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FOREWORD

I am pleased to put into the hands of readers Volume-4; Issue-10: 2017 (Oct, 2017) of “**International Journal of Advanced Engineering Research and Science (IJAERS)** (ISSN: 2349-6495(P)| 2456-1908(O)”, an international journal which publishes peer reviewed quality research papers on a wide variety of topics related to Science, Technology, Management and Humanities. Looking to the keen interest shown by the authors and readers, the editorial board has decided to release print issue also, but this decision the journal issue will be available in various library also in print and online version. This will motivate authors for quick publication of their research papers. Even with these changes our objective remains the same, that is, to encourage young researchers and academicians to think innovatively and share their research findings with others for the betterment of mankind. This journal has DOI (Digital Object Identifier) also, this will improve citation of research papers.

I thank all the authors of the research papers for contributing their scholarly articles. Despite many challenges, the entire editorial board has worked tirelessly and helped me to bring out this issue of the journal well in time. They all deserve my heartfelt thanks.

Finally, I hope the readers will make good use of this valuable research material and continue to contribute their research finding for publication in this journal. Constructive comments and suggestions from our readers are welcome for further improvement of the quality and usefulness of the journal.

With warm regards.

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Vol-4, Issue-10, October 2017

Sr No.	Detail with DOI
1	<p><u>Analysis of Extremely Low Frequency (ELF) Magnetic Field Effect to Oyster Mushroom Productivity</u> Author: Sudarti, Ainur Rosyidah, Zainur Rasyid Ridlo, Singgih Bektiarso, Tania Ardiani, Sri Astutik  DOI: 10.22161/ijaers.4.10.1 Page No: 001-008</p>
2	<p><u>Performance Evaluation of wide Bandwidth RF Signal Generator Chip</u> Author: Vindhya K, Bharathi, Nayana R Shenoy, Kamala C  DOI: 10.22161/ijaers.4.10.2 Page No: 009-012</p>
3	<p><u>Effect of Process Parameter in SAW- A Review</u> Author: Uma Gautam  DOI: 10.22161/ijaers.4.10.3 Page No: 013-017</p>
4	<p><u>Improving performance by improving the relationship with the companies in the supply chain</u> Author: Herlandí de Souza Andrade, Kátia Cardoso Bacelar, Ismar Pessoa, Messias Borges Silva  DOI: 10.22161/ijaers.4.10.4 Page No: 018-023</p>
5	<p><u>Numerical and experimental study of an air-soil heat exchanger for cooling habitat in Sahelian zone: case of Ouagadougou</u> Author: Boureima Kaboré, Sié Kam, Germain Wende Pouiré Ouedraogo, Belkacem Zeghmati, Xavier Chesneau, Dieudonné Joseph Bathiébo  DOI: 10.22161/ijaers.4.10.5 Page No: 024-032</p>
6	<p><u>Risk Attitude and Risk Controllability: Their Implications on the Subjective Quantification of Risk in International Construction Projects</u> Author: Ehsanullah Hayat  DOI: 10.22161/ijaers.4.10.6 Page No: 033-045</p>
7	<p><u>Detection of Paddies Reflectance Values to classify their Ages using RGB Photograph Images</u> Author: Bowo Eko Cahyono, Agung Tjahjo Nugroho, Miftahul Rizkiyani  DOI: 10.22161/ijaers.4.10.7 Page No: 046-050</p>

8	<p><u>Microstructural Modifications of As-Age Hardening 7071 Aluminium Alloy using Friction Stir Welding</u> Author: P. Satheesh Kumar, K. Polaiyah, Hemalatha.Naidu  DOI: 10.22161/ijaers.4.10.8</p>	Page No: 051-055
9	<p><u>Weldability of Friction Stir Welding using Aluminium Alloy with Pure Copper</u> Author: E. Kavya Pravala, A. Uday Kiran  DOI: 10.22161/ijaers.4.10.9</p>	Page No: 056-057
10	<p><u>The Role of Innovation: Enforcement Smart Mobile Application (SSMEYEs)</u> Author: Sathiya Seelan, Herman Shah Anuar  DOI: 10.22161/ijaers.4.10.10</p>	Page No: 058-062
11	<p><u>E-Services Effectiveness: A Case of Companies Commission of Malaysia</u> Author: Sharmila Avaniappan, Herman Shah Anuar  DOI: 10.22161/ijaers.4.10.11</p>	Page No: 063-066
12	<p><u>Value Management: Implementation of Asset Life Cycle in one of Oil and Gas Service Company</u> Author: Mohd Rizman Md Ghazali, Herman Shah Anuar  DOI: 10.22161/ijaers.4.10.12</p>	Page No: 067-072
13	<p><u>Design and Implementation of Welding Mobile Robot Using a Proposed Control Scheme Based On Its Developed Dynamic Modeling for Tracking Desired Welding Trajectory</u> Author: Nguyen Hung, Ho Dac Loc  DOI: 10.22161/ijaers.4.10.13</p>	Page No: 073-080
14	<p><u>Agromorphological characterization of three (3) hybrid carrot varieties (Daucus carota), cultivated in the commune of Korhogo, in northern Côte d'Ivoire</u> Author: Coulibaly Lacina Fanlégué, Siene Laopé Ambroise Casimir, Kouame Konan, Coulibaly Namongo Adama  DOI: 10.22161/ijaers.4.10.14</p>	Page No: 081-088
15	<p><u>Performance Analysis Vapour Absorption Refrigeration Chiller Run by Solar Thermal Energy</u> Author: Sohail Bux, Ezaz Ahmed Ansari  DOI: 10.22161/ijaers.4.10.15</p>	Page No: 089-096

16	<p><u>Mitigating Global Warming and Climate Change with Design of Super Efficient Greenhouse</u> Author: Matej Kline, Jernej Domanjko  DOI: <u>10.22161/ijaers.4.10.16</u></p>	Page No: 097-102
17	<p><u>Stress Analysis on a “L” shape Truss Optimization</u> Author: Miranda Ana Carolina, Portela Marcela, Magalhães Pedro  DOI: <u>10.22161/ijaers.4.10.17</u></p>	Page No: 103-105
18	<p><u>The Iteratively Regularized Newton Method for Reconstructing Image of Microwave Tomography</u> Author: Agung Tjahjo Nugroho, Wenny Maulina, Muhammad Ziaul Arif  DOI: <u>10.22161/ijaers.4.10.18</u></p>	Page No: 106-108
19	<p><u>Using of some novel derivatives of thiourea for Synthesis of pharmaceutical compounds of 5-Arylidine-2-imino-4-thiazolidinones and their medicinal properties study as anti-inflammatory agents</u> Author: Shadi Khodaie Sharabiyani, Naser Foroughifar, Alireza Khajeh-Amiri  DOI: <u>10.22161/ijaers.4.10.19</u></p>	Page No: 109-114
20	<p><u>Desinging of 3D Seismic Survey And Data Processing of Abu Amood Oil Field Southern of Iraq</u> Author: Salman Z. Khorshid, Ahmed I. Khaleel  DOI: <u>10.22161/ijaers.4.10.20</u></p>	Page No: 115-124
21	<p><u>Simple Processing Sequence to VSP-Seismic data matching in Sindbad oil field, south of Iraq</u> Author: Ali M. Al-Rahim, Osama S. Doohee, Abdul Zahra Iskandar  DOI: <u>10.22161/ijaers.4.10.21</u></p>	Page No: 125-133
22	<p><u>Proposed Steps to Projects Development in the Public Sector</u> Author: Francisco Antonio Maciel Novaes, Herlandí de Souza Andrade, Messias Borges Silva, Milton de Freitas Chagas Jr  DOI: <u>10.22161/ijaers.4.10.22</u></p>	Page No: 134-139
23	<p><u>Proposal for a technology vigilance system for a Technology License Office</u> Author: Herlandí de Souza Andrade, Messias Borges Silva, Milton de Freitas Chagas Jr., Adriano Carlos Moraes Rosa, Vanessa Cristhina Gatto Chimendes  DOI: <u>10.22161/ijaers.4.10.23</u></p>	Page No: 140-149

24	<p><u>Nominal Construction and Maintenance of Highway Roads by using FBF (Fly Ash-bc Soil-Foam) Method</u> Author: C. Giriprasad, Dr. Ajayswarup, Dr. G. M. Kapse  DOI: 10.22161/ijaers.4.10.24</p>	Page No: 150-156
25	<p><u>Controller Design of Automatic Guided Vehicle for Path-Following Using Input-Output Feedback Linearization Method</u> Author: Nguyen Hung  DOI: 10.22161/ijaers.4.10.25</p>	Page No: 157-165
26	<p><u>An algorithm for three-dimensional indoor positioning based on Bayesian inference, Fingerprinting method and Wi-Fi technology</u> Author: Hitalo Nascimento, Francisco R.P. Cavalcanti, Emanuel B. Rodrigues, Antônio R. Paiva  DOI: 10.22161/ijaers.4.10.26</p>	Page No: 166-175
27	<p><u>Study of Inelastic Behavior of Reticular Structures of Steel Bars - Phenomena of Plastification</u> Author: Pierre de Almeida, Pedro Americo Almeida Magalhães Jr  DOI: 10.22161/ijaers.4.10.27</p>	Page No: 176-180
28	<p><u>Processing Seismic Data with Open Source Software</u> Author: Ali M. Al-Rahim, Laith F. Terky  DOI: 10.22161/ijaers.4.10.28</p>	Page No: 181-188
29	<p><u>Structural and Stratigraphic 3D Seismic Study of NahrUmr and Zubair Formations in Kifl oil field center of Iraq</u> Author: Nawal Abed Al-Ridha, Ghazi H AL-Sharaa, Zainab Bassim Hassan  DOI: 10.22161/ijaers.4.10.29</p>	Page No: 189-197

Analysis of Extremely Low Frequency (ELF) Magnetic Field Effect to Oyster Mushroom Productivity

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Abstract— *Extremely Low Frequency magnetic field has frequency 0-300 Hz and included on non-ionizing radiation. The side effect of ELF magnetic field researched by many researcher on some sectors, such as on food sector and agriculture sector. In food sector, research of Sudarti (2016) shown that ELF magnetic field can use as alternative sterilization gado-gado food to decrease population of Salmonella. Oyster mushroom as alternative nutrition sources with many advantages for health, many people consume it and start cultivation it. ELF magnetic field can use as growth accelerator in agriculture sector, such as for oyster mushroom growth. This research aims to analyze of effect of ELF magnetic field to oyster mushroom productivity based on appearance of pin head and oyster mushroom wet weight. Result shown that exposure ELF magnetic field with intensity 500 μ T in 50 minutes influence appearance of pin head with average amount 20,2 and influence oyster mushroom wet weight amount 212,2 grams.*

Keywords—*ELF magnetic field, extremely low frequency, oyster mushroom*

I. INTRODUCTION

Everyday we always exposure by ELF magnetic field. Some electronic instruments around us are source of ELF magnetic field. Extremely Low Frequency (ELF) magnetic field is sub-class of electromagnetic waves spectrum with frequency 0-300 Hz. Radiation of ELF magnetic field is non-ionizing radiation and using electric energy to biologist object. Magnetic field has characteristic that can't blocked easily, able to penetrate on any material, no exception biologist materials. The capability of ELF magnetic field can penetrate biologist material, many researchers, researched about effect of ELF magnetic field on many sectors. Research result of Sudarti (2016) ELF magnetic field with intensity 646,7 μ T in 30 minutes can use as alternative for sterilization of gado-gado food to decrease Salmonella bacteria [1]. In addition can decrease Salmonella bacteria

population, ELF magnetic field can use as growth accelerator in plant. Research by Reza (2015) shown that exposure ELF magnetic field with intensity 300 μ T in 60 minutes give positive effect on ranti tomato growth. In addition as growth accelerator plant [11], research by Mardhika (2017) shown that ELF magnetic field with intensity 600 μ T in 70 minutes influence growth of *Auricularia auricular* [5].

In the study of Kristian et al. (2015) dose of ELF exposure of 500 μ T resulted in an increase of pH of 1.00 at 24 hours after fermentation and a decrease in bacterial count at 72 hours after fermentation of tape [14]. Study of Handoko et al. (2017), shown that exposure ELF magnetic field with intensity 300 μ T for 60 minutes and 90 minutes is capable of affecting to height of red chili plants and exposure ELF magnetic field with intensity 300 μ T for 60 minutes is capable influencing to the number of red chili leaves [15].

Based on the last research, shown that ELF magnetic field has different effect with different intensity and exposure duration. Oyster mushroom, as alternative nutrition source, many people starting to consume oyster mushroom. People start to consume oyster mushroom, because oyster mushroom has some benefits and nutrition to prohibit high blood pressure disease and heart disease as mushroom consumption. In addition, consume oyster mushroom can recover from anemia, as tumor resistant, and prohibit iron deficiency [9]. Oyster mushroom known as mushroom which contain lovastatin as blood cholesterol inhibitor [7].

Many people starting to consume oyster mushroom, oyster mushroom requirement is so high, so many people start to cultivate it. People cultivated it in big scale or in small scale. But, they still cultivate oyster mushroom with traditional cultivation. So, they still can't fill market requirement. So, researcher want to research about effect of ELF magnetic field which exposure to oyster mushroom.

ELF magnetic field is a sub-class of electromagnetic fields (EMF) having frequencies below the electromagnetic wave spectrum. ELF field radiation is a non-ionizing radiation that uses electrical energy to direct to biological media. Exposure ELF magnetic field radiation give results in a non-thermal effect on applied biological targets [16]. Electromagnetic waves are waves generated when there is a change of electric field and magnetic field at a time [17]. Electromagnetic fields are magnetic fields and electric fields generated by natural and electrically charged electronics. Humans as one of the biological systems among other biological systems, it is possible will always be emitted by electromagnetic fields [18].

Maxwell laid the foundations of the theory of electromagnetic waves by making Maxwell's equations based on the laws of Faraday, Gauss (Coulomb) and Ampere [19].

The law of Gauss in the electric field can be expressed:

$$\nabla \cdot \mathbf{D} = \rho$$

The law of Gauss on a magnetic field can be written:

$$\nabla \cdot \mathbf{B} = 0$$

The law of Faraday can be written:

$$\nabla \times \mathbf{E} + \frac{\partial \mathbf{B}}{\partial t} = 0$$

The law of Ampere can be written:

$$\nabla \times \mathbf{H} = \mathbf{J} + \frac{\partial \mathbf{D}}{\partial t}$$

If using the assumption of propagation in a vacuum, with $\rho = 0$ and $\mathbf{J} = 0$, then Maxwell's equation has the following modification:

$$\nabla \cdot \mathbf{D} = \rho$$

$$\nabla \cdot (\epsilon \mathbf{E}) = \rho$$

$$\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon}$$

$$\nabla \cdot \mathbf{E} = 0$$

$$\nabla \cdot \mathbf{B} = 0$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

$$\nabla \times \mathbf{H} = \frac{\partial \mathbf{D}}{\partial t}$$

The propagation of electromagnetic waves in free space, Maxwell's equations are rearranged to be explained explicitly on time and coordinates.

$$\frac{1}{\mu} \nabla \times \mathbf{B} = \epsilon \frac{\partial \mathbf{E}}{\partial t}$$

$$\begin{aligned} \nabla \times (\nabla \times \mathbf{E}) &= \nabla \times \left(-\frac{\partial \mathbf{B}}{\partial t} \right) = -\frac{\partial}{\partial t} (\nabla \times \mathbf{B}) \\ &= -\frac{\partial}{\partial t} \left(\epsilon \mu \frac{\partial \mathbf{E}}{\partial t} \right) \end{aligned}$$

$$\nabla \times (\nabla \times \mathbf{E}) = -\epsilon \mu \frac{\partial^2 \mathbf{E}}{\partial t^2}$$

$$\nabla (\nabla \cdot \mathbf{E}) - \nabla^2 \mathbf{E} = -\epsilon \mu \frac{\partial^2 \mathbf{E}}{\partial t^2}$$

Because $\nabla \cdot \mathbf{E} = 0$,

$$\nabla^2 \mathbf{E} = \mu \epsilon \frac{\partial^2 \mathbf{E}}{\partial t^2}$$

$$\nabla^2 \mathbf{B} = \mu \epsilon \frac{\partial^2 \mathbf{B}}{\partial t^2}$$

This equation is a wave equation, with wave velocity

$$v = \frac{1}{\sqrt{\mu \epsilon}}$$

In a material, the speed of light is less than. Can be grouped into materials depicted by refraction index, the ratio of the speed of light in vacuum to velocity in a medium

$$n = \frac{c}{v} = \sqrt{\frac{\epsilon \mu}{\epsilon_0 \mu_0}}$$

The wave propagation around the strings that move the energy with the wave is proportional to the square of the wave amplitude. Electromagnetic theory explains that energy density (J / m^3) is associated with electromagnetic waves as

$$U = \frac{(\mathbf{D} \cdot \mathbf{E} + \mathbf{B} \cdot \mathbf{H})}{2}$$

Using relation of $\mathbf{D} = \epsilon \mathbf{E}$ and $\mathbf{B} = \mu \mathbf{H}$ if applied in medium of propagation:

$$U = \frac{1}{2} \left(\epsilon E^2 + \frac{B^2}{\mu} \right) = \frac{1}{2} \left(\epsilon + \frac{1}{\mu c^2} \right) E^2$$

In vacuum place:

$$U = \epsilon_0 E^2 = \frac{B^2}{\mu_0}$$

In addition to propagating, the waves also carry energy. The change in energy density (energy per unit of sectional area, each time unit) transferred is represented by vector Poynting [20]. John Henry Poynting demonstrates that the presence of both electric fields and magnetic fields at the same time in place produces a flow in the energy field, called the Poynting theorem and the Poynting vector described

$$\mathbf{S} = \mathbf{E} \times \mathbf{H}$$

The unit of the Poynting vector is $J/(m^2 \cdot sec)$ using the wave field to describe some portion of the vector. \mathbf{S} involves a quadratic relationship on \mathbf{E} , it is important to use the actual form of \mathbf{E}

$$\mathbf{H} = \frac{\mathbf{B}}{\mu} = \frac{\sqrt{\mu\epsilon}}{\mu k} \mathbf{k} \times \mathbf{E}$$

$$\mathbf{E} = \mathbf{E}_0 \cos(\omega t - \mathbf{k} \cdot \mathbf{r} + \phi)$$

$$\mathbf{S} = \frac{\sqrt{\mu\epsilon}}{\mu k} \mathbf{E}_0 \times (\mathbf{k} \times \mathbf{E}_0) \cos^2(\omega t - \mathbf{k} \cdot \mathbf{r} + \phi)$$

$$= \frac{n}{\mu k} |\mathbf{E}_0|^2 \frac{\mathbf{k}}{k} \cos^2(\omega t - \mathbf{k} \cdot \mathbf{r} + \phi)$$

$$I = |\langle \mathbf{S} \rangle| = \frac{1}{T} \int_{t_0}^{t_0+T} A \cos^2(\omega t - \mathbf{k} \cdot \mathbf{r} + \phi) dt$$

[21]

The magnetic field on a transmittable carrier is written:

The law of Biot-Savart written as:

$$\mu_0 I = \int_0^{2\pi a} B \cdot dl$$

$$\mu_0 I = B \cdot dl \Big|_0^{2\pi a}$$

$$= B(2\pi a) - B(0)$$

$$\mu_0 I = B(2\pi a)$$

$$\frac{\mu_0 I}{2\pi a} = B$$

Utilizing ELF magnetic field in many sectors definitely has standard or limit that appropriate for accelerate growth oyster mushroom. Using ELF magnetic field with exact intensity, hope can increase oyster mushroom productivity. Utilizing ELF magnetic field hope can be innovation for oyster mushroom farmers who cultivate oyster mushroom in big scale or small scale. So, researcher want doing research about the influence ELF magnetic field to oyster mushroom productivity.

