godavari, Cauvery and the Damodar Valley are the most prospective sedimentary basins for carrying out shale gas activities in the country.

V. Pakistan

Pakistan has world's 9th largest shale gas and oil reserves which are far greater than the total resources available in Central Asian states. Three

Sedimentary basins of Pakistan; Indus, Balochistan, and Pasheen. The geological history of Indus basin comes from the Precambrian Age. The Indus Basin consists of the Upper Indus Basin, Kohat sub-Basin, Potwar sub-Basin, Lower Indus Basin, Central Indus Basin, Southern Indus Basin. Total area around 271, 700 kM, which is 33 percent of total sedimentary area of the country. Figure 12 provides the stratigraphic column for the key basins of Pakistan.

Pakistan has more than 827,365 Km^2 sedimentary basin area, Indus sedimentary area is enriched with thick sequence of shale formations as a source and has a proven petroleum system. The recent estimates by EIA Assessment have shown that the total Shale Gas reserves in Pakistan are estimated around 586 Tcf. However, the technically recoverable shale gas resources are close to 100-105 Tcf as shown in Figure 11. (Mahto, 2014).Not much work has been done for shale gas assessment in the upper Indus basin, Balochistan, and Pasheen.

Figure 11: Shale gas Potential in Pakistan (ARI, 2013)

Shale gas and oil assessment is restricted to the extensive in Central and Southern Indus basins, together called the Lower Indus Basin. (Kuuskraa V. S., 2013)The shales in this basin have sourced the significant volumes of conventional oil and gas discovered and produced in Pakistan. However, no shale specific exploration has been publicly reported for Pakistan.

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	BASIN		PAKISTAN BASINS			
			SOUTHERN INDUS	CENTRAL INDUS	NORTHERN INDUS	BALOCHISTAN
ERA	PERIOD	EPOCH	F O R M A T I O N			
CENOZOIC	QUATERNARY	Pleistocene	Siwaliks	Siwaliks		Ormara
						Chatti
		Pliocene				Talar/Hinglas
	TERTIARY	Miocene	Gaj	Gaj	Kamlial	Parkini
					Murree	Panjgur
		Oligocene	Nari	Nari		Hoshab
						Siahan
						Amalaf
		Eocene	Kirthar	Kirthar	Kohat	Saindak / Wakai
			Ghazij / Baska/Laki	Sakaser	Kuldana	/ Kharan
				Nummal		
		Paleocene	Dunghan	Dunghan	Patala	Ispikan
			Ranikot	Ranikot	Lockhart	Rakhshani
			Khadro		Hangu	
MESOZOIC	CRETACEOUS	Upper	Pab	Pab	Kawagarh	Humai
			Mughal Kot	Mughal Kot		
			Parh	Parh		
		Lower	Goru	Goru	Lumshiwal	Sinjrani
			Sembar	Sembar	Chichali	
	JURASSIC	Upper	Takatu/Chiltan	Samana Suk	Samana Suk	
		Middke	Lorolai/Data			
		Lower	Shirinab	Shinawari	Shinawari	
				Data	Data	
PALEOZOIC	TRIASSIC	Upper	Wulgai/Alozai	Kingriali	Kingriali	
		Middke		Tredian	Tredian	
					Mianwali	
		Lower		Mianwali	Chidru	
	PERMIAN			Zaluch	Wargal	
					Sardhai	
				Nilawhan	Warcha	
					Dandot	
					Tobra	
PROTEROZOIC	CAMBRIAN		Baghanwala	Baghanwala		
			Juttana	Juttana	Juttana	
			Kussak	Kussak	Khewra	
	PRECAMBRIAN		Khewra	Khewra		
			Salt Range	Salt Range	Salt Range	
			Jodhpur	Jodhpur		
			Basement	Basement	Basement	

Figure 12: Stratigraphic Column for Pakistan (EIA, 2013)

a) Lower Indus Basin

The Lower Indus basin has two types of shale formations, which are Sembar and Ranikotformation. Within the overall prospective area of the Lower Indus Basin, the Sembar Shale has risked shale gas in-place of 531 Tcf, with 101 Tcf as the risked, technically recoverable shale gas resource. In addition, prospective area of the Lower Indus Basin, the Ranikot Shale has 55 Tcf of risked shale gas in-place and 82 billion barrels of risked shale oil in-place.

i. *Sembar Formation*

- It mainly consists of clastic rocks, typically shale with lesser quantities of siltstone and sandstone in the Lower Indus. The sand content increases towards the Southeast in the Lower Indus Basin. However, in the Middle Indus Basin, the formation is composed of siltstone with few marl and shales.