II. METHODS

Type of this research is true experiment, which is this research engaging experiment group (group which exposure by ELF magnetic field) and control group (group which not exposure by ELF magnetic field) that sample given with randomly. Sample of this research is using oyster mushroom (*Pleurotus ostreatus*) seeds total 35 seeds. Oyster mushroom seeds got from oyster mushroom farmer with same age, 40 days. The oyster mushroom seeds in 40 days already have mycelium around seed media and ready for exposure with ELF magnetic field. Details 5 seeds for control group, 15 seeds for experiment group that exposure by ELF magnetic field 300 μT and 15 seeds for experiment group that exposure by ELF magnetic field 500 μT . Experiment group that exposure by ELF magnetic field 300 μT in 30 minutes 5 seeds, in 50 minutes 5 seeds, and 70 minutes 5 seeds. Experiment group that exposure by ELF magnetic

field 500 μT in 30 minutes 5 seeds, in 50 minutes 5 seeds, and in 70 minutes 5 seeds.

Sample that used in this research is oyster mushroom in ready condition to harvest. mushroom that used in this research is oyster mushroom seeds that already pass from inoculation period and incubation, so oyster mushroom seeds already ready to exposure by ELF magnetic field with indication appear mycelium. Researcher choose oyster mushroom seeds to exposure with ELF magnetic field 40 days after inoculation period because in this period choose growth hormone in oyster mushroom is starting active, and to stimulate hormone in oyster mushroom given treatment with increasing room temperature. In addition, different with other group, experiment group given extra treatment with exposure ELF magnetic field.

Weight of oyster mushrooms seeds that used approximately 1000 grams, with a length of 30 cm. In the study used oyster mushroom seeds that have been aged 40 days, where oyster mushroom seeds are filled by mycelium to be exposed to ELF magnetic field. Seeds of oyster mushrooms obtained are in a state ready for harvest. Oyster mushroom seeds bought form obtained from oyster mushroom farmers in Lumajang District.

This research using randomized post-test only control group design. Where is control group and experiment group separate randomly, measuring in once, that is after treatment has been given to experiment group. In control group class, oyster mushroom seeds save on oyster mushroom house, and experiment group oyster mushroom seeds exposure with ELF magnetic field.

This research held in Physics Education Laboratory, Building 3, Faculty of Teacher Learning and Training, University of Jember, with consideration any device ELF magnetic sources, current transformer, and EMF tester. After exposure by ELF magnetic field, both of experiment class and control class treatment doing in mushroom home. This research held on February on academic year 2016/2017.

In this research, sample that ready to exposure is oyster mushroom sample which already pass incubation period and then exposure by ELF magnetic field with intensity 300 μT and 500 μT for experiment group. Control group not give the treatment for comparator, so they're just save in mushroom house. Exposure with ELF magnetic field in duration 30 minutes, 50 minutes, and 70 minutes for every experiment group. Treatment with ELF magnetic field doing in one day. After exposure procedure, oyster mushroom seeds saved in a room, called mushroom house with maximal temperature 35°C. If temperature in mushroom house increasing, can doing cooling with spread some water around oyster mushroom house or around the body seed.

When still in growth process, can do treatment process for avoid plant diseases. If there is plant diseases, can do spread pesticide. But, in this research, researcher don't doing any treatment procedure for avoid mushroom diseases. Oyster mushroom that saved on mushroom house can be harvest after 3 days from appear of mushroom pin head. Research procedure can be seeing on Figure 1. When oyster mushroom in harvest period, can doing harvest process and collecting data. After that, analyze the data. Data analyze that used is descriptive statistic analyze, where is data will be shown on table or graphic.

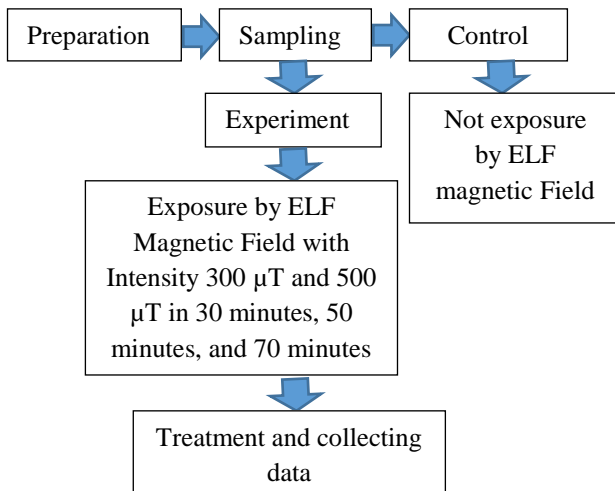


Fig.1: Research Procedure

III. RESULT AND DISCUSSION

1. Number of Oyster Mushroom Pin Head

This research aims to analyze the effect of ELF magnetic field to growth oyster mushroom (*Pleurotus ostreatus*). The process of exposure ELF magnetic field was carried out on May 6, 2017 at 06.00 AM. Oyster mushroom seeds for control class is not given treatment, so oyster mushroom seeds directly placed on mushroom house. The experimental group exposed to ELF magnetic field with intensity 300 μT and 500 μT with variation of exposure duration for 30 minutes, 50 minutes, and 70 minutes. After being exposed by ELF magnetic field, all experimental group of oyster mushrooms placed in the mushroom house same as the control group. During the treatment process, oyster mushrooms are preserved to be protected from mushroom disease that can damage oyster mushrooms.

This research was conducted from May 2017 until oyster mushroom seeds has reached the time of death, oyster mushroom seeds death about 4 month from breeding period with marked start to decompose planting medium which originally still white to brownish black color. Observation of oyster mushroom growth is done by

counting the number of pin head and wet weight of the oyster mushroom.

The results of this study include the observation of pin head and wet weight of oyster mushroom diameter that has been exposed to ELF magnetic field with variation of exposure duration and different intensity of exposure. Result of oyster mushroom pin head shown on Table 1.

Table.1: Average of Oyster Mushroom Pin Head

Group	Duration Exposure ELF Magnetic Field	Average of Pin Head
Control	-	12,2
Experiment 300 μT	30 minutes	14
	50 minutes	9,2
	70 minutes	14,2
Experiment 500 μT	30 minutes	15,4
	50 minutes	20,2
	70 minutes	14



Fig.2: Oyster Mushroom Pin Heads

Early growth of oyster mushrooms is characterized by the appearance of white oyster mushroom pin head. The indicator of the appearance of pin head on oyster mushrooms seeds is marked by the appearance of white pins on the seed medium. Then there will be a process of deference to form the rod and hood. The appearance of the first oyster mushroom pin heads occurs after 57 days after the ELF field exposure. While the control class pin head appeared on day-to-58. The oyster mushroom pin head appears first in the experimental class given exposure to a 500 μT ELF magnetic field with 50 minutes exposure duration.

In the experimental class with 300 μT exposure, based on Table 1, shows that the average number of oyster mushroom pin head the experimental class higher than the control class. In the control class, the average number of oyster mushroom pin head was 12,2, whereas in the

experimental class of exposure 300 μT , the average number of pin head was 14 with 30 minutes exposure, 9,2 with 50 minutes exposure time, and 14 ,2 with a 70 minute exposure time. The average number of lead pins in the exposure of 70 minutes.

In the experimental class with exposure ELF magnetic intensity 500 μT , based on Table 1, it appears that exposure to the ELF magnetic field of 500 μT has an effect on the appearance of oyster mushroom pin heads. It appears that the number of oyster mushroom head pin in the experimental class higher than the control class, where the average number of head pins appear is 15,4 in exposure for 30 minutes, 20,2 at 50 minutes, and 14 in 70 minutes. An increase in the number of head pins in the experimental class with exposure of 500 μT , occurred in oyster mushroom seeds exposed to ELF magnetic field for 50 minutes.

However, there is a decrease in the number of pin heads that appear on exposure for intensity 500 μT in 70 minutes. This proves that the exposure time or duration of the ELF magnetic field influence in number of appearance oyster mushroom pin heads.

2. Oyster Mushroom Wet Weight

The process of measuring the wet weight of oyster mushroom when the harvest time arrive. The oyster mushroom can harvest 2-3 days after the appearance of the oyster mushroom pin head. Harvesting oyster mushroom by removing all parts of the body of oyster mushrooms. After the harvesting process, wet oyster mushroom weighing should be done immediately to avoid the decrease in the water content in oyster mushrooms that can affect the wet weight of fresh oyster mushrooms. Measurement of wet weight of oyster mushrooms is done using a digital balance sheet. The results of wet oyster mushroom weight measurement can be seen in Table 2.



Fig.2: Process of Weighing Oyster Mushroom Wet weight

Based on Table 2, the wet weight of oyster mushrooms in the experimental group with exposure to the ELF magnetic field of 300 μT higher compared to the control group. At 30 minutes exposure obtained an average wet weight of 161 grams, 156,8 grams with exposure for 50 minutes, and 166,6 grams with exposure for 70 minutes. The experimental group with exposure ELF magnetic field intensity 500 μT has an increase compared to the control class. The average wet weight of oyster mushroom with 30 minutes exposure was obtained for 199,2 grams, wet weight of 212,2 grams with 50 minutes exposure time, and 194,4 grams with 70 minutes exposure time.

In the intensity 500 μT 70-minutes exposure, oyster mushroom weight decreased. However, the average wet weight obtained is still more than the control class. At 50 minutes exposure with intensity 300 μT , the wet weight of oyster mushroom also decreased compared to 30 minutes of exposure time. However, the oyster mushroom seeds exposed to ELF 300 μT magnetic field for 50 minutes still has a wet weight greater than the control class. Oyster mushrooms with 300 μT exposure for 70 minutes had the greatest wet weight compared to the control class as well as the experimental class with 30 minutes and 50 minutes exposure time. This result suggests that giving ELF magnetic field exposure with intensity 500 μT in 50 minutes influence to wet weight of oyster mushroom.

3. Discussion

Biological materials, such as oyster mushrooms, are better conductors than air. Due to the polarization effect of the electric field on the outermost surface of the body, the time variation of the electric field induces the surface of the body that produces current in the body, the magnitude corresponding to the surface charge density. In the sinusoidal electric field the value of the current in the body increases with the magnitude of the frequency [4].

Table.2: Oyster Mushroom Wet Weight

Group	Duration Exposure ELF Magnetic Field	Average Wet Weight (grams)
Control	-	144,8
Experiment 300 μT	30 minutes	161
	50 minutes	156,8
	70 minutes	166,6
Experiment 500 μT	30 minutes	199,2
	50 minutes	212,2
	70 minutes	194,4

ELF magnetic field has biological effects such as, inducing cell metabolism [3], altering chemical or enzyme processes (Agustrina, 2013: 405-412), and altering membrane surface properties [13]. The ability of the biological effects of the magnetic field to affect the permeability of the ion channels in the membrane can give the effect of ion transport into the cell and give changes to the organism [6]. Magnetic fields with frequencies less than 300 Hz are able to induce cells and tissues, primarily capable of affecting calcium in cells [10].

Various study shown that magnetic fields including the ELF magnetic field have an effect on cell membrane function, especially the transfer of Ca^{2+} ions through the membrane. Ca^{2+} ions are part of a variety of connections that signal the cells by involving protein kinases [8]. When magnetic field exposure, intracellular and extracellular mechanisms begin to activate. The magnetic field is able to penetrate the plasma and nuclear membrane of the cell, affecting cells and tissues. Ca^{2+} ion transport occurs continuously on the channel of the cell membrane [2].

The appearance of the first oyster mushroom pin head in the experimental class with 500 μ T exposure for 50 min on the 57th day after the exposure process was performed. On the 58th day, the oyster mushroom pin appeared on the control class. This proves that exposure to the ELF magnetic field is capable of accelerating the appearance of oyster mushroom pin heads compared to the control class without exposure to the ELF magnetic field. In addition to affecting the appearance of the number of head pins, ELF magnetic field is able to influence the wet weight of oyster mushrooms when harvested. After oyster mushroom pin head appeared, there is a process of development from pin head to hood after 2-3 days from the appearance of pin head. After growing into a hood, oyster mushrooms can be done the process of harvesting. Harvesting is done by removing all parts of the body oyster mushrooms. Then performed the process of measuring the wet weight oyster mushrooms.

Dosage of ELF magnetic field exposure, able to influence the growth of oyster mushrooms. It appears that the ELF magnetic field is capable of affecting the appearance of the number of pin head oyster mushroom and wet weight oyster mushroom. When exposed to the ELF magnetic field, there is a process of changing the nature of oyster mushroom cell member resulting in changes in the transport of calcium ions in oyster mushrooms. Calcium itself, known as the carrier of responses to cells [12] and has various biological effects on living things. Exposure to the ELF magnetic field with the intensity and duration of certain exposure that can affect the transport speed of calcium ions in oyster mushroom cells that affect the

growth of oyster mushrooms. In addition, ELF magnetic field capable of affecting cell metabolism is also able to influence the growth of oyster mushroom.

It appears that exposure to a 500 μ T ELF magnetic field for 50 minutes was able to increase the number of oyster mushroom pin heads and the wet weight of oyster mushrooms during harvest. However, the magnetic field exposure of 500 μ T for 70 minutes indicates a decrease in the number of head pin and wet weight on oyster mushroom. This indicates the existence of the process of blocking the growth of oyster mushrooms as a result of massive calcium ion transport. The presence of excessive calcium ions in the cell makes the cell decrease or growth delay (Toshio et al., 2006: 597-602). As a result, the oyster mushroom is unable to grow to the maximum indicated by a decrease in the number of pin head and wet weight. This indicates that the long exposure of the ELF magnetic field has considerable influence.

Based on Table 1 and Table 2, both number of pin head oyster mushroom and wet weight oyster mushroom decreasing in intensity 300 μ T in 50 minutes. This is happen because of the oyster mushroom medium nutrition factor. The nutrition in the oyster mushroom seed not spread evenly. So, it can be disturb growth process. The largest number of oyster mushroom pin head and wet weight, is on the exposure of a 500 μ T ELF magnetic field for 50 minutes. Decreasing number of oyster mushroom pin head and wet weight in exposure 500 μ T in 70 minutes shown that this exposure make some cells on oyster mushroom have too much calcium ions. So, the oyster mushroom cells can't growth well.

After the process of measuring of the oyster mushroom done, oyster mushroom seeds undergo a process of death characterized by the emergence of pathogens in oyster mushroom medium, pathogens that appear on oyster mushroom medium is greenish. Oyster mushrooms seed can't be reused after the age of 4 months from the nursery, because more than that, the nutritional content in the oyster mushroom seed has been decreased.

IV. CONCLUSION

Giving a proper dose of ELF magnetic field exposure, able to maximize the growth of oyster mushrooms. However, if excessive doses of exposure are given, making the transport of calcium ions in oyster mushroom cells becomes uncontrollable. In this research, exposure of ELF magnetic field influence to oyster mushroom growth at 500 μ T exposure for 50 minutes, with growth parameters of pin head number and wet weight.

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Performance Evaluation of wide Bandwidth RF Signal Generator Chip

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Abstract— The work in this paper is to give an overview of the compact wide band RF signal generator board design, emphasizing on the analyses and evaluation of the performance characteristics corresponding to the output signal purity and stability. The paper describes the design aspects involved in developing a reliable RF generating source which includes details regarding the factors that have taken care for optimum output power, spectral purity and noise performance. The simulation results obtained from the tool given by Maxim integrated are used as reference to evaluate the actual board when it is realised. These results are shown here for reference. Design aspects such as the power supply, noise filtering, loop filter component selection board layout consideration along with easy and compact form factor is considered. The board contains not only the signal generator device but also an FPGA from Xilinx to control the device, to make the board more useful for future applications; the board also has an SDRAM and an USB controller. This paper mainly concentrates on to MAX2870 signal generator and simulation results obtained by EE-Sim tool. Since the actual board is still in the process of being developed, the comparison of the actual performance to the simulation performance may not be possible at this point of time but definitely is in pipeline.

Keywords—FPGA, VCO, USB, SDRAM, PLL and DCM.

I. INTRODUCTION

Ultra wide band technology has been a very active field of research since last decade due to the advancements in IC technologies. Wide bandwidth signal generation has become a core part in communications, RADARs and high resolution sensor technologies. The challenge of integrating multiple modules to make signal generation systems more compact and reliable has been to an extent being addressed using the latest state of art synthesizer devices with integrated VCOs having reasonable spectral performance that is sufficient for number of applications. Analog devices, Hittite and Maxim are some of the leading IC manufacturers for synthesizer chips of similar kind. The recently released IC from Maxim is the

industry's only device which can output frequency from 25MHz to 6.0GHz while maintaining superior phase noise and spurious performance when combined with an external reference oscillator and loop filter. The high bandwidth requirements for systems such as Archaeological surveying instruments require multiple output matching stages which make it difficult for designer to design a system with constant pass band response along with high speed frequency hopping mechanisms.

High fabric frequencies with which FPGAs can be operated make a good choice for those to be used as a control and processing applications. Using FPGAs along with synthesizer allows us to configure the devices at high speeds so as to achieve large instantaneous bandwidth with good dwell time specifications.

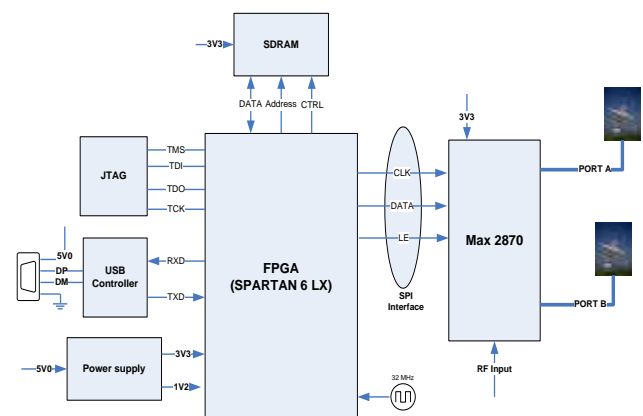


Fig. 1: Transmitter part of MAX2870 RF signal generator

II. THEORETICAL DETAILS

The Figure 1 shows the Transmitter part of RF signal generator which has Spartan 6 LX FPGA for controlling the MAX2870 synthesizer through SPI interfaces. The FPGA has approximately 50 I/O lines. The block diagram also shows a dual channel USB, integrated JTAG programmer, 128Mb SDRAM, efficient switching power supply and MAX2870 synthesizer [7]. The MAX2870 is an ultra-wideband phase-locked loop (PLL) with integrated Voltage Control Oscillators (VCOs) capable of synthesizing frequencies from 25MHz to 6.0GHz while

maintaining superior phase noise and spurious performance when combined with an external reference oscillator and loop filter. The MAX2870 is a high-performance frequency synthesizer [1]. The ultra-wide frequency range is achieved with the help of multiple integrated VCOs covering 3000MHz to 6000MHz, and output dividers ranging from 1 to 128. The device also provides dual differential output drivers, which can be independently programmable to deliver -4dBm to +5dBm output power. Both outputs can be muted by either software or hardware control [1].

Comparison was made between MAX 2870 and ADF4350 Synthesizers. The MAX device was chosen for the applications because of the advantages over other synthesizers in terms of the MAX2870 provide an additional method to switch between integer and fractional modes. The MAX2870 provides a 16-bit resolution with an extended usable range; The MAX2870 provides programmability on the CP output clamp to achieve better noise performance in integer-N mode. The MAX2870 allows the user to disable the VCO auto selection (VAS) machine, and manually set the VCO sub band. Using a VCO lookup table, the user can achieve a faster PLL lock time than with the VAS enabled [8].

The Spartan 6 offers the more flexible CMT which allows 36Kbit BRAM blocks to be split into two 9Kbit BRAM blocks. It also provides DCMs and PLLs [7]. The Spartan 6 has more built-in SRAM - 64Kbytes [7].

The PCB is a four layer, independent analog and digital ground separation design, for the in-built ADC in the MAX2870. The differential clock outputs are maintained to avoid noise injection through the track. The ground layered is sandwiched between the signal layer as the TOP layer and the Power layer at the BOTTOM.

III. EXPERIMENT AND SIMULATION

The first paragraph under each heading or subheading should be flush left, and subsequent paragraphs should have a five-space indentation. A colon is inserted before an equation is presented, but there is no punctuation following the equation. All equations are numbered and referred to in the text solely by a number enclosed in a round bracket (i.e., (3) reads as "equation 3"). Ensure that any miscellaneous numbering system you use in your paper cannot be confused with a reference [4] or an equation (3) designation.

The MAX2870 is controlled by a 3-wire serial interface and is compatible with 1.8V control logic. Maxim integrated has a tool to simulate the design parameters. When design requirements are entered in the EE-sim tool, the interactive schematic and bill of materials are generated and can be used for evaluating the design. In this paper the tool is used for evaluating the theoretical

part of the design and the board is generated to evaluate the design with practical output [7].

The design parameters that were considered for the simulations are:

Output Frequency: 4.5GHz

Rset: 5.1K Ω

Charge Pump Current (Icp)*: 0.32mA

Reference Multiplier: x1

Reference Divider: 2

Reference Frequency: 50MHz

Loop Filter Design Specifications:

Desired PLL Loop Bandwidth: 50 kHz

Desired Phase Margin: 50

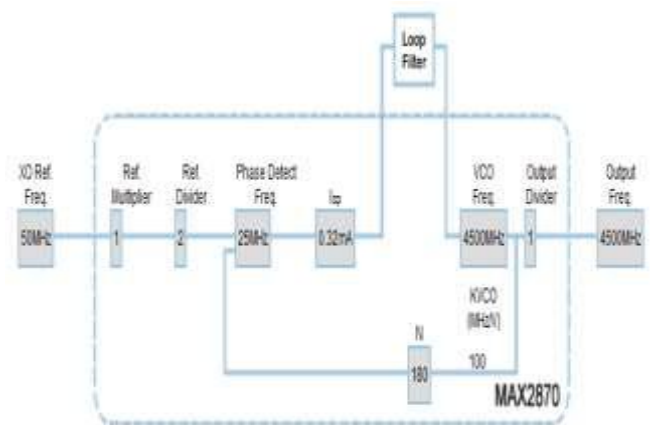


Fig. 2: PLL configuration [6]

When above configuration parameters are fed to the EE-Sim tool of Maxim integrated, the configuration block diagram was generated and is shown in Figure 2

The design parameters can also be modified using the EE-sim tool for designing to different frequencies. The parameters that can be varied to get different frequencies are allowed to modify in the EE-sim tool.

The design performance has been investigated through simulation via EE-sim tool of maxim integrated. The results are captured for various parameters and the simulations are done for 4.5GHz centre frequency. Presently the board is being developed as per the block diagram shown in Figure 1 and also, parallel to board design the component procurement and the simulation of the MAX2870 device is also being conducted. Once the fabricated board arrives and the components are assembled; then the simulated results are evaluated with the practical outputs.

The registry update rate of MAX2870 device compared with other synthesizer device available from analog devices is of the value is 8 nS approximately which could lead to slew rate of less than 2 nS at the control signal clock. There has to be ground stitching around the critical traces which are required to be isolated through low power RF signals.

Some of the major factors that has to be considered for step frequency synthesizer is the hop signal time and the locking period required by the device, this requires operational calculation for getting the designed loop bandwidth and phase margin (Figure 5) so as to achieve step of 1 MHz instantaneous with in dwell time of one millisecond.

The overall integrated phase noise (Figure 6) could be judged based on the noise floor of the external clock signal, the loop bandwidth and internal VCO characteristics which intern also be effected by the jitter on control signal.

The various simulation results are captured in Figure 3, Figure 3, Figure 4 and Figure 5.

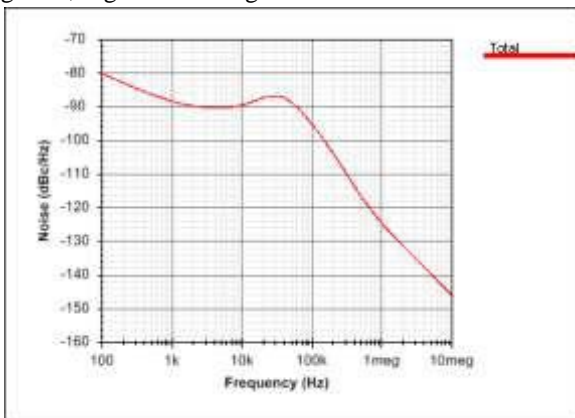


Fig. 3: Noise Total

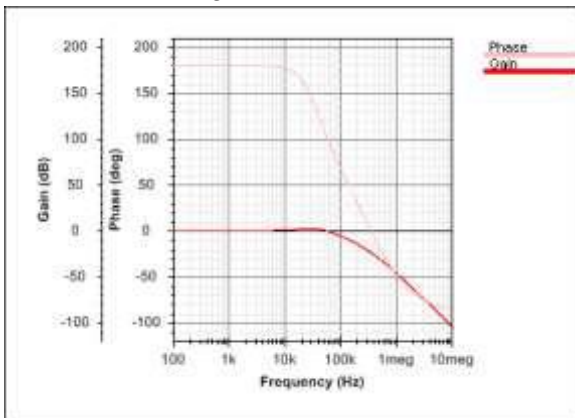


Fig. 4: Closed Loop Gain/Phase Margin

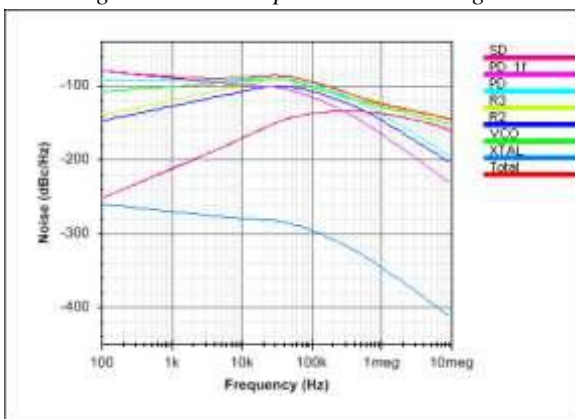


Fig. 5: Noise Total (w/ Component Curves)

IV. RESULTS AND DISCUSSION

The digital circuit has the switching regulator which generate noisy digital signal that could affect noise floor of the system. High-Q dc line filter has to be implemented at the output of regulator in the digital section and add ferrite beads at all significant power supply lines given to the synthesizer chip and associated circuitry. Snap shot of the schematics of the board that is being developed is shown in Figure 8. ORCAD is the tool used for generating the schematics.

The power supply circuit that is required to drive the board is designed using Linear Technologies step down regulator. The Figure 7 shows the snapshot captured in orcad. The input voltage range is 2.5V to 5.5V, making it ideal for USB powered applications. Supply current during operation is only 35 μ A and drops to <1 μ A in shutdown. A user-selectable mode input allows the user to trade-off between high efficiency Burst Mode operation and pulse-skipping mode. An internally set 2.25MHz switching frequency allows the use of tiny surface mount inductors and capacitors. Internal soft-start reduces inrush current during start-up. Both outputs are internally compensated to work with ceramic output capacitors.

One of the most important things to be taken care for generating clean spectral output is to see that the loop filter does not induce coupling due to the nearby high speed signals on the board. This could act as modulation signal to the output if loop filter section is not properly isolated. The output trace has to be matched for wide band so as to keep VSWR constant throughout the desired band within the acceptable limit. The input clock has to be fed directly to synthesizer chip to avoid any phase noise degradation.

The MAX2870 serial interface contains five write-only and one read-only 32-bit registers. The 29 most-significant bits (MSBs) are data, and the three least-significant bits (LSBs) are the register address. Register data is loaded MSB first through the 4-wire serial interface (SPI). When LE is logic-low, the logic level at DATA is shifted at the rising edge of CLK. At the rising edge of LE, the 29 data bits are latched into the register selected by the address bits. The user must program all register values after power-up [7].

The MAX2870 can be put into low-power mode by setting SHDN = 1 or by setting the CE pin to logic-low [7].

The device has dual differential open-collector RF outputs that require an external RF choke 50 ohm resistor to supply for each output. Each differential output can be independently enabled or disabled by setting bits RFA_EN and RFB_EN. Both outputs are also controlled

by applying a logic-high (enabled) or logic-low (disabled) to pin RFOUT_EN [7].

The output power of each output can be individually controlled with APWR for RFOUTA and BPWR for RFOUTB. The available differential output power settings are from -4dBm to +5dBm, in 3dB steps with 50Ω pull-up to supply. The available single-ended output power ranges from -4dBm to +5dBm in 3dB steps with a RF choke to supply. Across the entire frequency range different pull-up elements (L or R) are required for optimal output power. If the output is used single ended, the unused output should be terminated in a corresponding load [7].

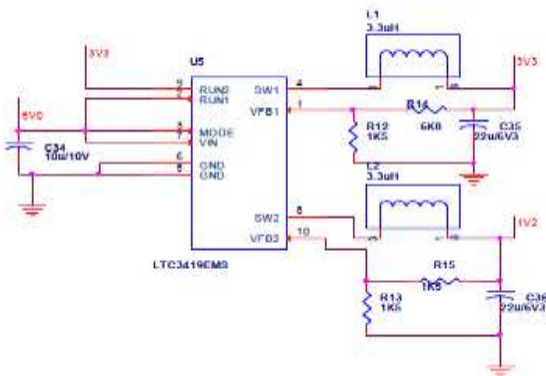


Fig. 6: Schematic of power supply circuit

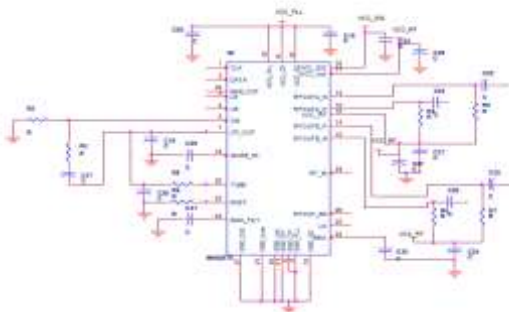


Fig. 7: Schematic of Max2870 captured using ORCAD tool

VCO: The fundamental VCO frequency of the device guarantees gap-free coverage from 3.0GHz to 6.0GHz using four individual VCO core blocks with 16 sub-bands within each block. Connect the output of the loop filter to the TUNE input. The TUNE input is used to control the VCO [7].

V. CONCLUSION FUTURE WORK

This paper provides simulation results from the tool that are used to derive the output performance of device in ideal conditions based on the system requirements and design features described error margin will be tested on the practical board. One channel of this transmitter board

will be used to provide the local oscillator frequency to the base band conversion receiver as well, which will provide more accurate phase locked source as the lag between transmitted source and the receiver reference source will be same. The work is still pending on developing a SDRAM controller and USB controller inside FPGA. The reason for developing a board is to use the synthesizer output at the antenna for transmitting as well as for receiving the signals from the antenna and sampling them. Antenna design work is in preliminary stages and yet to decide the type of antenna [9] along with the specs that is to be used.

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Effect of Process Parameter in SAW- A Review

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Abstract— In research organizations and industries, most widely used welding methods are shield metal arc welding (SMAW), gas metal arc welding (GMAW), gas tungsten arc welding (GTAW) and submerged arc welding (SAW). The SAW process is often preferred because it offers high production rate, high melting efficiency, ease of automation and low operator skill requirement. This study expose the different works have been done in the past for improving different properties of welded material. This study also exhibits the effect of different welding process parameters that affect the weld chemistry. Depending upon the requirement the details of past work will we easily obtained for future work with the help of this study.

Keywords— *Welding Current, Arc Voltage, Welding Speed, Wire Diameter, Wire size.*

I. INTRODUCTION

In industries and research organizations, submerged arc welding (SAW) is one of the most widely used welding method, because it offers high production rate, high melting efficiency, ease of automation and low operator skill requirement, the SAW process is often preferred. It was first used in industries in the mid 1930's as a single-wire welding system (Parmar, 1992). The operating variables used in the SAW process results in varying heat input in the weldment. The consequence of this is the deterioration of the chemical constituents of the weld bead. Therefore, the properties of the parent metal cannot adequately match those of the weldment to ensure good performance in service, especially in low temperature services.

II. CONTROL PARAMETERS

2.1. Welding Current: It controls the melting rate of the electrode and also control the weld deposition rate. It also controls the depth of penetration and thereby the extent of dilution of the weld metal by the base metal. Too high a current causes excessive weld reinforcement which is wasteful, and burn-through in the case of thinner plates or in badly fitted joints, which are not provided with proper backing.

2.2. Arc-Voltage: Arc voltage, also called welding voltage, means the electrical potential difference between the electrode wire tip and the surface of the molten weld puddle.

2.3. Welding speed : The welding speed also affects the penetration. If the speed is increased relative to the original value, penetration will be decreased and the weld will be narrower. Reducing the speed, increases penetration and results in a wider weld. However, reducing the welding speed to about 20–25 cm/min (depending on the actual value of the current) can have the opposite effect, i.e. a reduction in penetration, as the arc is prevented from transferring thermal energy to the parent metal by the excessive size of the weld pool. If the welding speed is to be changed while penetration is kept constant, it is necessary to compensate by adjustment of the welding current, i.e. to increase or decrease it.

2.4. Wire diameter: For a given current, current density can be changed by changing the wire size. Greater wire diameter results in a reduction in penetration and, to some extent, also the risk of burning through at the bottom of the weld. In addition, the arc will become more difficult to strike and arc stability will be adverse.

2.5 Wire sizes and types of current: Wire sizes normally used for butt welding are 2.0, 2.5 and 3.0 mm, with wire separations of about 8 mm. DC welding, with the wire positive relative to the work piece, is preferable, as this results in the best arc stability and least risk of porosity. When hard facing using tubular wires, it is generally preferable for the wire to be negative, resulting in minimum penetration and highest deposition rate. Commonly used tubular wire diameters are 2.4, 3.0 and 4.0 mm.

III. LITERATURE SURVEY

In this Paper, important research works related to present work have been reviewed. These works provide the background for defining the objective of our work i.e., to see the effect of input processing parameters on welding qualities, welding properties and internal defects. Findings from the papers studied are discussed below.

(V.Gunaraj and N. Murugan, 2000) They studied the various process control variables and weld bead quality parameters in SAW of pipes manufactured out of structural steel (IS: 2062). Mathematical models were developed for the submerged arc welding of 6- mm-thick structural steel plates using 3.15-mm-diameter steel electrodes. The models were developed using the five-level factorial technique to relate the important process-control variables — welding voltage, wire feed rate,

welding speed and nozzle-to-plate distance — to a few important bead-quality parameters — penetration, reinforcement, bead width, total volume of the weld bead and dilution. The models developed were checked for their adequacy with the F test. Using the models, the main and interaction effects of the process-control variables on important bead geometry parameters were determined quantitatively and presented graphically. The developed models and the graphs showed the direct and interaction effects of process variables on the bead geometry are very useful in selecting the process parameters to achieve the desired weld bead quality. Also, the precision of the results obtained with the mathematical models were tested by using conformity test runs.

(V.Gunaraj and N. Murugan, 2000) developed mathematical models to relate the process parameters and the weld bead quality parameters. Further, the optimization of weld bead volume was carried out using the optimization module available in the *MATLAB* version 4.2b software package. The mathematical models thus developed for optimization are also helpful in predicting the weld bead quality parameters and in setting process parameters at optimum values to achieve the desirable weld bead quality at a relatively low cost with a high degree of repeatability and increased production rate. Total volume of the weld bead, an important bead parameter, were optimized (minimized), keeping the dimensions of the other important bead parameters as constraints, to obtain sound and superior quality welded pipes. Sensitivity analysis was also carried out to predict the direct and few interaction effects of important bead parameters on the total volume of the weld bead, and the results are presented in graphical form. The results of the sensitivity analysis are very useful in understanding the interdependence of various weld bead quality parameters in controlling the volume of the weld bead, to improve weld quality, to increase productivity with the available welding facilities and to minimize the total welding cost.

Datta et al. (2002) investigated the weldability properties of 20 mm thick plates using the shielded metal arc welding (SMAW) process. The authors suggested that susceptibility of steel to cold cracking is related to the carbon equivalent (CE) and its position in the Graville diagram. High strength, quench and tempered plates having yield strength of 670 MPa (carbon equivalent, CE: ~0.6) are susceptible to a crack-sensitive microstructure and cold cracking during welding.

Rayes et al, (2004) predicted weld bead penetration as a function of welding process parameters. They optimized process parameters for maximizing weld penetration.

Murugan and Gunaraj (2005) suggested that mechanical strength of welds is influenced not only by the composition of the metal but also by the weld bead shape in SAW. So the selection of the process variables and control of weld bead shape has become essential. In the experimental work, bead on plate has been taken on plates (IS 2062 carbon steel of 6mm thickness) with 3.15 mm diameter wire. Prediction equations were developed for penetration, reinforcement, bead width, PSF and RFF in terms of weld parameters; voltage, speed, wire feed rate and nozzle to tip distance.

S. R. Bhide et. al.(2006) compares submerged arc welding (SAW), gas metal arc welding (GMAW), and friction stir welding (FSW) in terms of their buckling property by measuring the longitudinal residual stresses on HSLA-65 steel welded plates of identical dimensions. The blind hole drilling method was used to measure the longitudinal residual stress and distortion measurements were obtained by using digital gauges at 40 points on the plates. Analyses of the longitudinal residual stresses and distortion measurements revealed that the FS-welded plate has buckling distortion, while the GMAW and SAW plates have angular and bowing distortions.