- Shale in Sembar Formation is basically medium hard, pyritic, moderately indurated and slightly calcareous in the area. The gross thickness varies from >50m to800 m.

- The TOC and thermal maturity (Ro) of Sembar formation as per exploration targets is around 2% and 1%-1.6% respectively.

ii. *Ranikot Formation*

- The shale in Paleocene Ranikot Formations is primarily upper carbonate unit, which is tailored with fossiliferous limestone inter-bedded with dolomitic shale, calcareous sandstone and abundant bituminous material.

- The prospective area of the Ranikot formation has a thickness of around 1,000-3,000ft with net shale thickness of 200 ft.

- Ranikot Shale are estimated around 4 Tcf of wet Shale Gas.

VI. Thailand

This large Southeast Asian country has significant prospective shale gas potential. Nearly 90% of its current petroleum output comes from offshore fields in the Gulf of Thailand, with only limited production from small onshore fields. Approximately 40% of Thailand's primary energy consumption is supplied by natural gas.

Thailand's greatest potential appears to be shale gas deposits contained in Permian and Triassic shale source rocks in the Khorat, the country's largest onshore sedimentary basin. (Jeenagool, 2015) These shales can be locally thick, organic-rich, dry gas prone, deeply buried, and overpressure.

Thailand has three main onshore sedimentary basins which may have unconventional oil and gas potential, Figure-13. These include the large Khorat Basin in the northeast; a series of smaller, isolated pull-apart basins in the Northern Intermontane Basin, where shale oil deposits are being mined; and the similarly complex Central Plains Basin.

The Khorat Basin in northeast Thailand has an estimated 5 Tcf of risked technically recoverable shale gas resources. While no shale gas/oil exploration activity has been reported to date.
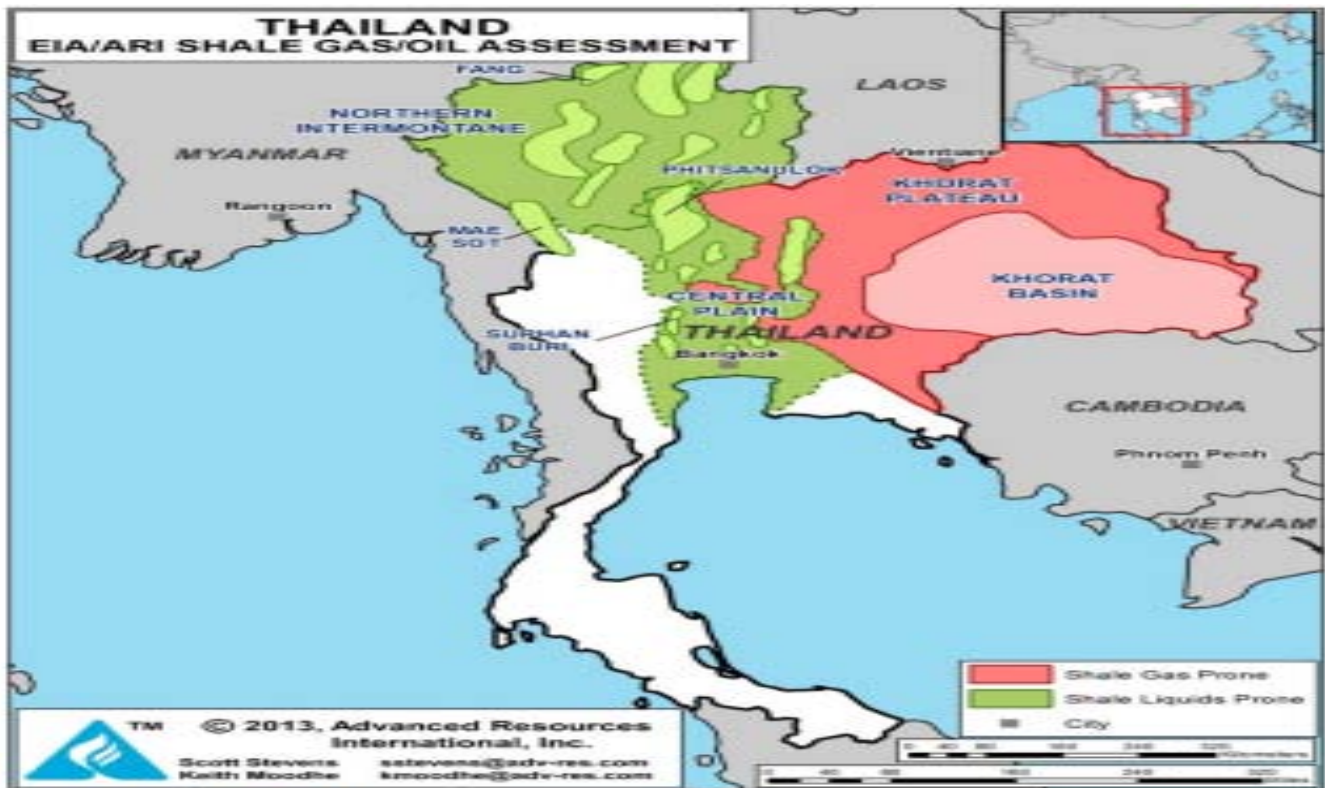
Figure 13: Thailand sedimentary basin (EIA, 2013)