P. Kanjilal, et. al.(2007) studied the transfer of elements across the molten weld pool by developing quadratic models in terms of flux ingredients with the application of statistical experiments for mixture design. Bead-on-plate weld deposits were made at fixed welding parameters using submerged arc welding fluxes prepared as per extreme vertices algorithm of mixture experiments in a CaO-MgO-CaF₂-Al₂O₃ flux system. The results show that some of the individual flux ingredients and their binary mixtures have a predominant effect on weld metal transfer of oxygen, manganese, silicon, and carbon contents. The analysis of experimental data also indicates that transfer of oxygen is affected by several properties of flux ingredients such as oxygen potential, thermodynamic stability, and viscosity. In the element transfer of silicon, both thermo chemical and electrochemical reaction mechanisms operate simultaneously. Transfer of manganese is principally related to the weld metal oxygen contents as well as electrochemical reaction in the molten weld pool. The transfer of carbon was generally governed by the oxidation reaction. Iso-response contour plots were also developed to quantify the transfer of elements against different flux compositions.

P. J. Konkol et.al.(2007) develop procedures, and demonstrate the feasibility of FSW 0.25-in.- (6-mm-) thick HSLA-65 steel weldments fabricated from 10-ft- (3-m-) long plate sections, on a production- size, purpose-

built FSW machine. Measurements were taken to compare the amount of weld distortion with that of a conventional submerged arc weldment. In addition, the mechanical properties and microstructures of the weld regions were evaluated to further compare the two welding processes. Both the friction stir and submerged arc weldments exhibited significant longitudinal weld distortion. The submerged arc weldment was bowed in the transverse direction, while the friction stir weldment exhibited no transverse distortion. The transverse weld tensile strengths of both weldments were acceptable, and the CVN toughness of the FSW stir zone was significantly higher than that of the submerged arc weld metal. There was little difference in heat-affected-zone toughness. This indicates that FSW is technically feasible for joining HSLA-65 steel for structural applications.

Kaaoglu and Secgin (2008) carried out the sensitivity analysis of SAW parameters; welding current, welding voltage and welding speed for optimum weld bead geometry. The weld bead width, height and penetration were selected as design variables. A mathematical model was constructed using multiple curvilinear regression analysis. The study revealed that the penetration is almost non-sensitive to the variations in voltage and speed.

Datta et al. (2008) optimized bead geometry (bead width, reinforcement, depth of penetration and depth of HAZ) using grey relational analysis. Taguchi's L25 orthogonal array (OA) was used in the work for design of experiment and experiments were conducted to obtain bead-on-plate weldment on mild steel plates. Welding parameters were determined for bead width, reinforcement and depth of HAZ with lower-the-better and for depth of penetration with larger-the-better criterion.

Sharma et al. (2009) used 'Best subset selection method' and 'Mallows criterion' for development of model for deposition rate in twin-wire submerged arc welding. The deposition rate had been measured by varying process parameters; welding current, welding voltage, welding speed, contact tube to workpiece distance and wire-diameter for both DCEN and DCEP polarities. The authors concluded that welding voltage and welding speed have considerable effect on the deposition rate.

Nandi et al. (2010) conducted experiment using Taguchi's L25 Orthogonal Array (OA) to produce bead-on-plate weld on mild steel plates by Four bead geometry parameters: depth of penetration, reinforcement, bead width and percentage dilution have been determined in terms of voltage, wire feed rate, traverse speed and electrode stick-out. Two hybrid techniques; firstly,

Taguchi method coupled with grey relational analysis; and secondly, Taguchi method in combination with desirability function approach had been applied. The authors also described that in most of the cases; the optimization had been performed using single objective function. For solving multi-criteria optimization problem, it had been suggested to transform multiple objectives into an equivalent single objective function which may be assumed to be a representative of all the quality characteristics of the process, which is to be optimized.

Ghosh et al. (2011) suggested that in submerged arc welding process parameters play a significant role in determining the quality of a weld. So for such applications, optimum welding process parameters must be selected providing desired weld properties. In the work; beads were taken on 15mm thick plate by varying heat input and wire feed rate. Prediction equations were developed for penetration, reinforcement height and width using multi-regression method and artificial neural networks; a comparative study of both techniques had been also performed.

Narang et al. (2012) developed mapping technique for graphical representation of weld bead profile. The authors developed prediction equations for depth of penetration, bead height, HAZ width, bead width, bead contact angle, depth of HAZ and dilution for bead on plate on MS plates. It was suggested that bead contact angle is an important output response among weld bead shape parameters..

Biswas et al. (2012) discussed limitations of Taguchi method along with other techniques such as grey relation theory, desirability function approach, utility theory etc. to solve multi-response optimization problems. Weighted Principal Component Analysis (WPCA) has been applied to eliminate response correlation in the study on optimization of multiple bead geometry parameters of submerged arc weldment using Taguchi method. Experiments had been conducted based on Taguchi's L25 Orthogonal Array design with combinations of process control parameters: voltage, wire feed, welding speed and electrode stick-out to optimize different bead geometry parameters: bead width, bead height, penetration depth and HAZ dimensions.

X. R. LI et.al. (2013) To conveniently monitor weld penetration and acquire the needed feedback for weld penetration control, welding parameters and conditions affecting weld penetration were analyzed and specific variables subject to variation and fluctuation were identified. Experiments were conducted to see what

parameters affect the weld penetration and what their significances are. It was found that the base metal current is the dominant parameter that determines weld penetration with a sufficient accuracy when other major parameters are in their stated ranges. A control system has been established to monitor and control weld penetration using a proportional integral derivative (PID) control algorithm. This algorithm is based on penetration feedback provided by the penetration model that correlates weld penetration depth to base metal current. Experiments on DH36 square butt joints verified the effectiveness of the proposed method.

P. F. Mendez et.al.(2015) presented here high speed video analysis of metal transfer and the design of complex waveforms in SAW, Analysis of the videos show that at 500 A, a very chaotic, nonaxial globular metal transfer involving frequent explosions and bursts is present in both AC and DC polarities. A droplet detachment frequency of approximately 9 Hz was observed at 500A DCEP, and 13 Hz at 500A AC. At 1000A DCEP, a tapering electrode tip with a buried arc was observed ejecting a molten tail through a mechanism resembling an electromagnetic kink instability. Analysis of the voltage signal indicates a $1/f$ pink noise without any indication of the events observed in the videos. Spectrometry of the arc in the weld cavity was performed, and no obvious signs of external gas entrainment were detected.

G. GÖTT et al.(2016) For the first time, a combination of high speed imaging and spatially resolved spectroscopy at 5000 fps was performed on a submerged arc welding process. This was achieved by inserting a thin gauge steel tunnel into the flux and aligning the diagnostics accordingly. Four processes were observed; both direct current electrode positive (DCEP) and direct current electrode negative (DCEN), as well as alternating current (AC) at 600 A and DCEP with a higher current at 1000 A. The videos show an erratic droplet transfer with a lot of spatter that was caught by the cavern walls and directed into the weld pool. The observed processes showed only a slight change in chemical composition of main alloying elements in the solidified weld joint, while the oxygen content varied significantly in the droplet stage and weld joint between the processes. The high speed images indicated a correlation between droplet flux interaction and oxygen content. The spatially resolved spectra showed intense self reversed lines of Na, Ca, and Mn. Fe lines suggested that the arc was also dominated by metal vapor. Especially during the AC process, a fluctuating emission of Mn lines was observed, which correlated with the frequency of the shifting polarity.

IV. GAPS IDENTIFIED FROM THE LITERATURE REVIEW

After study of the existing literature, following gaps were identified towards the design and development of SAW:

- 4.1) Literature concluded that the researchers have carried out most of the work to study the effect of weld parameters on the weld bead geometry but little work has been done on flux composition and its effects on mechanical property estimation and chemical composition of the weld metal.
- 4.2) Literature review reveals that the use of multi response optimization has not been explored for the optimization of process variables and flux compositions.
- 4.3) Cold cracking is still the major issue in higher-strength steel welds. Limited work has been done on flux chemistry modification with an aim to minimize cold cracking.

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Improving performance by improving the relationship with the companies in the supply chain

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Abstract—This paper will address issues related to strategy, quality and management of customers and suppliers, and its main objective is to demonstrate the benefits of cooperation between customers and suppliers in the supply chain. A case is presented about a Brazilian company with assets in several sectors of the economy that implemented a program to reward the cooperation of its key suppliers and obtained several benefits with this program. Finally, it is concluded that issues such as identification of the real needs and expectations of stakeholders, the philosophy of quality at source, consolidation of the customer base and suppliers and cooperation between companies are key points for improving business performance, at every link in the supply chain.

Keywords—supply chain, customer relationship supplier, performance in supply, quality; cost reduction.

I. INTRODUCTION

In the last years, it has been commented that the competition happens between chains of supplies and not only between companies. According to Garbade (2004) apud Alves, Andrade and Fernandes (2006), this requires companies to increase the efficiency and effectiveness of their processes and operations, seeking to produce more and more, with fewer resources and at the lowest possible cost. Toledo et. al. (2004) states that companies generally live a reality in which they can no longer plan or act in isolation, requiring a coordinated behavior between those belonging to the same supply chain. Adapting from Schramm (2008), organizations recognize the need to improve their relationship with supply chain partners, but find it difficult to develop effective mechanisms that can bring improvements in the performance of these partners to their needs.

Thus, the study on the management of the supply chain is an emerging issue and deserves several contributions. In this context, issues related to strategy, quality and management of customers and suppliers will be addressed in this article. The main objective of this work is to demonstrate the benefits of cooperation between customers and suppliers in the supply chain. This research was conducted through a case study in a steel company. The work was organized in 4 sections. Section 2 presents issues related to improving the performance of the supply chain. Section 3 describes improving the relationship in the supply chain. Section 4 presents an example of relationship and improvement of performance in the supply chain, through the management of the relationship with suppliers. Finally, in Section 4 the final considerations of the present work are presented.

II. IMPROVING SUPPLY CHAIN PERFORMANCE

One way to implement improvements in the performance of these partners is through identifying their needs and expectations. According to Frooman (1999) apud Chiavenato and Sapiro (2003), an organization is a system that brings together various stakeholders with whom it establishes its relations. According to Loureiro (1999), it is necessary to validate the requirements of the stakeholders before starting a project. In the possession of the validated requirements, they should be converted into technical requirements and then detailed. With this, formulate and establish a project that is effective to meet such requirements. Also, adapting from Loureiro (1999), the identification of stakeholders is carried out by identifying the people or organizations that are affected or affect the attributes of the final product, its business processes and the organization that performs them.

In Figure 1, a suggested tool is presented, according Womack and Jones (1996), to address stakeholders' needs, expectations and interests. This tool consists of a graph for identification of value for stakeholders, in which the vertical axis represents the level of performance desired and on the horizontal axis the importance that the stakeholder attributes to that characteristic. The main factors that contribute to aggregate value to the stakeholder are listed at the top of the chart and then allocated to each position of the chart according to the criteria of each axis described above.

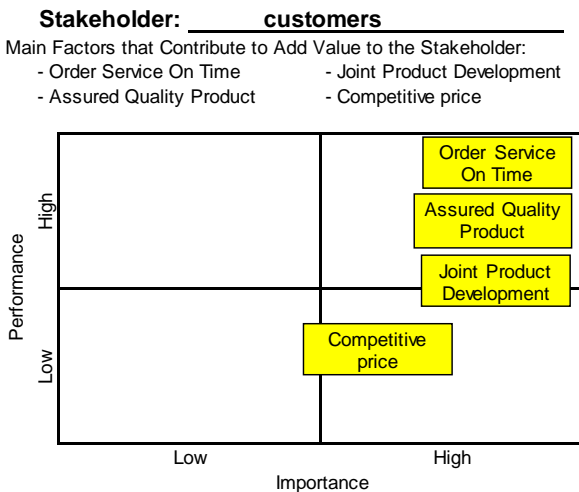


Fig.1: Value comparison chart for stakeholder

Identifying stakeholders' needs and expectations will give insight into what they expect or want at each link in the supply chain, including rating them according to their relevance for performance or performance and importance. This vision will be useful in formatting programs and actions that encourage or motivate such partners to achieve the results needed to encourage cooperation between organizations that are part of the supply chain rather than competition between them.

Cooperation and competition are, in general, opposing positions in inter-company relations. In the competition, the companies have conflicting objectives: for one to win, another must lose. In cooperation, there are common goals: the gain of one does not exclude that of another. Carvalho and Sobral (2002) apud Rodrigues and Sellitto (2008) present a method to explain relationships between companies: If only the result of the transaction matters, competition arises. If the future relationship is also important, collaboration comes along. According to Narayanan and Raman (2004), in order to offer quality products, competitive strategies must be implemented, the logic and importance of decisions must be transmitted to suppliers in the supply chain, from suppliers to consumers, and generate motivation for continuous

performance improvement, through the stimulus to commitment and cooperation.

Pavan and Pires (2004) argue that the business scenario has been showing profound changes in the last decades derived from the high levels of national and international competition. Therefore, management systems and tools have been created in order to make the organization more competitive and profitable. More recently, the concept of Supply Chain Management has been highlighted, and is related to the connection of the main suppliers, manufacturing companies and distribution centers in order to meet the needs of the customer in the most appropriate way, in the shortest time possible and with the minor's costs. The main orientation of Supply Chain Management is end-customer satisfaction and cost reduction throughout the supply chain.

There are several examples of cooperation between companies: promoting improvements in customer processes, sharing best practice information, integrated product development, burden sharing, and more. A basic way of cooperation and to ensure the improvement of performance in costs and quality is the application of the philosophy of Quality in Origin.

According Alves and Alves (2015) the origin of the quality is: ensure that the parts I receive in my operation and the parts I send to my client are free of defects. The Origin Quality system is defined by the slogan "I do not receive, I do not produce and I do not defect". Quality at source has six principles applicable to the Supply Chain:

- The objectives and goals are shared by all members of the chain;
- Quality is the result of commitment to the objectives and goals, responsibility and high performance of the organizations that make up the chain;
- Work methods and processes are continually improved;
- Work methods and processes are designed to satisfy customers and achieve the goals and objectives of the organization and, consequently, the chain;
- Effective communication (efficient and effective), from the raw material supply to the final customer, leads to agility and quality in decision making;
- The added value increases with the elimination of waste.

III. IMPROVING SUPPLY CHAIN RELATIONSHIP

In an illustrative way, Toledo et. al. (2004) presents indications of possible coordinated strategies or actions to improve the relationship with partners, and their respective results, along the supply chain:

- Relationship Strategies in the Supply Chain - Sense Amount:
 - Partnership relationships between the industry and its suppliers, to guarantee quality in the chain;
 - Incentives and actions provided by the industry to improve the quality of products received from suppliers such as: investments in training, technical assistance, joint improvement actions, payment for quality, financing of production resources, etc .;
 - Involvement of the supplier in the process of developing new products;
 - Shared adoption of systematic quality management to ensure consistency in standardization of products;
 - Joint quality assessment (quality audits performed at the supplier);
 - Joint elaboration of improvement action plans;
 - Follow-up of the improvements implemented; and
 - Measurement and analysis of performance indicators in quality (reduction of costs of failures and waste, improvement in product quality and customer satisfaction, etc.).
- Relationship Strategies in the Supply Chain - Downstream
 - Actions of requirements and guidelines for the preservation of the quality of the final product, such as training, in order to ensure the proper handling, storage, transportation and exposure of the final product;
 - Incentives provided by the industry to the distributor in terms of price discounts, better payment terms, preferential treatment, etc., due to the preservation of product quality;
 - Obtaining feedback from customers regarding the quality of the product and the services offered;
 - Awards for services provided by the distributor;
 - Survey and formulation of specific customer needs;
 - Customer involvement in the new product development process;
 - Shared adoption of quality management practices to ensure consistency in product standardization;

- Joint quality assessment (audits performed at distributors and retailers);
- Joint elaboration of improvement action plans;
- Follow-up of the improvements made; and
- Measuring improvements through performance indicators (on quality preservation, losses, customer satisfaction, etc.).

It is important to note that actions must be carried out based on the analysis of stakeholder needs and expectations. The actions cited here are by way of example only.

According to Pires (2009), in recent years one of the most notable trends in supply chain management is the process of restructuring and consolidating the supplier and customer base. The main objective of this movement is to define a set of companies (both suppliers and customers) with which one really wants to build a true partnership. In this restructuring, a fundamental point is the identification and the alignment of competences such that the result can give a positive distinction to the competition and final consumers. With respect to the supplier base, the restructuring process is practically reduced to the reduction of the number of suppliers with whom the company intends to continue working and maintaining a direct and agile channel of communication. Regarding the customer base, the idea of restructuring tends to be more complicated in most companies, because it brings with it the idea of losing something. But it is important for the company to be clear about the return provided by each of its clients, to be aware of the limitations of resources to be able to serve them satisfactorily and to have the perception that, often, it is necessary to define priorities in the service.

Pires (2009) also defines:

- Customer Relationship Management: it is the process that provides the structure for the development and maintenance of the relationship with customers. The key clients and client groups for which goals are set are usually identified. Also, teams focused on these clients worked to improve processes, eliminate variation in demand and activities that do not add value to customers. At the same time, reports are designed to measure the return that each key customer provides.
- Supplier Relationship Management: it is the process that defines how the company interacts with its suppliers and can be considered as a "mirror image" of customer relationship management. Thus, the company must develop

partnerships with key suppliers in order to support business processes such as manufacturing flow management and product development and marketing. Generally, suppliers are ranked based on factors such as degree of contribution and importance to the company and long-term partnerships are developed with only a select group of them. The goal is to build win-win relationships and engage key suppliers from the early stages of product design.

About the supply chain, ISO-9001, among several other items, defines:

- The organization must evaluate and select suppliers based on their ability to deliver products (and services) according to the requirements of the organization.
- The organization shall determine and take effective action to communicate with customers regarding: product information, handling of inquiries, contracts or orders, including customer amendments and feedback, including complaints.
- As one of the performance measures of the management system, the organization should monitor information regarding the client's perception of whether the organization has met the requirements of the client.

These initiatives and practices form the basis for building business-to-business cooperation, improving relationships and reducing costs. The end customer earns both by receiving a product of better quality as well as in cost issues.

IV. CASE STUDY ON SUPPLIER RELATIONSHIP MANAGEMENT: IMPROVING RELATIONSHIP AND SUPPLY CHAIN PERFORMANCE

Handfield et. al. (2000) states that developing a supplier is any activity that a customer company performs in order to improve supplier performance and / or capacity in the short or long term.

Pires (2009) points out that as manufacturing companies increasingly pass on components and services and reinforce their focus on achieving their core competencies, they increasingly expect their suppliers to perform properly. This usually means delivering quality components or services delivered on time, with innovative features and competitive pricing. When this does not happen, the client company has at least three alternatives: to go on to produce the component or perform the service internally, switch to a more capable supplier, or help the current supplier to improve its capacity.

Handfield (2000) apud Pires (2009) defines a 5-step procedure for supplier development:

- Identify the most critical items, or the most strategic items for the companies, which are generally high value-added items, purchased in large volumes and difficult to replace.
- Identify critical suppliers, which consisted in evaluating the performance of vendors of items classified as critical.
- Building a team, aligning objectives and defining key projects, consists of arranging the house and setting up a multifunctional work team before beginning work with suppliers. The objectives of the client company and the rules of the conduct of development must also be clearly defined. Once this is done, the next step is to contact, discuss and strategically align the objectives with the supplier, defining the key development projects to be conducted.
- Define agreement details, that is, both companies need to define the specific metrics to monitor their process. The agreement should also specify the dates of the important events and the final deadlines of the improvement process, as well as the role to be played by each company in the process.
- Monitor development and modify strategies, that is, continuously monitor supplier development and adjust the initial plan whenever necessary.

A large Brazilian company with assets in several sectors of the economy, including the steelmaker, has implemented a program to reward the cooperation of its key suppliers. The assumptions and evaluation methodology for the awards are as follows:

- The suppliers eligible to participate in the awards are those with a turnover above R \$ 1 Million / year.
- Evaluation of the physical growth of turnover among the group companies (client companies).
- Evaluation of the improvements in the productive processes of the company-client, through innovative measures that the supplier has suggested.
- The supplier must present the results of the cost reduction projects to the client company, that is, the supplier develops projects in the company that will impact on the cost reduction in the client's operation.
- Evaluation of compliance with contracts or purchase orders.
- Evaluation of punctuality in delivery.
- A questionnaire for self-assessment is sent to suppliers, with questions related to quality

management, environmental management, occupational health and safety management, issues related to product quality, logistics and internal improvements in the process.

All suppliers that meet billings above R \$ 1 million / year are invited to participate in the pre-selection for the award, however, suppliers must apply and prepare the evidence together with the client company. This is not just an evaluation of the client company towards the suppliers. It is a joint assessment by the parties. After the evaluation period, the suppliers are invited to an awards event and in this event, the suppliers that have contributed to the success of the client company are then announced and awarded.

After the implementation of this award, the following benefits were noted:

- Reduction in the Base of Suppliers (main inputs and services): from 748 to 362.
- Improvement in Delivery Performance: from 77% to 92%.
- Reduction in the Cost of Productive Processes: More than R \$ 7,000,000.00.

With this case, important points, previously discussed, are observed, such as:

- To participate in the premium, it is necessary to have a high turnover and to increase the volume of business with the client company, this refers to the discussions about the consolidation of the supplier base.
- Improvements in the client's process lead us to identify the needs and expectations of the stakeholders. Without identifying these needs and expectations it is not possible to suggest or implement such improvements.
- The cost reduction projects to be implemented by the supplier in the client company is an example of cooperation between supplier and customer.
- The evaluation of contract compliance, punctual delivery and the self-assessment questionnaire are examples of the application of the philosophy of quality at source.

V. CONCLUSION

During this research, the importance of improving the relationship between customers and suppliers was verified as a starting point for the improvement of the companies' performance. The improvement in this relationship allows generating benefits, translated into results for companies. Issues such as identifying the real needs and expectations of stakeholders, the philosophy of quality at source, consolidation of the customer base and suppliers and cooperation between companies are key points for

improving the performance of companies at all links in the chain of supplies.

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Numerical and experimental study of an air-soil heat exchanger for cooling habitat in Sahelian zone: case of Ouagadougou

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Abstract— *The use of air-soil heat exchangers for the cooling home has developed considerably in recent years. In this work, we have led the numerical study of an air-soil heat exchanger by using a nodal approach. We have also presented our experimental prototype implemented in Ouagadougou. This study has allowed determining the evolution of air temperature along the exchanger and also validating our numerical results with those of the literature and the experiment.*

Keywords— *Air-soil heat exchanger, Numerical study, Nodal approach, Experimental prototype.*

I. INTRODUCTION

An air-soil heat exchanger is a geothermal system that uses the thermal inertia of the soil to heat or cool some of the air renewing a habitat. The principle of the system consists to inject into a habitat a flow of air coming from the outside that is forced beforehand to circulate in a pipe buried at a depth in the soil [1].

Air-soil heat exchangers have been the subject of numerous numerical and experimental works. Numerical works are based on different models. Among them are the diffuse model and the model which assumes given the temperature of the soil. Among the various works explicitly dealing with conduction in the soil, a good part only allows the study on a single tube of the system. These are the cases of [2, 3] and [4, 5]. Whereas in the first case [2], the conduction equation is resolved numerically in soil cut into horizontal slices at uniform temperatures. At the surface of the soil, the radiations and convections are retained and the lower part assumed to be adiabatic. The two other works [3, 4] assume cylindrical soil layers as well as horizontal segmentation along the tube (iterative calculation, air temperature at output of a segment serving as input to the next segment). In the first case [3] an adiabatic condition is assumed to be applied at a large radial distance from the tube (thus not taking into account the mutual influence of parallel tubes) and the coupling with the free surface is done in a not very

explicit way via the analytical solution of seasonal diffusion in undisturbed soil.

In the second case [4], the concentric cylinders are subdivided into three portions (adjustable proportions), each subject (at adjustable distance) provided at the adiabatic or isothermal edge. There are also works that are interested in studying the thermal performance of this system. To this end, the research work carried out by [6] is devoted to the performance of an air-soil heat exchanger. The study is carried out with the aim of a dimensioning of this system, necessary to optimize its performances which are analyzed throughout the year distinguishing the winter and summer seasons. In 2016, [7] also conducted an experimental study of the thermal performance of an air-soil heat exchanger used to improve the efficiency of heating, ventilation and air conditioning in a building. The soil temperature is considered constant and the soil is used as a cold source or as a hot source for cooling or heating the building. Thermal efficiency is assumed to be a function of the number of transfer units. They have mainly studied the influence of speed on changes in the temperature of the air at the outlet of the exchanger and the thermal efficiency of the system. [8], is one of the main references for the thermal efficiency of air-soil exchangers. The author sets out simple rules for the dimensioning of air-soil exchangers. One of the references also in the field of air-soil exchangers is the work of [9]. The author has produced a very advanced mathematical model which gives the temperature of the soil at any moment and at any depth, taking into account the thermal behavior of the soil. In Burkina Faso, [10] carried out an experimental study of the evolution of soil temperature in the case of an air-soil exchanger. They showed that at a depth of 1.5 m, the soil temperature was approximately 30.4 °C.

The objective of this work is the numerical and experimental study of an air-soil heat exchanger used for the cooling habitat in the Sahelian zone. Our numerical study is based on a mathematical approach by the nodal

method. We present the results concerning the evolution of the air temperature in the horizontal part of the exchanger and their validations by results of the literature and also of our experimental measurements.

II. MATHEMATICAL MODELING

The system we propose to study is an air-soil heat exchanger consisting with one tube buried in the soil at a given depth. It is described in Fig. 1.

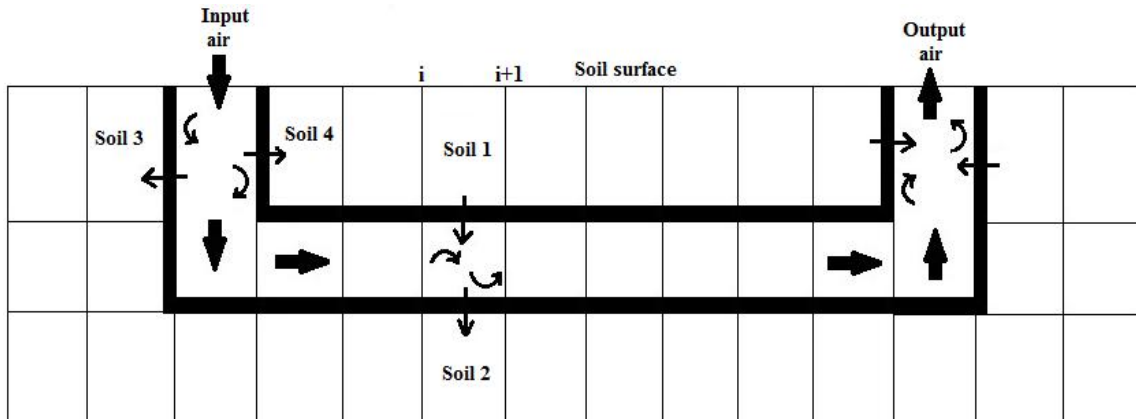


Fig. 1: Diagrams of the model of air-soil heat exchanger

For mathematical modeling, we are interested to the "horizontal part" of the system (Figure 2). We use a one-dimensional model for heat exchanges. For modeling, we use the nodal method. This method consists of a fictitious spatial division of the system into "slices" of thicknesses whose sections are perpendicular to the direction of flow. In each slice, the homogeneous variables are assumed and

the energy balances are written in successive time intervals until exhaustion of the duration of study. The transition from one slice to the next is carried out by retaining the output conditions of the slice (i) as input data of the slice (i + 1).

The following Fig. 2 describes the horizontal part of the air-soil heat exchanger.

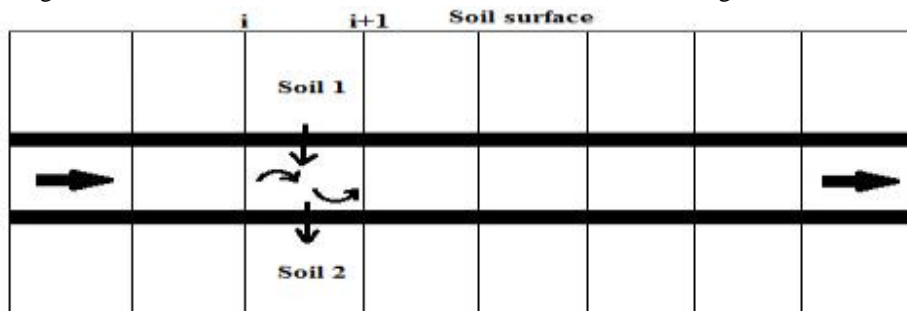


Fig. 2: Diagram of the horizontal part of the system

Generally, the instantaneous variation of the energy rate within an element (i) is equal to the algebraic sum of the

$$e_i \rho_i c_{pi} \frac{dT_i}{dt} = DFSA_i + Q_{mi} + \sum_j \sum_X h_{Xij} (T_j - T_i) \quad (1)$$

$DFSA_i$: Density of solar flux absorbed by (i) ($W m^{-2}$)

Q_{mi} : Mass flow density exchanged in (i) ($W m^{-2}$)

h_{Xij} : Coefficient of heat exchange between (i) and (j) ($W m^{-2} K^{-1}$)

We apply equation (1) to the various media of the vertical input part. The thermo-physical properties of materials are assumed homogeneous and constant.

flux densities exchanged within this element. The basic equation (1) of heat exchanges is [11]:

- In soil surface :

$$e_s \rho_s c_{ps} \frac{dT_{ss}}{dt} = DFSA_{ss} + -h_{cae} (T_{ss} - T_{ae}) - h_{ds} (T_{ss} - T_{sol1}) + -h_{rssvc} (T_{ss} - T_{vc}) \quad (2)$$

- In soil 1 :

$$e_s \rho_s c_{ps} \frac{dT_{sol1}}{dt} = -h_{ds} (T_{sol1} - T_{ss}) + -h_{ds} (T_{sol1} - T_{ptSE}) \quad (3)$$

- At the outer superior wall of the tube :

$$e_{pt} \rho_{pt} c_{ppt} \frac{dT_{ptSE}}{dt} = -h_{ds} (T_{ptSE} - T_{sol1}) - h_{dpt} (T_{ptSE} - T_{ptSI}) \quad (4)$$

- At the inner superior wall of the tube :

$$e_{pt} \rho_{pt} c_{ppt} \frac{dT_{ptSI}}{dt} = -h_{dpt} (T_{ptSI} - T_{ptSE}) - h_{cat} (T_{ptSI} - T_{ath}) \quad (5)$$

- In the air into the tube:

$$\frac{Vol_{at}}{S_{pt}} \rho_a c_{pa} \frac{dT_{ath}}{dt} = -h_{cat} (T_{ath} - T_{ptSI}) - h_{cat} (T_{ath} - T_{ptII}) \quad (6)$$

- At the inner inferior wall of the tube :

$$e_{pt} \rho_{pt} c_{ppt} \frac{dT_{ptII}}{dt} = -h_{cat} (T_{ptII} - T_{ath}) - h_{dpt} (T_{ptII} - T_{ptIE}) \quad (7)$$

- At the outer inferior wall of the tube :

$$e_{pt} \rho_{pt} c_{ppt} \frac{dT_{ptIE}}{dt} = -h_{dpt} (T_{ptIE} - T_{ptII}) - h_{ds} (T_{ptIE} - T_{sol2}) \quad (8)$$

In order to solve the previously obtained equations, we determine the coefficients of transfer by conduction, convection and radiation.

- Radiation between soil surface and the vault of heaven:

$$h_{rsvvc} = \varepsilon_{ss} \sigma (T_{ss}^2 + T_{vc}^2) (T_{ss} + T_{vc}) \quad (9)$$

With : $\sigma = 5,67 \cdot 10^{-8} Wm^{-2} K^{-4}$, constant of Stefan-Boltzmann ; T_{ss} , soil surface temperature ;

$\varepsilon_{ss} = 0,85$, soil emissivity.

The temperature of vault of heaven is given by Swinbank expression [12]:

$$T_{vc} = 0,0552 \times T_{ae}^{1,5} \quad (10)$$

T_{ae} is the ambient air temperature.

- The coefficient of convection between soil surface and ambient air [12]:

$$h_{cae} = 2,8 + 3,3 \times V_{ae} \quad (11)$$

V_{ae} is ambient air velocity.

- Soil conduction coefficient [11] :

$$h_{ds} = \frac{\lambda_s}{e_s} \quad (12)$$

λ_s is thermal conductivity of soil and e_s is the thickness of the soil.

- Tube conduction coefficient [11] :

$$h_{dpt} = \frac{\lambda_{pt}}{D_E \times \frac{e_{pt}}{D_I}} \quad (13)$$

λ_{pt} is the thermal conductivity of the tube ; D_E is the outer diameter of the tube ; D_I is the inner

diameter of the tube ; e_{pt} is the thickness of the tube.

- Coefficient of forced convection of the air in the tube [9]:

$$h_{cat} = \frac{Nu \times \lambda_a}{L} = \frac{(0,023 Re^{0,8} \times Pr^n) \times \lambda_a}{L} \quad (14)$$

$$Re = \frac{V_a \times D_i}{\nu_a} ; \quad Pr = \frac{\mu_a \times C_{pa}}{\lambda_a} ;$$

$$\mu_a = \nu_a \times \rho_a$$

If $T_{ath} > T_{sol}$ (cooling) then $n = 0.3$ or if $T_{ath} < T_{sol}$ (heating) then $n = 0.4$.

The characteristic length L is equal to the inside diameter D_I of the tube; T_{ath} is the temperature

of the air in the vertical tube; T_{sol} is the soil

temperature. Nu is the number of Nusselt; λ_a is the

thermal conductivity of the air; Re is the Reynolds number; Pr is the number of Prandtl; V_a is the velocity

of the air in the tube; μ_a is the dynamic viscosity of the

air ; $\nu_a = 15,6 \cdot 10^{-6} \text{ m}^2 \text{ s}^{-1}$ is the kinematic viscosity of the air; ρ_a is the density of the air.

For numerical simulation, we use an implicit finite difference method [13, 14]. The numerical resolution of the system of equations is done by the Gauss method. The selected space step (ΔX) is 0.1 m. This value allows obtaining an acceptable number of iterations and precision. With the implicit schema of finite differences, we retained a time step of 30 s. At the initial instant, we assume the 6 unknown temperatures

($T_{ss}, T_{solI}, T_{ptSE}, T_{ptSI}, T_{ptII}, T_{ptIE}$) equal to the soil temperature and the unknown temperature T_{ath} equal to the ambient air temperature. The temperature of the air at the inlet of the exchanger is equal to that of the ambient air. The calculation code used for the simulation is Fortran.

Table 1 shows the thermo-physical properties of the materials of the system.

Table.1: Thermo-physical properties of the constituent materials of the system [1]

System materials	Density (kg m ⁻³)	Thermal conductivity (W m ⁻¹ K ⁻¹)	Thermal capacity (J kg ⁻¹ K ⁻¹)
Soil	1700	1	912
Tube	1380	0.15	900
Air	1.16	0.026	1006

Table 2 shows the values of the parameters used for the simulation.

Table.2: Values of the parameters used for the simulation

Physical parameter	Values
Tube length	15 ; 50 m
Tube diameter	0.1 ; 0.35 m
Air velocity	2 ; 5 m/s
Soil temperature	297 ; 304 K
Input air temperature	313 ; 317 K

III. EXPERIMENTAL DEVICE

This device is an air-soil heat exchanger consisting with one PVC tube of 15 m of length, of 16 cm of diameter (5

mm thickness) and buried in the soil at 1.5 m of depth in a moist clay soil. Some parts of the system are described in following Fig. 3.



Fig. 3: Description of some parts of the system

This prototype is carried out within the platform of the Laboratory of Physics of the University Ouaga I Pr Joseph KI-ZERBO. The interchange is connected to a habitat of 32.82 m³ of volume.

The sheath which connects the exchanger to the habitat is insulated with glass wool to limit thermal losses. We opted for the PVC tube taking into account several

considerations that are cost, tightness, rigidity and durability. [2, 15] have shown that the nature of the tube has very little influence on the thermal performance of an air-soil heat exchanger. Our experimental work consists in measuring, on the one hand, the temperature of the air from the input of the exchanger to the output at steps of length 2 m and on the other hand the temperature of the

soil at 1.5 m deep. These measurements are performed using K-type thermocouples connected to two programmable temperature recorders (MIDI LOGGER GL 220). The accuracy of these devices is 1% for temperatures between 20 °C and 50 °C. We conducted measurements during the months of June, July and August 2016 to study the thermal behavior of the system.

IV. RESULTS

4.1. Experimental results

Figs. 4, 5 and 6 present evolution of air temperature along the horizontal part of the tube respectively in June, July and August 2016.