a) *Khorat Basin*

Thailand's largest onshore sedimentary basin, the 35,000-mi2.The Khorat Basin in northeast Thailand appears to have the country's best shale gas potential As shown in the Table-4 the prospective of shale gas in the Khorat, Northern Intermontane and Central Plains basins.

The structural Khorat Basin depression was initiated during the Middle Paleozoic, with widespread deposition of clastic and carbonate sedimentary rocks, beginning with the Carboniferous Si That Formation. (Kuuskraa V. , 2013)

Fluvial and lacustrine deposits of the Triassic Kuchinarai Group also have been identified as petroleum source rocks in the Khorat Basin, with high-TOC intervals. The Kuchinarai Group reportedly averages a prospective 6,500 to 7,000 feet deep within the basin. Thermal maturity modeling suggests it reaches the dry gas window, with no liquids potential (Ro> 2.0%).

Table 4: Khorat basin properties

Basic Data	Basin/Gross Area		Khorat (32,400 mi²)
	Shale Formation		Nam Duk Fm
	Geologic Age		Permian
	Depositional Environment		Marine
Physical Extent	Prospective Area (mi²)		1,750
	Thickness (ft)	Organically Rich	400
		Net	200
	Depth (ft)	Interval	6,000 - 12,000
		Average	9,000
Reservoir Properties	Reservoir Pressure		Mod. Overpress.
	Average TOC (wt. %)		3.0%
	Thermal Maturity (% Ro)		2.50%
	Clay Content		Low
Resource	Gas Phase		Dry Gas
	GIP Concentration (Bcf/mi²)		83.0
	Risked GIP (Tcf)		21.8
	Risked Recoverable (Tcf)		5.4

Figure 14 illustrates the stratigraphy and petroleum systems of the Khorat Basin.The shallow marine to basinal Permian Saraburi Group is considered the primary source rock, while the fluvial to lacustrine Triassic Kuchinarai and HuaiHinLat Groups offer additional source rock potential. Permian dolomite and karstedlimestones form the main conventional petroleum reservoirs.

Figure 14: Stratigraphy an Petroleum Systems of the Khorat Basin. Shallow Marine Permian Saraburi Group is the Primary Source Rock

VII. INDONESIA SHALE GAS POTENTIAL

Indonesia is the world's fourth most populous country (250 million) and a major producer of coal, oil, and natural gas. Indonesia has shale gas and shale oil potential within selected marine-deposited formations, as well as more extensive shale resources within non-marine and often coaly shale deposits, Estimated 46 Tcf technically recoverable shale gas resources out of 303 Tcf of risked shale gas in-place.