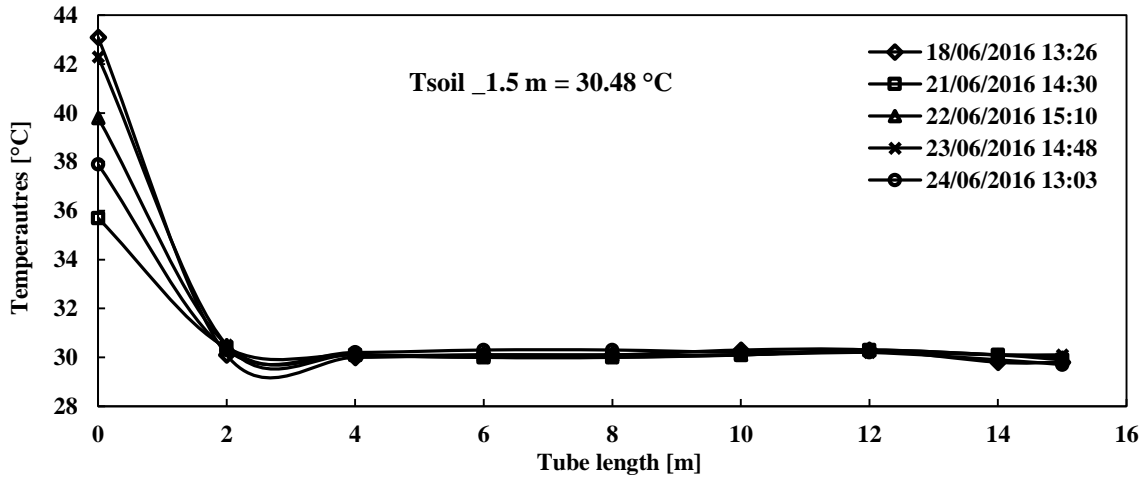


Fig. 4: Evolution of air temperature in the horizontal part in June 2016

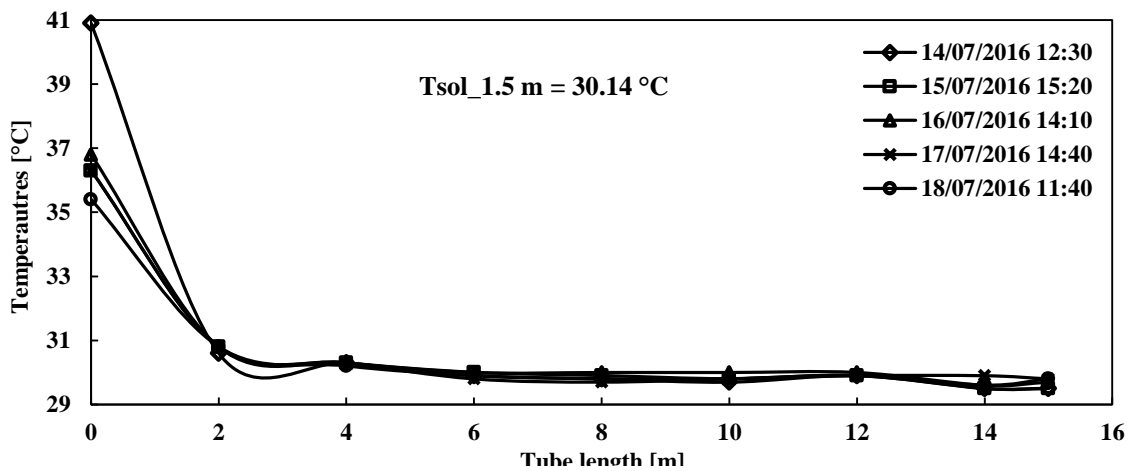


Fig. 5: Evolution of air temperature in the horizontal part in July 2016

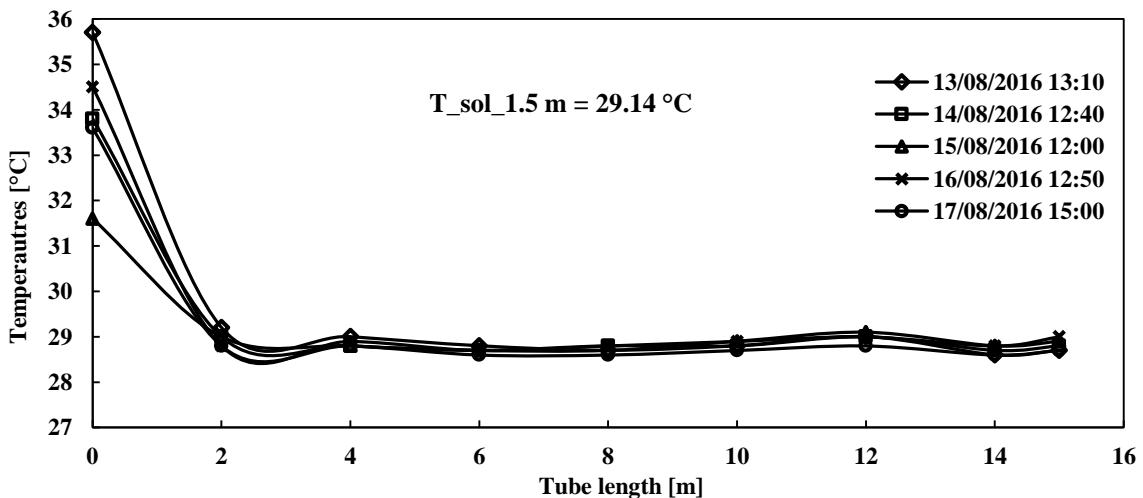


Fig. 6: Evolution of air temperature in the horizontal part in August 2016

In the previous Figs. 4, 5 and 6, we observe that, whatever the month in question, the temperature of the air decreases along the tube. There is therefore a cooling of the air along the exchanger. In general, the air temperature stabilizes above 4 m to 6 m length of the tube. For this purpose, according to [9], beyond a certain length, the lengthening of the tube does not improve the heat exchange. Similarly, work by [16], showed that the drop in air temperature is abrupt in the first 10 meters and subsequently moderates. For the month of June (Fig. 4), we note a significant decrease in temperature between 6 °C and 13 °C. On June 18th at 13:26 pm, the input temperature is 43.1 °C while at the output it is 29.8 °C. For the month of July (Fig. 5), the drop is between 6 °C and 12 °C. On July 14th at 12:30 pm, we note at the input 40.9 °C and output 29.5 °C. As for August (Fig. 6), the drop is between 4 °C and 8 °C. On August 13th at 1:10

pm, we note at the input 35.7 °C and the output 28.7 °C. Temperatures are relatively low during the month of August as it is a particularly rainy month in Burkina Faso. We note that the soil temperature is lower in August (mean value of 29.14 °C) than in June (average value of 30.48 °C) and July (mean value of 30.14 °C). Our values are in agreement with the results of [10], which showed that in Burkina Faso at 1.5 m depth in soil the temperature is about 30.4 °C. Our results justify the important role played by the soil in the functioning of the system. The soil dampens considerably the temperature of the air along the exchanger and that whatever the temperature of the air at the input or even the period.

4.2. Numerical results

Fig. 7 describes evolution of air temperature along the horizontal part of system for different values of input air temperature.

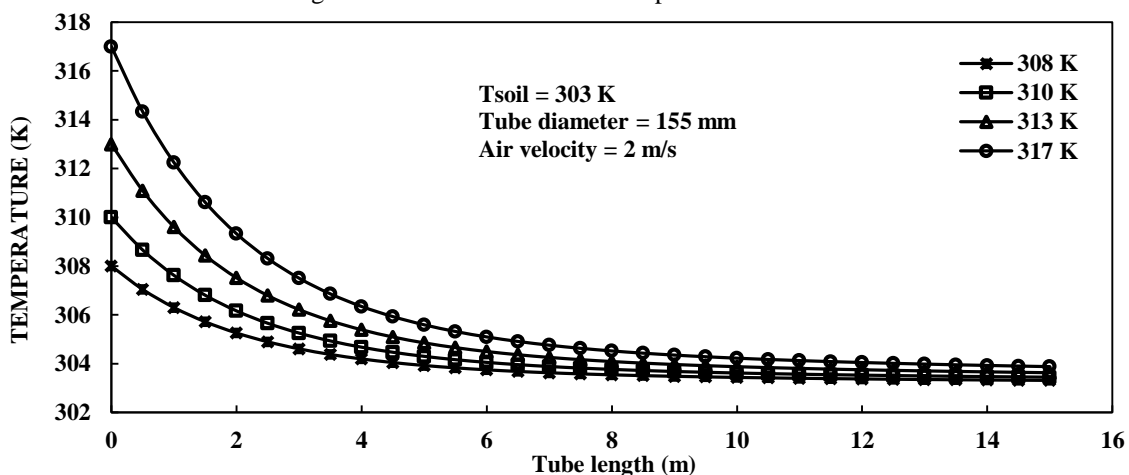


Fig. 7: Evolution of air temperature in the horizontal part for different values of input air temperature

In Fig. 7, we note that whatever the input temperature there is a cooling of the air along the tube. For an input temperature of 317 K, the temperature of the output air is 303.88 K (decrease of 13.12 K). For an input temperature of 317 K, the drop is 13.12 K and for an input temperature of 308 K, the decrease is 4.69 K. Indeed, the temperature of the soil being set at 303 K, when the temperature gradient between the soil and the input air is higher, the heat exchange is greater.

To test the reliability of our model, we validate our simulation results with those of models published in the

literature and also with our experimental work. For the evaluation of errors, we use the RMSE (Root Mean Square Error) statistical correlation.

$$RMSE = \sqrt{\frac{1}{N} \sum_{i=1}^N (X_{exp,i}^* - X_{pre,i}^*)^2}$$

(15)

4.3. Validation with numerical model of [16]

Fig. 8 describes evolution of air temperature along the exchanger in our model and the one of [16].

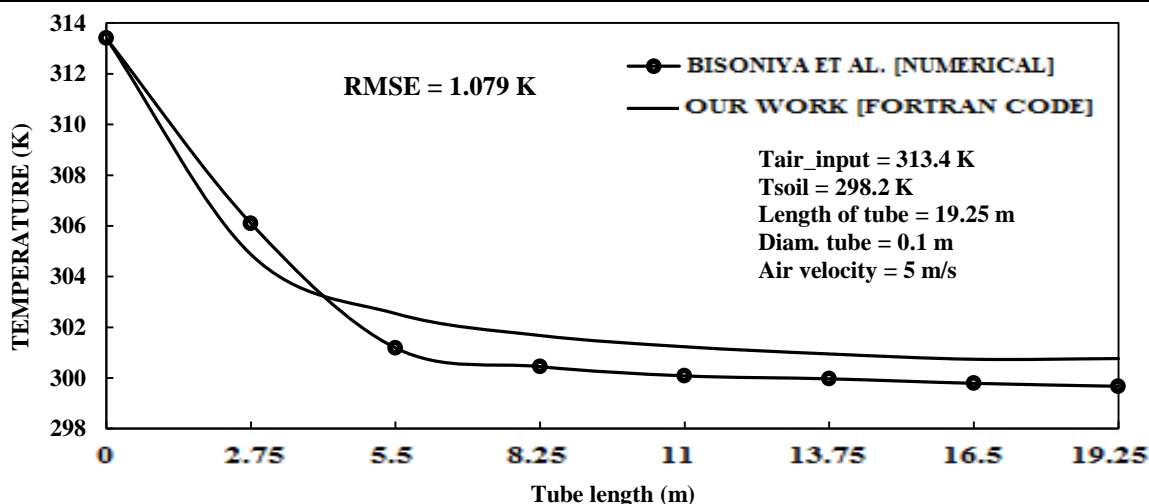


Fig. 8: Validation of our results with the one of [16]

The air-soil heat exchanger model developed by [16] is a 3D numerical model that uses the CFD (Computational Fluid Dynamics) method. It consists of a single tube buried in the soil. Based on the value of the calculated

error, we note an acceptable agreement between our numerical results and those of [16].

4.4. Validation with numerical model of [17]

Fig. 9 describes evolution of air temperature along the exchanger in our model and the one of [17].

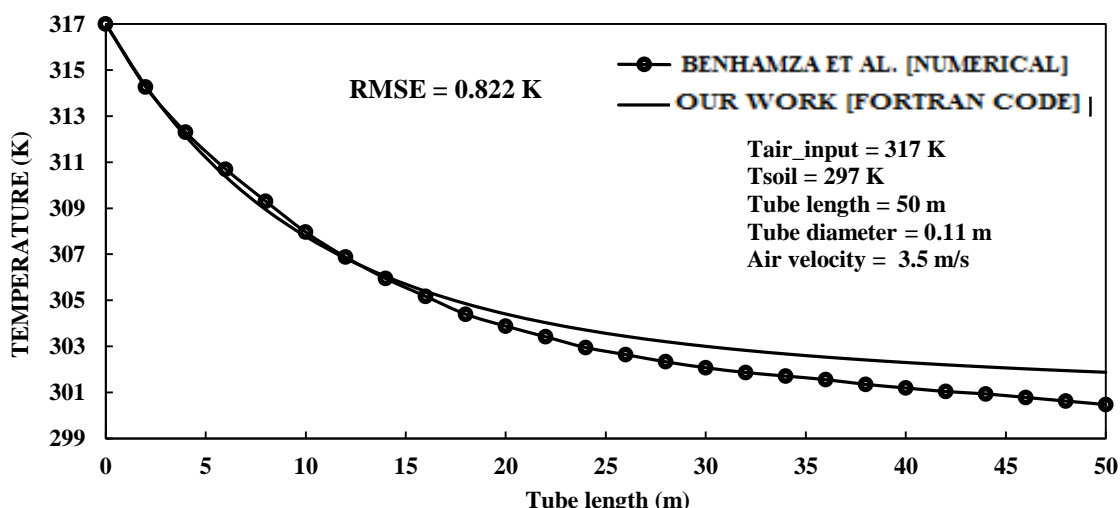


Fig. 9: Validation of our results with the one of [17]

The model of [17] is a numerical model based also on the CFD method. This model consists of one tube buried in the soil. In Fig. 9, there is good agreement between our numerical results and those of [17].

5.5. Validation with our experimental results

Figs. 10 and 11 present evolution of air temperature along of horizontal part of air-soil heat exchanger in the case of our numerical model and our experimental results of June and August 2016.

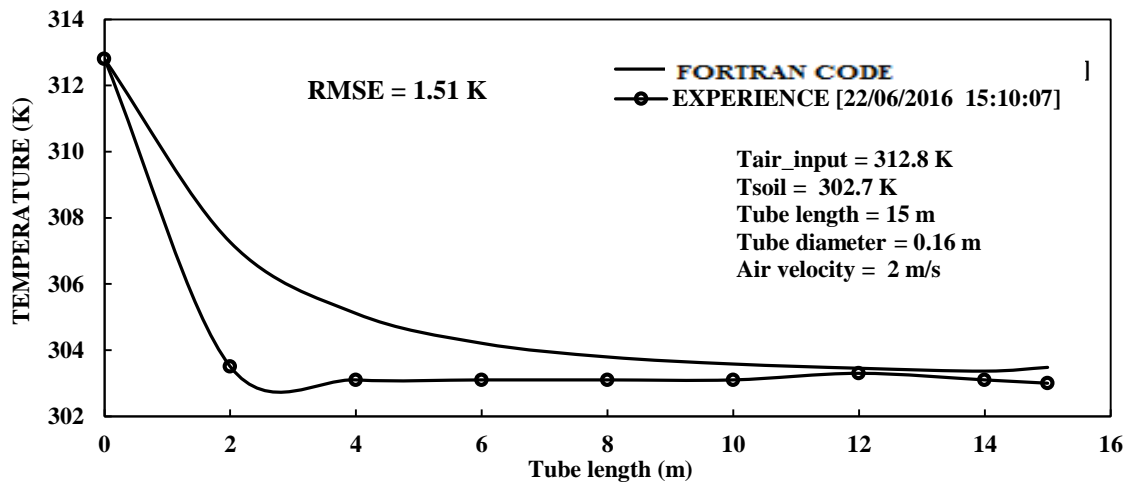


Fig. 10: Validation of our numerical results with our experimental results of juin 2016

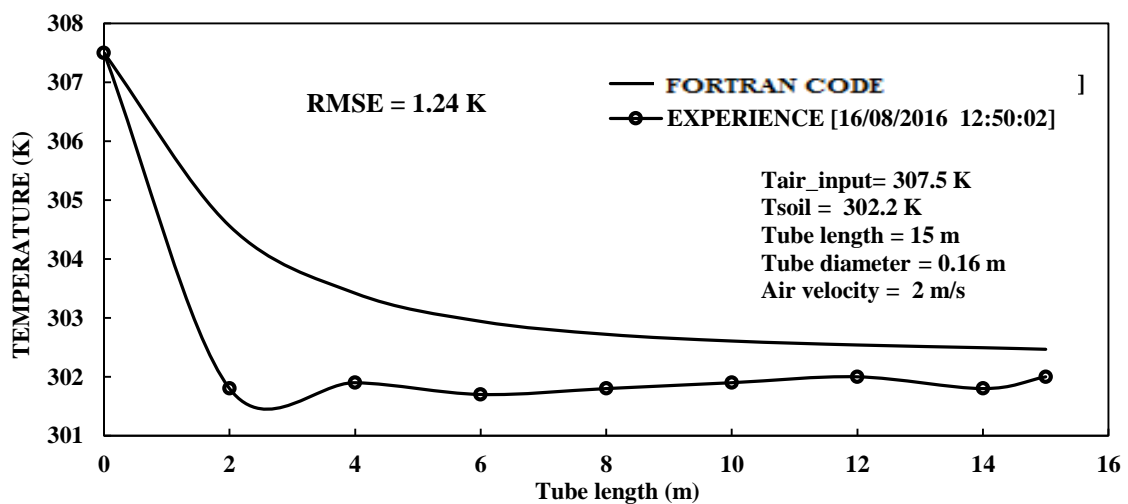


Fig. 11: Validation of our numerical results with our experimental results of August 2016

In Figs. 10 and 11, we observe that the air temperature evolution curves have the same profile, but they include deviations at certain levels. In the case of the experiment, the air temperature stabilizes above 4 to 6 m of length. On the other hand, at the level of the numerical model, the stabilization takes place starting at about 8 m. In addition, the cooling of the air is more important at the level of the experiment than in the simulation. This is partly due to the presence of a source of water in the soil of the experimental site. Indeed, during the implementation of our system, we encountered moisture at 1.5 m depth in the soil. This water contributes favorably to the cooling of the air along the exchanger, whatever the input temperature or even the period. According to [9], water has higher thermal capacity and conductivity than other soil constituents. Thus, moist soil stores heat better than dry soil and transmits it more easily to the air in the exchanger ducts. For simplification reasons, we did not integrate this parameter (presence of a source) in our numerical model. This justifies the temperature differences observed between the curves. However, given

the margins of error, we can say that our numerical results clearly reflect the physical phenomenon studied.

V. CONCLUSION

In this paper, we have shown that a nodal approach is efficient for the study of air-soil heat exchangers. This method leads to acceptable results from the literature and from the experimental measurements.

This study allowed us to show that in the Sahelian zone, with an exchanger about 15 m long and buried at a depth of 1.5 m in the soil, we can cool the air during hot periods. The experimental exchanger makes it possible to stabilize the air temperature above 4 m to 6 m of length in the tube, regardless of the input temperature and for all periods. Decreases in air temperature along the system can reach 13 °C in June, 12 °C in July and 8 °C in August. These experimental results show that the cooling of the air is all the more important as the period is warmer. Given the margins of error between our numerical results and those of the literature, we are convinced that our numerical work can serve as reliable

support for future study or possible improvement of the design of our experimental setup.