Indonesia has shale gas within selected marine-deposited formations, more extensive shale resources. The petroleum source rocks in onshore Indonesian basins are relatively young, mostly Eocene to Pliocene. (Rahmalia, 2012) Indonesia have many onshore sedimentary basins (Figure 15) which may have shale gas potential, these include the Central and South Sumatra basins on Sumatra Island; the Kutei and Tarakan basins in Kalimantan; most reserve of shale gas in the eastern part (Salawati, Bintuni, Tomori) but it

structurally complex basins. Other basins in Indonesia appear to be less prospective due to low TOC, high clay and CO_2 contents Many of Indonesia's organic-rich shales are non-marine coaly deposits that may not be brittle enough for shale development. Their depositional setting ranges from deepwater marine in eastern Indonesia to mostly lacustrine and deltaic environments in central and western Indonesia. (Fig.15 shows Stratigraphy of Source Rocks)
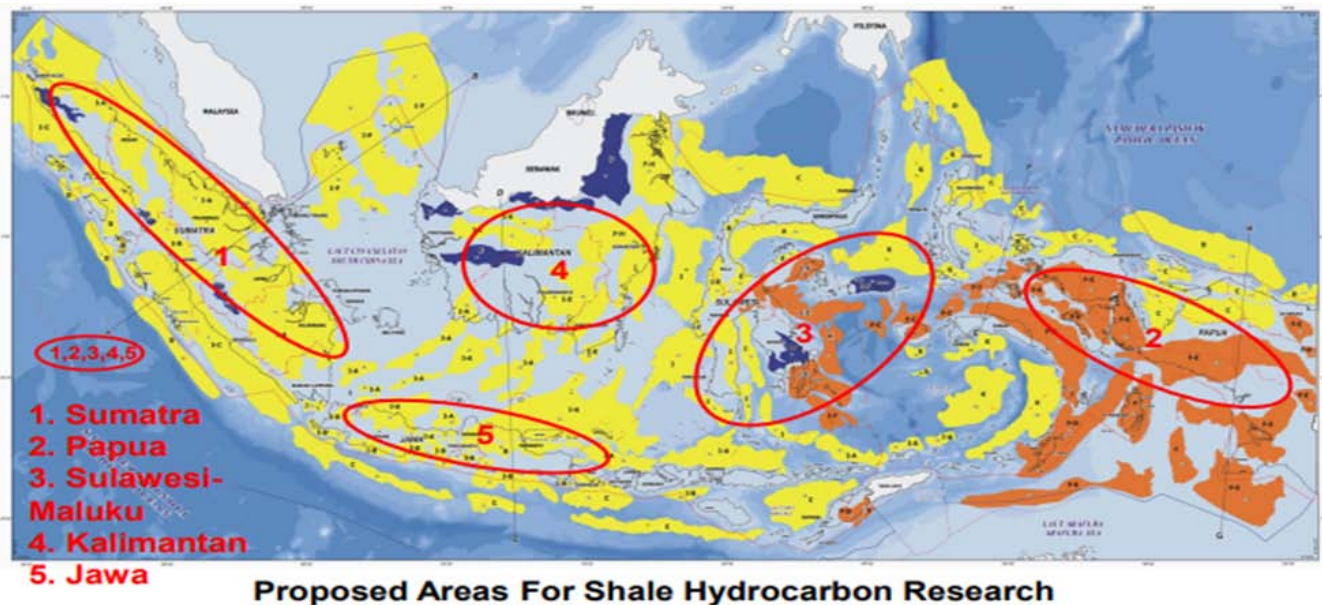

Figure 15: Shale gas Potential in Indonesia (EIA 2013)

Indonesia has two main shale gas potentials, which are Bintuni basin and Sumatra Basin.

a) Bintuni Basin

The Bintuni Basin, located in the eastern side of the Bird's Head region, appears to have the simplest structural conditions and best shale prospectively in the eastern Indonesia region. The stratigraphic section resembles that of the Salawati Basin, with preserved Paleozoic, Mesozoic, and Tertiary units. The prospective areas of the Permian Aifam formation have an estimated 29 TCF of technically recoverable shale gas resources out of 114 Tcf of gas in-place. (Kuuskraa V. S., 2013) This marine-deposited unit could be the best shale gas target in Indonesia. To date No shale gas/oil leasing or exploration activity has been reported in eastern Indonesia.

b) Sumatra Basin

Sumatra has shale oil and gas potential in three deep basin complexes: The North, Central, and South Sumatra basins. The North Sumatra Basin produces mainly conventional gas both onshore and offshore. Central Sumatra Basin one of main resources in Shale gas with technically recoverable resources from the

Brown Shale are estimated at 3.3 Tcf out of 42 Tcf shale gas.

South Sumatra Basin, this basin is a significant conventional oil and gas producing area as well as a focus of Shale gas & coalbed methane exploration. The basin contains late Eocene to early Oligocene deposits of clastic sediments in transgressional pull-apart depressions. The Eocene to Oligocene TalangAkar Formation is prospective within a large 15,490-mi2 area and estimated to have a 367-ft thick high-graded zone with average 5% TOC and 0.7% Ro. The pressure gradient is normal and the clay content is considered high. The TalangAkar Formation has an estimated 4.1 of technically recoverable shale gas resources, out of 68 Tcf.

VIII. Conclusion

- Shale gas refers to natural gas in organic rich fine grained rocks (shale and/or mud rock). Gas stored in shale as: 1) adsorbed gas attached to organic matter, 2) free gas in matrix pores, micro pores and natural; fractures and 3) solution gas in liquids such as bitumen and oil. For shale gas, hydraulic

fracturing of a reservoir is the preferred stimulation method.

- Shale gas reservoir to become a successful shale gas play, the following characteristics need to be considered: organic richness (TOC), maturation, thickness, gas in place, permeability, mineralogy, brittleness and pore pressure. An optimum combination of these factors leads to favorable productivity. Geophysical methods can help in characterizing the shale gas resource plays

- The economic feasibility of shale gas as unconventional resources is highly dependent on the price of conventional resources, and the assumption that the price will remain at a certain level for some time to come. Available technology and development plans have great impact on the forecasting of unconventional resources either as complement or replacement of the conventional resources.

- It can be stated that the potential for shale gas as a source of energy in Southeast Asia appears to be moral. However, more work needs to be carried out to establish the exact capacity of this gas in each country mentioned. The below table summarizes all shale gas reserve potential Basins of Malaysia and South-East Asia Region, where china has the largest share of 1115 TCF, followed by India presenting 584 TCF and Malaysia represents the lowest potential of 8.8TCF.

Country	Basin	Risked Gas in place TCF
Malaysia	Sarawak & Sabah	8.8
China	Sichuan	1,115
	Tarim	
	Ordos	
India	Cambay	146
	Godavari	381
	Cauvery	30
	Damodar	27
Pakistan	Indus, Balochistan & Pasheen	105
Thailand	Khorat	22
Indonesia	Sumatra	68
	Bintumi	114

Acknowledgment

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New Effective Way to Protect our Air against Gases from Plants, Boiler-Houses and Cars

By K.N. Voinov, A. Hildayati & Y. Ghellab

University ITMO

Abstract- To be accurate it should be preliminary noted that the humanity is standing before the greatest problem in the world at the present moment. Namely: it's the huge dangerous connected with the too much volumes of bad gases which are constantly turning out from different chimneys and pipes (factories, works, laboratories, cars, lorries and so on). Numerous attempts to effectively defend our land, water, nature and all our life don't have the very effective result. At the present day there isn't any excellent filter which could catch all of the perilous chemical elements into the gases. That's why in this paper we try to solve this actual problem practically in full. The first experiments give hope to the future realization positive results in practice.

Keywords: gases, plants, cars and lorries, clean air, protect.

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K.N. Voinov [α], A. Hildayati & Y. Ghellab [ρ]

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I. Introduction

As it is just mentioned above there aren't unique filters which can clear hot gases entirely. The very small chemical particles practically fly out freely from the pipes/ chimneys into the air. We breathe with such dirty air and spoil our lungs. It can accelerate the appearance of different diseases (even cancer, for example).