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Risk Attitude and Risk Controllability: Their Implications on the Subjective Quantification of Risk in International Construction Projects

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Abstract— *The Probability-Impact (P-I) risk matrix is one of the frequently used techniques among the qualitative risk assessment methods in construction projects, which usually utilizes a 1 to 5 rating scale in order to quantify risk. Decision-makers usually apply their personal judgement, experience, and intuition for the quantification of the intensity of a probable risk event in the first stages of analyzing risks. However, the fluctuation observed by many researchers in the risk rating scales that differs from one individual to another is a substantial drawback of the qualitative risk assessment process where some driven factors may have influence the ratings. Hence, in this research the effects of two factors such as decision-makers' attitudes towards a potential risk event and their assumptions about its controllability during the qualitative risk assessment process in international construction projects are studied through a questionnaire survey. In this survey, 74 professionals and 7 academics from the Turkish construction industry have participated. Two hypotheses are tested for their validity, confirming that risk attitude and assumption about risk controllability are the two critical factors that may have influence on the the risk ratings of the individual decision-makers.*

Keywords— *Decision-Making under risk and uncertainty, Qualitative risk assessment, Risk analysis, Risk attitude, Risk controllability.*

I. INTRODUCTION

Risk management in construction projects is not a strange process anymore. Still, construction companies are subjected to major losses as a result of insufficient risk management [1]. In this process, risk assessment is one of the critical steps, which should be undertaken carefully in order to manage uncertain situations [2]. However, it is impossible to eliminate a risk, but should be mitigated and managed [3]. Therefore, different techniques and methods are introduced in literature in the last few decades for the assessment of risk that fall into a qualitative, quantitative or even semi-quantitative method as per Ebrahimnejad et al. [4]. However, qualitative risk

assessment is still dominant in construction projects in comparison to the quantitative one [5; 6; 7; 8; 9; 10; 11; 12; and 1]. Moreover, Mead [13] found out that during the risk assessment process of construction projects, qualitative approaches are generally used. Also, complicated risk assessment techniques are not being used in practice frequently due to two reasons such as lack of knowledge about the situation where a specific technique could be utilized, and limitations of the existing resources like risk assessment experts, time, money, and the necessary technology [15]. The reason for its dominance is the application of intuition, professional judgment, and personal experience of decision-makers [10; 12; 6; 9; 1; and 12]. Further, Li et al. [1] argue that risk assessment in construction projects is usually carried out using subjective manner due to the unique nature of construction projects and data deficiency. Among the qualitative risk assessment methods, the Probability-Impact (P-I) risk matrix is largely used in the construction industry due to its ease [12].

Being simple and handy, there are still problems and complications with the utilization of the qualitative risk assessment to be addressed, especially with the widely used risk tool often called as a Probability-Impact (P-I) risk model or matrix. Indeed, Cox [16] also believe the weaknesses and techno-mathematical problems that exist in the risk matrices. The critical point in this method is when decision-makers assign ratings to risk factors. Cox [16] further suggests the urgency for investigations to be conducted in order to consider the utilization of risk matrices under different situations to see where they can be helpful and where harmful. Some researchers have examined the factors that might affect the risk ratings in risk assessment such as Dikmen and Birgonul [17]; Dikmen et al. [18]; Aven et al. [3]; and Keizer et al. [19]. These authors have used the words such as 'controllability', 'manageability', or 'influence' being the factors that may affect the risk ratings. Moreover, 'risk attitude' is another factor that may affect the risk ratings according to Dikmen et al. [20]; Akintoye and MacLeod [6]; Cox [16]; and Ball and Watt [21]. Thus, the gap that

exist in order to investigate the effects of both ‘risk attitude’ and ‘risk controllability’ of decision-makers together on risk rating scale is filled here in this study.

This research investigates a particular matter that why risk rating scales have inconsistencies from one decision-maker to another, and to observe the effects of the two latent factors named as ‘risk attitude’ and ‘risk controllability’ on decision-makers’ judgment while assigning the ratings. Two hypotheses are tested for their validity throughout a questionnaire survey, where 81 individuals from the Turkish construction industry (most of them involved in international construction) have participated in the survey. The response to the survey comprised of 51 contractors, 12 consultants, 7 clients, 7 graduate students from the construction engineering and management field, and 4 from the other fields of the construction industry that represented a 40% of response rate of the questionnaire. Based on the experience of the participants in the construction field, 23 of them had more than 15 years of experience, 13 had experience between 11 and 15 years, 28 of them between 5 and 10 years, and 17 had less than 5 years of experience. Moreover, 12 of the respondents had high level experience in the risk management field, 38 of them had medium, and 31 of them had a low level risk management experience.

II. QUALITATIVE AND SEMI-QUANTITATIVE RISK ASSESSMENT

While conducting risk assessment, the risk intensity is derived from probability of occurrence of a risk event multiplied by its severity [22; 23; 16; 24; 25; 26; and 27]. Since the qualitative risk assessment represents linguistic terms, we need probability and impact be indicated in a numerical term in order that a risk level can be calculated. Zhi [22] has defined a numerical term between 0 and 1 that could be used for both the probability of occurrence of a risky event and its impact on the project objectives. Tah and Carr [28] have used a Fuzzy Associative Memories (FAMs) applying subjectivity for calculation of the risk magnitude (Risk Likelihood multiplied by Risk Severity) using linguistic terms such as very low, low, medium, high, and very high representing a 1 to 5 scaling. Hastak and Shaked [29] utilized the Analytical Hierarchy Process (AHP) for international construction project risk assessment with adoption of the Probability-Impact risk matrix. The risks were subjectively assessed using a predetermined scale of 0-100, where 0 meant no risk and 100 meant maximum risk. However, the risk Probability-Impact (P-I) matrices that represent 1-5 risk rating system or linguistic terms such as very low, low, medium, high, and very high are adopted or discussed by some researchers such as Cox [16]; El-Sayegh [30]; Abdelgawad and Fayek [31]; Baccarini and Archer [32];

Chapman [33]; and Hanna et al. [34] in construction industry and in the risk analysis field, which generally uses subjective judgment of experts. In the existing literature, there are some other qualitative risk assessment methods, which rely on the intuition, experience, and subjective judgment of the experts. Some of the techniques used for qualitative and semi-quantitative risk assessment in the literature are briefly summarized in Table 1.

In one of the studies carried out by Taroun [12], which is almost a complete literature review on the construction risk modeling and assessment, it demonstrates that the Probability-Impact (P-I) risk model is a popular method by which risk is usually assessed through assessment of probability of occurrence and its impact. That is why, most of the times subjective data and expert judgments are used for risk analysis in construction projects due to the lack of available data and limitations on the practical usage of formal risk analysis process. Risk analysis and management depend centrally on experience, judgment, and intuition in the construction [6; 7; 12; 10; 5; 8; and 9]. Likewise, Dikmen et al. [14] explored that experience, and personal judgment are the two main tools in qualitative risk assessment process. Among the researchers mentioned above, Akintoye and MacLeod [6] in the UK, Shen [4] in China, Wood and Ellis [9] in the UK, Raz and Michael [7] in Israel, and Lyons and Skitmore [10] in the Queensland; they all found that complex tools were not being used extensively for the risk assessment process as most of the risk assessment tools were based on expert judgment, intuition, and experience of the practitioners that has a similarity with the Cox’s [16] argument, which emphasizes on the importance of risk attitude and subjective judgment while rating risks during the risk assessment process.

The P-I risk rating model is usually developed by decision-makers’ subjective judgment where ratings are assigned to the probability of a risk event occurrence and its impact on the project objectives. Usually, a Likert scale (1 – 5) is used for P-I risk table development in the literature. Due to the heavy reliance of this technique on the subjective judgment of individuals, it is important to know that what factors may affect their judgment when assigning ratings to risks. Focusing on risk attitude as an influential factor on the ratings, Dikmen et al. [20] admit the role of risk attitude as one of the important factors on the risk ratings and quantification. Akintoye and MacLeod [6] assert that individual attitude, belief, feeling, and judgment have influence on risk perception in general. Moreover, Ruan et al. [35] report the defect that decision-makers’ risk attitudes are not being taken into account while preparing risk matrices, which represent the importance of risk attitude in decision-making

process. Besides, Kim and Reinschmidt [36] studied the effects of contractors' risk attitude on competition in construction where they found risk attitude as one of the critical and influential elements.

Dikmen and Birgonul [17] described 'controllability' as a latent factor, which is not being used in the formulas of the risk quantification. Later, Dikmen et al. [18] pointed out the same issue and stated that in general, decision-makers count an implied factor while assigning the risk ratings called 'controllability', which is not considered in the formulas for risk quantification, but its effect is generally taken into account under impact and probability ratings. They believe that if a firm is able to reasonably control a risk factor, then a lower risk rating might be assigned, which means that the experience of a company will have a considerable influence that can mitigate the

level of risk in the projects. Keizera et al. [19] also described the project risk character not to be determined by its likelihood and effect only, but by a firm's ability to influence the risk factors as well. Aven et al. [3] raised some issues related to the risk 'manageability' concept but different from that of Dikmen et al. [18], where they expressed that some risks are more manageable than others, which means that the possibility of effects reduction for some risks may be larger in comparison to the other risks. They also argued that a higher risk with a higher manageability would provide a considerable opportunity than the risk with a medium level and low manageability, but no specific methodology was provided to show the importance of manageability in the risk assessment process while assigning the risk ratings.

Table 1. List of Tools/Methods used for Qualitative and Semi-Quantitative Risk Assessment based on the Subjective Judgment After Year 2000

Tool/Method Name	Author(s)	Publication Year	Brief Explanation
AHP	Hastak and Shaked	2000	In the ICRAM-1 model, the hierarchy of risk indicators is systematically evaluated through matrix calculations for preference order determination of a decision maker from the various existing criteria.
FST	Tah and Carr	2001	HRBS model is used. For risk assessment, the likelihood, severity and timing values are determined using qualitative measures such as low, medium and high.
PI Grid	Chapman	2001	Probability-Impact matrix scoring using subjective judgment is involved in this method.
PRR	Baccarini and Archer	2001	Project Risk Rating, where the likelihood and consequence of risks that affect the project cost, quality, and time are rated qualitatively using a matrix.
P-I Matrix, Subjective Judgment	Wood and Ellis	2003	Subjective judgment in RM practice based on experience.
Judgment, Intuition, and Experience	Lyons and Skitmore	2004	Survey results of individuals' perceived risk tolerances involved in senior management in the Queensland engineering construction industry, which shows frequent use of qualitative risk assessment.
P-I & Questionnaire	Fang et al.	2004	In this method, a questionnaire is used to collect the data from respondents who are qualitatively assigning the risk ratings based on risk occurrence probability and influence.
AHP	Dikmen and Birgonul	2006	AHP as a MCDM technique is used for risk and opportunity assessment in the international projects as well their rankings.
FST & Influence Diagramming	Dikmen et al.	2007	This is an influence diagramming method combined with fuzzy risk assessment approach to estimate cost overrun using risk ratings.
FST & AHP	Zeng et al.	2007	This model can handle the expert judgment; also, risks can be evaluated directly using linguistic terms.
P-I Matrix & Questionnaire	El-Sayegh	2008	Based on the survey results, the relative importance index (RII) is calculated based on probability-impact rating for each risk in this method.
P-I and use of MS Access as a Database	Dikmen et al.	2008	This is a post-project risk assessment tool where the risk assessment step is done using probability-impact risk rating with expert judgment.
AHP & Questionnaire	Zayed et al.	2008	A risk index (R) model is proposed in order to assess the effect of sources of risk and uncertainty on a construction project. The weight of risks is calculated with the use of AHP. Also, questionnaires are used to collect the data from experts who have used subjective judgment for the weights of risks.
Fuzzy FMEA & Fuzzy AHP	Abdelgawad and Fayek	2010	This method is applied in a case study using probability, impact, detection/control, and the level of criticality of risk event with the help of linguistic term usage.
Risk Rating	Hanna et al.	2013	In this method, the relative impact (RI), likelihood of risk realization (LORR), risk rating, and the input of recommendations and notification of a 1-5 scale is involved with the application of subjective judgment.

III. RISK ATTITUDE

Hillson and Murray-Webster [37] define risk attitude as “a chosen state of mind with regard to those uncertainties that could have a positive or negative effect on objectives.” They also insist that attitude only exist in relation to a datum point, which shows that attitude of same individuals changes with the change of circumstances in which they make a decision. Also, it depends on the decision maker’s attitude whether to take risk or not. The ISO Guide [38] in their risk management vocabulary defines risk attitude of an organization as “organization’s approach to assess and eventually pursue, retain, take or turn away from risk.”. Risk attitude can be measured and assessed by expected utility function or via psychometric approaches such as questionnaires and scales [39 and 40]. In the expected utility framework, choices over lotteries are used to represent the attitudes to risk, shown by a probability distribution, and the utility curvature function will imitate these attitudes. On the other hand, psychological approaches ask the people directly about their willingness and agreement about some questions on risky situations, which directly measures risk attitudes [40]. Another approach that challenges the expected utility theory and measures risk attitude of individuals is prospect theory proposed by Kahneman and Tversky [41]. Some researchers have used the technique of lottery choices for the risk attitude assessment in the field of both psychology and economy such as Wärneryd [42]; Kahneman and Tversky [41]; Fellner and Maciejovsky [40]; Pennings and Smidts [49]; Dohmen et al. [43]; Donkers et al. [44]; Kachelmeier and Shehata [45]; Cardenas and Carpenter [46]; and Ye and Wang [47]. Furthermore, some others have used the method of gamble choices to measure attitudes toward risk in various fields like Eckel and Grossman [48]; Binswanger [49]; and Balaz and Williams [50].

Considering risk attitude in the construction Raftery et al. [51] investigated professionals’ risk attitudes vigorousness toward monetary risks via interviews before and after a business cycle variation where they found that decisions will vary in response to three stimuli such as framing of decisions, the amount of money involved, and economical condition background. Au and Chan [52] studied the risk attitudes of contract parties to see that how contractors request for payments, and how employers are willing to make payments for the time delay risk due to weather in a construction project. Wang and Yuan [53] identified the important factors that affect risk attitudes of contractors in the Chinese construction industry so that to improve the Risk Based Decision-Making (RBDM). From the 26 factors that were identified, three of them were determined to be of great importance such as: engineering experience,

consequences of decision-making, and completeness of project information. For this reason, they developed an evolutionary simulation model to investigate that how risk attitudes will have effect on the success of contractors and the market. Moreover, Bossuyt et al. [54] explored risk attitudes through utility theory in risk-based design so as to address the important risks via numerically based approach rather than the gut feeling usage, and to explain risk-based decisions.

IV. SHORTCOMINGS OF P-I RISK MATRIX

There are still some shortcomings with the utilization of risk matrices to be addressed. Cox [16] claims about the logical and mathematical drawbacks of the risk matrices, which are considered as the bases of information for risk management decision making. In his study, which is titled “What’s wrong with risk matrices?”, Cox identifies some rational and mathematical limitations of the risk matrices performance such as suboptimal resource allocation, errors, ambiguous inputs and outputs, and poor resolution. He further agrees with the widespread and uncomplicated utilization of risk matrices in the risk management decisions, but strongly recommends a research to be conducted for its better understanding in order to provide some specific indications that in which situations these risk matrices can help and in which situations cannot. Later, Ball and Watt [21] examined the utility and reliability of the risk matrices in the context of public leisure activities and travel where they found that: “(1) Different risk assessors may assign vastly different ratings to the same hazard. (2) Even following lengthy reflection and learning scatter remains high. (3) The underlying drivers of disparate rating relate to fundamentally different worldviews, beliefs, and a panoply of psychosocial factors that are seldom explicitly acknowledged.” Actually in this study, which was a two-stage survey, international postgraduate and undergraduate students those studying either occupational health and safety or risk management had participated. A risk matrix used in this study was a product of (1-5) scaling method where the (1-5) scores were assigned to the individual likelihood and consequence ratings, then the respondents were asked to assign the risk ratings accordingly. At the first stage of the survey, 50 students participated, and then in the second stage of the survey, 21 students representing a subset of the first 50 students participated. The important findings of Ball and Watt’s research were that they prepared a table of factors affecting the risk ratings. The risk attitude and lack of specific knowledge were the two factors out of the 15 that can have effect on the risk ratings and which can be connected to this study. Further, Ruan et al. [35] also claimed about the limitation of risk matrix establishment.

They proposed an approach that integrates risk attitudes based on utility theory with the risk matrix so that to explain how risk attitudes of decision-makers affect the matrix during the risk assessment.

V. RESEARCH METHODOLOGY

The objective of this research is to study the variances in risk ratings that decision-makers assign to risks during qualitative risk assessment process with respect to their attitudes toward risk. As well as the assumptions on risk controllability, which may affect these ratings too. Therefore, a questionnaire survey was administered where 81 individuals from Turkey (most of them working in international construction projects) participated in this survey. The survey data was then analyzed in order to acquire the research objectives and to test the validity of the hypotheses below:

H1: Risk ratings vary with respect to the risk attitudes of decision-makers during the risk assessment process.

H2: Assumptions about risk controllability also affect the risk ratings in addition to the risk attitudes of decision-makers.

The questionnaire was formed of three general parts. In Part 1, general information about respondents are asked, which are composed of four questions such as respondents' current position/title in a firm/company where they work, organization type, experience in the construction industry, and finally their experience in the risk management field. In Part 2, there is a question about respondents' controllability level on a risk factor followed by four risk rating scenarios, where a ready-made risk checklist containing nineteen (19) risk factors is utilized for all four risk scenarios and the risk controllability level. The risk checklist is borrowed from the research paper of Dikmen et al. [18] with their permission as shown in Table 2. The aim for the risk controllability ratings in Part 2 is to find out that how a decision-maker assumes the controllability level for a risk factor. Also, to see that how controllability affects the risk ratings with respect to magnitude of the risk in different risk scenarios, or how the assumptions about controllability change according to the magnitude or level of risk during risk assessment process in international construction projects. The respondents are then asked to assign the risk ratings for

the four different risk scenarios after they assign ratings to the risk controllability section. The four risk scenarios are designed based on the project and country risk level, where the first scenario is formed as a case of a project with high complexity (high risk) in a high risky country, the second scenario is formed as a case of a project with low complexity (low risk) in a high risky country, the third scenario is formed as a case of a project with high complexity (high risk) in a low risky country, and the fourth scenario is formed as a case of a project with low complexity (low risk) in a low risky country. This is also important to mention that all four risk scenarios are arranged to represent an international project case. In addition to above risk scenarios design, respondents are asked to evaluate the risk level of a project in each scenario depending on their own perception toward that specific case, rating the case as low, medium, or high level of risk. The risk controllability ratings are considered to range between 1 and 3 rating scale, and the four risk scenario ratings are considered to range between 1 and 5 ratings scale. The legends for the risk ratings and risk controllability ratings are explained to the respondents in order to help them for selecting their choices from the existing legends and assign the risk ratings accordingly, using their subjective judgment. After all the risk ratings are assigned in Part 2 of the questionnaire, the Mean, Standard Deviation (SD), and Coefficient Of Variation (COV) of each risk in each risk scenario will be calculated. The risk factors with highest or lowest Mean ratings, SD, and COV in each risk scenario will be considered for some further analyses and comparisons. These comparisons will then help us to discuss some important points about respondents' attitudes toward risk and their assumptions about risk controllability. Some cases and evidences will be acquired to show the importance of risk attitude and risk controllability as two important factors that may affect the risk ratings. Some statistical correlations will be then tested among the risk attitude, risk controllability, and the four risk scenarios, which will be used for the validation of research hypotheses. Figure 1 represents explanation on risk scenarios and provides information on how and what ratings respondents should assign to risk factors and controllability asked in the questionnaire.