On the other hand, if it is the raining day at that time we get the acid rain which ruins or damages the all around on the earth.

Moreover gases from the exhaust pipes of the cars and lorries practically make the same harm for people. It's no secret that the contamination in the city's or town's air, by this reason, is far worse than in the country.

There are many references in technical literature and Internet connected with described problem and with the attempts to solve it, for example [1-15]. They aren't only articles, books, text-books, guides, official documents resolutions and laws, but also the devices to control the environment as well. In the last case they can be the devices to test the chemical composition of gases, their temperature, velocity of outflow, pressure, capacity, density and so on.

Sector 1: Examples of devices

II. To Pump Out And Test Gases

There are very many devices to control the composition of gases which were made both in Russia and abroad (Fig. 1- 6). Some of them are represented in here.

These equipments help to pump out gases from the pipes / chimneys into the air which works, factories and special chemical laboratories are carrying out during their industrial process.

Fig. 1: Water-ring vacuum pump

Fig. 2: Vacuum-rotor pump

Fig. 3: Diaphragm-vacuum pump

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Fig. 4: Pump (TMP)

Fig. 5: Industrial spiral vacuum pump

Fig. 6: Plunger (slide valve) pump

Using these or others equipments it is the possibility to catch gases from the pipes / chimneys directly. After that action we can clean all dangerous gases by means of various ways one of which will be described below in detail.

III.   CONTROL AND TESTS OF GASES

To protect our air against the harmful gases there are many filters and special ways, for example (Fig. 7-12).
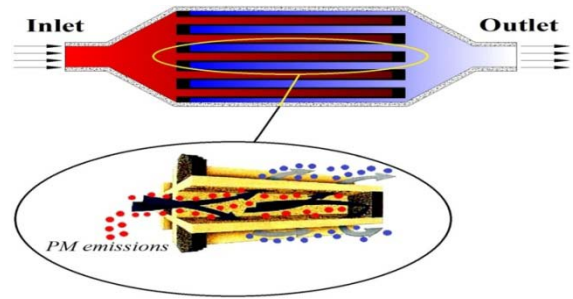
Fig. 7: Diesel Particulate Filter (DPF)

This filter guarantees the travel for the exhaust gases and makes the filtration in the next form $2MgO–2Al_2O_3–5SiO_2$ or as in silicon carbide SiC through the monolith porous structure with canals.
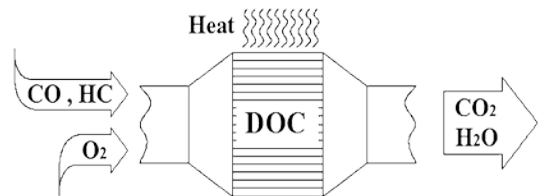
Fig. 8: The sketch of dizel catalizator DOC

This device can generate the oxidizing process and its structure usually consists of the mixtures Al_2O_3, CeO_2, ZrO_2 and Pt, Pd or Rh.

The form of the device to do a control of temperature and humidity is shown below (Fig. 9).

Fig. 9: The shape of device

Fig. 10: Pyrometer Fluke-574CF
(control *T* from -30 till 900 °C)
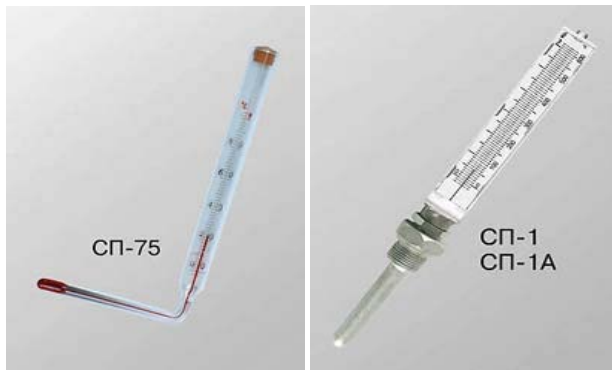
Fig. 11: Thermometers (control *T* from 0 till 600 °C)

Fig. 12: Laser pirometer AXIOMET

This device can determine temperature till +1370 °C. Pyrometer DT-8835 can make the un-contact temperature test in the range from -50 till 50 °C with the optical permission 30:1. Moreover the additional measurements can be realized till 1370 °C using special probe TXA. At last, the pyrometer DT-8858 permits to do the temperature measurements for the range from -50 till 1300 °C with the optical permission 50:1.

Many famous foreign firms make very different devices as well, for example: NEC (Japan) TH-7716, NEC TH-9260, NEC portable Thermo Shot series F30, NEC TH-9100 ML/WL/PMV/PWV.

IV. TO CONTROL GAS CONSUMPTION

To this purpose there are many different devices. They help to calculate the volume of the harmful gas from the pipe in the unit of time. For this we must know the diameter of pipe and the gas velocity of flowing. Such devices as usually have the primary transformer (measuring part) and the second one (electron block).

Let's enumerate some of these devices:

- electromagnetic counter (model ADMAG AXF);
- capacity device/counter (pattern ADMAG CA);
- electro-magnetic device (models, for example: DWM2000 or DWM2000L);
- device using the vertical principle of working (model DY);
- super-sonic device (pattern UFM3030 or OPTISONIC6300);
- model RAMC and so on.

The firms which supply such kinds devices are the next: Standard – Device, Yokogawa Electric, Wika, Servomex, Michell Instrument and so forth.

In particular, the device RAMC has the next characteristics (as parameters of the medium /gas, steam, liquid/ which we needed to test):

- temperature -180…+370 °C;
- pressure < 4 MPa;
- signal (continuous or discrete).

It is known from practice that the amount of exhaust gas smoke is less if there is more hydrogen in benzine (Fig. 13). It improves the quality of combustion for fuel.
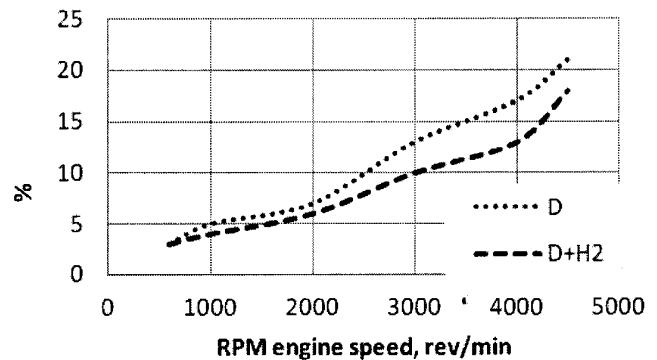

Fig. 13: Character of dependence on between gas smoke (percentage) to RPM engine speed

Sector 2: The gist of novelty

The basic aim of our investigation is to find the technical decision how to reduce practically to zero the amount of harmful exhausted gases from smoke-stacks [19]. The additional information can be read in [20]. The common picture is given below (Fig. 14).
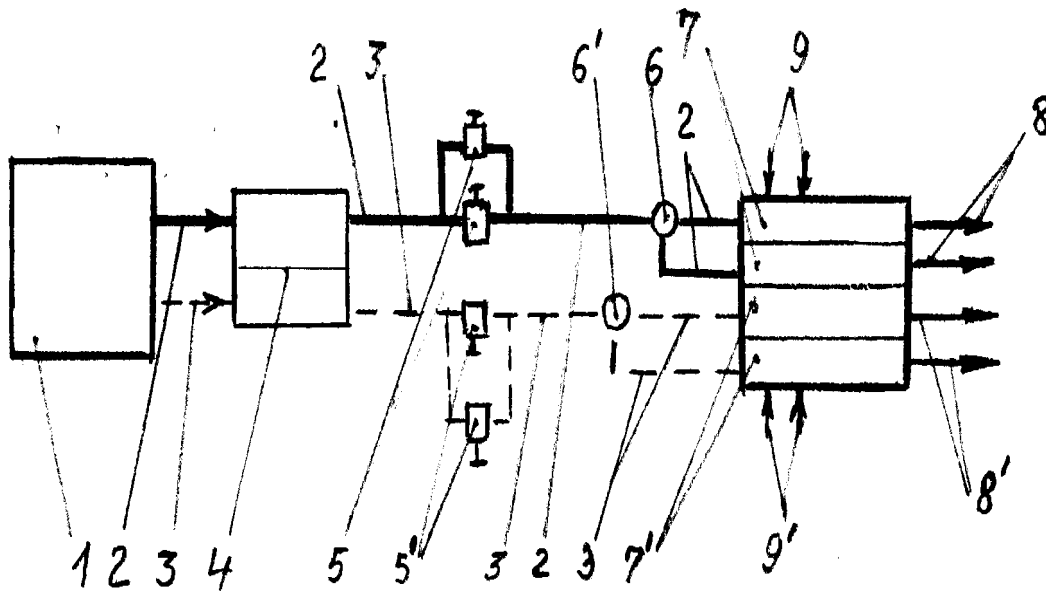
Fig. 14: Common sketch of the way to protect air against harmful gases

V. Designations

1 – industrial works or organization (plant, factory, boiler-house, lab, shop and so on) which are throwing out in the air harmful gases through pipes/ smoke-stacks; *2* – the main smoke-stack (it doesn't stick out up) with the pump to draw aside gases; *3* – the reserve drain smoke-stack with the pump to take aside gases; *4* – two section chemical devise; *5* and *5'* – valves/slide-valve; *6* and *6'* – valves to let go for gases; *7* – two section main reservoir; *7'* – the reserve two section reservoir; *8* – ways to delete the harmful siftings accumulated into the water from the main reservoir; *8'* – ways to delete the harmful siftings accumulated into the water from the reserve reservoir; *9* and *9'* – pipes to bring up chemical compositions to disinfect or neutralize the harmful siftings. The more bold line connected with the basic way of cleaning and the more thin one connected with the reserve itinerary.

So, in our case all harmful gases don't go into the open air; they are going into the technical water in reservoir. By this way we can clean all gases and smog entirely. And else there is another important factor. The gases are as usually rather hot. That's why the water in reservoir will be warm or even hot too. But above the reservoir there is the roof. And all evaporations in the shape of drops or small stream will fall or flow down into the water.

To get the high reliability of our method the all elements and equipments have redundancy. The small water reservoir we'll use when the basic reservoir demands cleaning or repair.

And some words about the additional positive effects connected with this worked out system.

Namely. We deleted all drain smoke-stacks which spoil atmosphere (Fig. 15).

Fig. 15: Example of the level for contamination for air

We protect the environment against the appearance of harmful rains, hotbed effects, ozone holes and so on. Moreover this way helps to save the health for people.

VI. Conclusion

The new and very effective method to keep safe is supplied and described. It protects the life against different harmful gases which are going constantly from the pipes from works, factories, laboratories, cars and lorries at the diagnostic or repair station and so forth.

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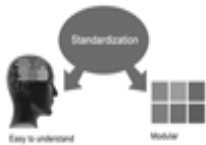
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The recommended size of original research paper is less than seven thousand words, review papers fewer than seven thousands words also.Preparation of research paper or how to write research paper, are major hurdle, while writing manuscript. The research articles and research letters should be fewer than three thousand words, the structure original research paper; sometime review paper should be as follows:

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(b) A brief Summary, "Abstract" (less than 150 words) containing the major results and conclusions.

(c) Up to ten keywords, that precisely identifies the paper's subject, purpose, and focus.

(d) An Introduction, giving necessary background excluding subheadings; objectives must be clearly declared.

(e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition; sources of information must be given and numerical methods must be specified by reference, unless non-standard.

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- One should avoid outdated words.

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References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

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26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

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28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

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30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

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34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

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Key points to remember:

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- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

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· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

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The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

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- Fundamental goal
- To the point depiction of the research
- Consequences, including <u>definite statistics</u> - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

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- Center on shortening results - bound background information to a verdict or two, if completely necessary
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- Explain materials individually only if the study is so complex that it saves liberty this way.
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- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

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- Report the method (not particulars of each process that engaged the same methodology)
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- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

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- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
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What to keep away from

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- Leave out information that is immaterial to a third party.

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The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.

- Do not present the similar data more than once.
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- Never confuse figures with tables - there is a difference.

Approach

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- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

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