Table 2. Risk Factors Checklist Borrowed from Dikmen et al. [18]

No.	Risk Factors
1	Poor international relations
2	Instability of political condition
3	Poor attitude towards foreign companies
4	Poor macroeconomic conditions
5	Immaturity of legal system
6	Societal conflict
7	Cultural/Religious differences
8	Vagueness of construction techniques/methods
9	Complexity (technical and managerial)
10	Unavailability of resources
11	Poor planning
12	Vagueness of scope
13	Design errors
14	Unavailability of funds
15	Delay in payments
16	Attitude of client
17	Inexperience of client
18	Unavailability of subcontractors
19	Poor performance of subcontractors

Risk Scenarios	Project Risk Level (Complexity)	Country Risk Level	Intensity of Risk	Rating Scale
First Risk Scenario	High	High	Very Low Impact	1
Second Risk Scenario	Low	High	Low Impact	2
Third Risk Scenario	High	Low	Medium Impact	3
Fourth Risk Scenario	Low	Low	High Impact	4
			Very High Impact	5

Fig 1 (a)

Fig 1 (b)

Risk Controllability Level	Rating Scale
Fully Uncontrollable	1
Partially Controllable	2
Fully Controllable	3

Fig 1 (c)

Fig. 1: Explanation for Project and Country Risk Levels, and Rating Legends for Risk Factors and Risk Controllability

In the last part of the questionnaire, which is Part 3, a risk attitude measurement scenario is put in place so that to capture respondents' attitudes toward risk whether they have risk averse, risk neutral, or risk seeking attitudes. In this section of the questionnaire, a very simple example of a coin flipping game is offered to respondents in order that everyone can understand it easily, and to provide correct answers based on the attitudes they have toward risk. In this game, a coin will be flipped, if the coin comes heads, the participant will get \$100, and if the coin comes tails, the participant will get \$0 means nothing. The important point here is to mention that this coin flipping game is just for once and it is not a continuous game, the game will be stopped after one flip. What respondents are asked is to choose the minimum certain amount of money they would accept to leave the game for from the give options in the questionnaire. The Expected Monetary Value (EMV) for this game is \$50, as $EMV = 100 \times 0.50 + 0 \times 0.50 = 50$. Therefore, it is aimed that if a respondent selects \$50, he or she has a risk neutral attitude, if selects less than \$50, a risk averse attitude, and if selects more than \$50, will has risk seeking attitude. This is very important to state that the questionnaire was prepared and designed in a very simple and attractive way in order that every respondent can understand and can answer each question easily.

5.1. Questionnaire distribution and collection

The questionnaire was sent electronically in E-mail to a total of 202 intended respondents. The target respondents of this questionnaire were the professionals working in the construction industry and the academics as well. One E-mail was sent to 190 practitioners where most of them working in the Turkish construction industry involved in international construction projects, and some other professionals working in International Companies and Organizations inside and outside of Turkey. Another E-mail was sent to 12 graduate students of the Middle East Technical University (METU) who were involved in the construction management and Engineering studies. In return, a total of 81 useable responses were received making a total of 40% response rate of the survey which is an acceptable response rate in E-mailing questionnaire survey as per Moser and Kalton [55]. For more information about the questionnaire, please refer to Hayat [56].

VI. DATA ANALYSIS PROCESS

After receiving the questionnaires, the data was analyzed in order to acquire some basic statistics about respondents such as respondents' organization type, experience in the construction industry, and their experience in the risk management field at the beginning. The statistics about

risk levels that respondents had chosen for the four risk scenarios and information about their risk attitudes were also obtained in the first step of the data analysis. In the second stage of the analysis, risk factors in each risk scenario and in the risk controllability sections were ranked with respect to their Mean ratings so that to see their locations in different risk scenarios, compare them with each other, and observe that how the assumptions of decision-makers about risk controllability affect these ratings or these rankings. Observing the effects of decision-makers' risk attitudes on the risk ratings was another task in this step of the analysis as well. Some significant cases are then chosen for the support and validation of the research hypotheses. The third stage of the data analysis is a correlation test among the six variables such as risk attitude, risk controllability level, and the four risk scenarios. Taking into account that all these variables are categorical (ordinal and nominal), a Spearman's Rank Correlation Coefficient or Spearman's rho test was performed to discover the strength of link between the pairs of variables. This is to remind that before performing Spearman's rho test, the relationships were checked through scatter plot diagrams confirming the relationships for further correlation testing. Spearman's rho test is considered as an appropriate analysis for the non-parametric tests and for the strength of association between a pair of random variables according to Schmid and Schmidt [57]. The numerical value for Spearman's rho ranges from +1.0 to -1.0, and in general, correlation coefficient or $r > 0$ represents a positive relationship and $r < 0$ represents a negative relationship between pairs of variables. For Spearman's rho test, the level of significance or alpha was set to 5%, which means that the null hypothesis will be rejected at the p-value smaller than or equal to 0.05 ($p \leq 0.05$). The following statistical formula represents Spearman's rho or Spearman's Rank Correlation Coefficient.

$$r_s = 1 - \frac{6 \sum d_i^2}{n(n^2-1)} \dots\dots\dots (1)$$

According to Cohen and Cohen [58], the significance of a positive/direct or negative/inverse relationship between two variables is small/weak when the correlation coefficient (r) is between 0.1 and 0.3, moderate/medium when r is between 0.3 and 0.5, and strong when r is between 0.5 and 1. Therefore, this significance is used for the correlation among the variables here in this study.

VII. RESULTS AND DISCUSSIONS

Table 3. Represents some basic data showing the frequencies of the participants' organization types, experience in construction, experience in the risk management field, and finally their risk attitudes

categorized as risk averse, risk neutral and risk seeking. The mean ratings for 1st and 4th risk scenarios are presented in Table 4. Here we can see that risk #14 and #15 from the original checklist are ranked as the highest two factors with respect to mean values. However, the mean ratings for these two factors are 4.19 and 3.96 in the case where a high complex project is located in a high risky country, and 3.17 and 3.02 in a situation of a low complex project located in a low risky country. This noticeable change in the mean rating of 81 respondents from once situation to another shows that their risk attitudes have played a role in decision-making. Besides, the risk #7 from the original list is ranked the lowest in terms of mean ratings in both mentioned scenarios, but with different values. Looking to the overall mean ratings

of all the 19 risk factors, the 1st and 2nd scenarios have 3.51 and 2.38 mean values respectively. It is not just about the risk attitude influence; we also argue that the individuals have also taken their experience into account here to utilize how controllable these risk events are. Therefore, is clearly understandable that the risk attitudes and illusion of risk controllability of the respondents change with respect to the magnitude of risk in different risk scenarios. As a result, it can be claimed that decision-makers with a risk averse attitude are usually assigning higher risk ratings in comparison to that of decision-makers with risk neutral and risk seeking attitudes, which represents a perspective on influence of risk attitude in rating scales.

Table 3. Statistics on Respondents' Organization Type, their Experience in the Construction and Risk Management Field, and their Attitudes towards Risk

Org. Type	Frequency	Experience in Construction	Frequency	Experience in Risk Management	Frequency	Risk Attitude	Frequency
Client	7	< 5 years	17	Low/Limited	31	Risk Averse	25
Contractor	51	5 to 10 years	28	Medium	38	Risk Neutral	19
Consultant	12	11 to 15 years	13	High	12	Risk Seeking	37
Academic	7	> 15 years	23				
Other	4						
Total	81		81		81		81

Table 4. Comparison of 1st and 4th Risk Scenarios

1 st Risk Scenario (High Risky Project-High Risky Country)				4 th Risk Scenario (Low Risky Project-Low Risky Country)			
Ranking with Respect to Mean Ratings	Ranking in the Risk Checklist	Risk Factors	Mean Ratings	Ranking with Respect to Mean Ratings	Ranking in the Risk Checklist	Risk Factors	Mean Ratings
1	14	Unavailability of funds	4.19	1	14	Unavailability of funds	3.17
2	15	Delay in payments	3.96	2	15	Delay in payments	3.02
3	2	Instability of political condition	3.96	3	11	Poor planning	2.64
4	5	Immaturity of legal system	3.94	4	10	Unavailability of resources	2.63
5	11	Poor planning	3.81	5	12	Vagueness of scope	2.62
6	10	Unavailability of resources	3.72	6	19	Poor performance of subcontractors	2.53
7	19	Poor performance of subcontractors	3.68	7	16	Attitude of client	2.49
8	13	Design errors	3.64	8	13	Design errors	2.48
9	12	Vagueness of scope	3.62	9	5	Immaturity of legal system	2.46
10	4	Poor macroeconomic conditions	3.52	10	18	Unavailability of subcontractors	2.37
11	18	Unavailability of subcontractors	3.47	11	4	Poor macroeconomic conditions	2.27
12	16	Attitude of client	3.44	12	2	Instability of political condition	2.22
13	8	Vagueness of construction techniques/methods	3.40	13	6	Societal conflict	2.21
14	9	Complexity (technical and managerial)	3.38	14	8	Vagueness of construction techniques/methods	2.19
15	1	Poor international relations	3.31	15	9	Complexity (technical and managerial)	2.15
16	3	Poor attitude towards foreign companies	3.20	16	17	Inexperience of client	2.11
17	17	Inexperience of client	3.12	17	3	Poor attitude towards foreign companies	2.04
18	6	Societal conflict	3.10	18	1	Poor international relations	1.84
19	7	Cultural/Religious differences	2.30	19	7	Cultural/Religious differences	1.72
Mean Ratings for the 1st Risk Scenario			3.51	Mean Ratings for the 4th Risk Scenario			2.38

From the results, we present another interesting case in which mean risk ratings in each risk scenario with respect to three categories of risk attitudes of the respondents are summarized, shown in Table 5. Here we can witness that respondents with a risk averse attitude have assigned mean ratings of 3.90, 3.49, 3.13, and 2.72, respondents

with a neutral risk attitude have assigned mean ratings of 3.35, 3.01, 2.98, and 2.40, and respondents with a risk seeking attitude have assigned mean ratings of 3.37, 2.86, 2.71, and 2.13 to the 1st, 2nd, 3rd, and 4th risk scenarios respectively. A sharp decrease exists in the mean ratings from a risk averse attitude to risk neutral and risk seeking

attitude that confirms the relation of risk attitude on decision-makers rating scales.

Table 5. Mean Ratings of the Respondents with Respect to their Risk Attitudes

Explanation	1 st Risk Scenario	2 nd Risk Scenario	3 rd Risk Scenario	4 th Risk Scenario	Risk Attitude
Mean Ratings of 25 Respondents	3.9	3.49	3.13	2.72	Risk Averse
Mean Ratings of 19 Respondents	3.35	3.01	2.98	2.4	Risk Neutral
Mean Ratings of 37 Respondents	3.37	2.86	2.71	2.13	Risk Seeking

In addition to these, a critical case explaining the association of controllability with decision-makers' risk rating scales is summarized in Table 6. In this case, mean ratings of all 19 risk factors in four risk scenarios with respect to highest and lowest values are presented so as to validate the second hypothesis of the research. A respondent with the highest mean ratings of 4.32, 3.90, 3.53, and 2.79 for the four risk scenarios is the person who has the lowest controllability with respect to mean ratings of 1.26 among all the respondents. On the other

hand, a respondent with the lowest mean ratings of 3.63, 2.79, 2.42, and 1.84 for the four risk scenarios is the person who has the highest controllability with respect to mean ratings of 2.53 among all the respondents. This contrast in thinking of less controllable situation and assigning higher ratings to risk, and thinking of more controllable circumstance and then assigning lower ratings to risk is a clear indicator on how the illusion of risk controllability affects the risk rating scales.

Table 6. Comparison of the Highest and Lowest Mean Ratings for Risk Controllability vs. Mean Ratings of the Four Risk Scenarios

Explanation	Controllability	1 st Risk Scenario	2 nd Risk Scenario	3 rd Risk Scenario	4 th Risk Scenario
Mean Ratings (Lowest Controllability, Highest Risk Ratings)	1.26	4.32	3.90	3.53	2.79
Mean Ratings (Highest Controllability, Lowest Risk Ratings)	2.53	3.63	2.79	2.42	1.84

Finally, the correlation test results between risk attitude and risk controllability, risk attitude and four risk scenarios, and risk controllability and four risk scenarios are presented in Tables 7, 8, and 9 respectively. Ratings of 1, 2, and 3 are assigned to controllability on a risk event from fully uncontrollable to partially controllable and fully controllable situation shown in Figure 1. The risk averse, risk neutral, and risk seeking attitudes are then also changed to a numerical form such as 1, 2, and 3 respectively. Then correlation test between these two factors indicate +0.461 significance level that shows a moderate positive relationship in Table 7, which means that a person with a risk seeking attitude may usually tend to be able of controlling a risky event, but when it comes to a risk averse attitude, people may be inclined toward the feeling of not being able to fully control a risky

situation. Further, the correlation between risk attitude and four risk scenarios indicate a medium correlation as well except for 3rd risk scenario, which is -0.262, but it is still close to a negative moderate significance. The results from this correlation in Table 8 indicate that a risk averse decision-maker may assign higher ratings to risks than a decision-maker who has risk seeking attitude. In Table 9, the correlation between risk controllability and the four risk scenarios is observed to be a negative moderate relationship. The negative relationship underlines that a person who is judging a risk event to be more controllable may assign lower risk rating scales rather than a person who personally judge a risk event to be not fully controllable if happens. Therefore, all the results discussed above support the two hypotheses of the research.

Table 7. Correlation Test Results between Risk Controllability and Risk Attitude

Spearman's rho		Assumptions on Risk Controllability Level	Risk Attitude
Assumptions on Risk Controllability Level	Correlation Coefficient	1.000	0.461**
	Sig. (2-tailed)	.	0.000
	N	81	81
Risk Attitude	Correlation Coefficient	0.461**	1.000
	Sig. (2-tailed)	0.000	.
	N	81	81

** . Correlation is significant at the 0.01 level (2-tailed)

Table 8. Correlation Test Results Between Risk Attitude and the Four Risk Scenarios

Spearman's rho		1 st Risk Scenario	2 nd Risk Scenario	3 rd Risk Scenario	4 th Risk Scenario
Risk Attitude	Correlation Coefficient	-0.372**	-0.422**	-0.262*	-0.380**
	Sig. (2-tailed)	0.001	0.000	0.018	0.000
	N	81	81	81	81

** . Correlation is significant at the 0.01 level (2-tailed)

* . Correlation is significant at the 0.05 level (2-tailed)

Table 9. Correlation Test Results Between Risk Controllability and the Four Risk Scenarios

Spearman's rho		1 st Risk Scenario	2 nd Risk Scenario	3 rd Risk Scenario	4 th Risk Scenario
Assumptions on Risk Controllability Level	Correlation Coefficient	-0.445**	-0.452**	-0.423**	-0.447**
	Sig. (2-tailed)	0.001	0.000	0	0.000
	N	81	81	81	81

** . Correlation is significant at the 0.01 level (2-tailed)

VIII. CONCLUSION

This research investigated the effects of both “risk attitude” and the illusion of “risk controllability” on the risk ratings using 1 to 5 scaling method while conducting qualitative risk assessment in international construction projects. Two hypotheses are tested and validated through a questionnaire survey, and the major findings of the study are:

- Risk attitude is critical factor that can affect the risk ratings of decision-makers during the risk assessment process.
- Illusion of risk controllability is also an important factor that may affect the risk ratings in addition to risk attitude.
- Risk attitude has a negative moderate correlation with the risk ratings, which means that a risk averse person may assign higher ratings to risks, whereas a risk seeking person may assign lower ratings.
- Risk controllability has a negative moderate correlation with the risk ratings too, as such, the higher the controllability, the lower the risk ratings are or vice-versa.
- Decision-makers always consider a latent but crucial factor into account while assigning the risk ratings during assessment risk, which is controllability.

- Decision-makers are more sensitive to country risk rather than the project risk per se.
- Comparing country and project risks, country risks are less controllable than project risks for decision-makers while using their subjective judgment.
- Although being prevalent and dominant, the P-I risk ratings still have some drawbacks.

This study can be a good reference for those who are willing to pursue a comprehensive research about the effects and factors that can affect the risk ratings while decision-makers assign to risks using 1 to 5 scaling method, conducting qualitative risk assessment in international construction projects. Further researches can focus on more specific risk cases and scenarios for international construction projects conducting a questionnaire survey with a greater sample size than what was performed by this research. In addition to mailing survey, brainstorming session, group interviews, and Delphi method surveys may help further researches to find stronger relationships among the risk ratings, risk attitude, and assumptions about risk controllability. Much detailed cases for risk attitude measurement and illusion of risk controllability may also help further researches.

To conclude, the P-I risk matrices are widely used and easy to utilize while conducting qualitative risk assessment. Nevertheless, they have some serious

shortcomings in terms of variances in the rating scales from one individual to another. Thus, in this study we have focused on two significant factors such as “risk attitude” and the illusion of “risk controllability” so that to provide some contribution to the improvement of the P-I risk matrices usage, especially in international construction project.

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Detection of Paddies Reflectance Values to classify their Ages using RGB Photograph Images

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Abstract— *Rice is a very important food in the world, a staple food for more than half of the world's population, especially Asia. People in Asia plant rice crops, more than 90% of the world's rice crops which are grown. In the current technological era the conditions of agricultural crops such as rice can be monitored rapidly from the air. This study aims to classify the age of rice plants based on cartesian coordinate position vectors from the extracted basic, red, green, and blue color spectrum of reflectance. The research was done by taking the image of rice plants based on age classification and Furthermore, the extracted values of each spectrum is normalized and then be plotted on cartesian coordinate. The result obtained from this research is the position vector of normalized RGB values be able to differentiate the age classification of rice plant. The each vector position represented a single group of age classification. The three vector units i.e. red, green and blue figure every axis on the 3 dimensional Cartesian coordinates. This research concluded that the 3-dimensional position vector method of cartesian coordinates, can classify the age of rice plants.*

Keywords— *Cartesian coordinates, Position vector, RGB, Rice.*

I. INTRODUCTION

Rice is a very important food crop in the world. It becomes a staple food for more than half of the world's population, especially Asia, in which more than 90% of the world's rice crops are grown and consumed [1]. Although the staple food can be substituted by other foodstuffs, but they cannot easily satisfy people who use to eat rice daily. People say that they do not eat yet when they do not eat rice in a day [2]. As rice crops are very important, monitoring the rice field to know the growth condition is also important. In today's technological era, agricultural crop conditions such as rice can be monitored rapidly from the air. The methods can be observations using camera or sensor which is plat formed on helicopter, aircraft, drone (UAV=Unmanned Aerial Vehicle) and satellite [3].

In principle, detection of crop plant using remote sensing is based on the identification of the reflectance value of the light which strikes the plantation such as rice [4]. The algorithm used can be vary as like as NDVI (Normalized Difference vegetation Index), VIDN (Vegetation Index Differencing), LAI (Leaf of Area Index) and others [5]. Different spectral bands are also applied depend on the purposes and applications of detection. The greenness level detection usually uses red and infrared bands [6], while red, green, and blue (RGB) spectrum bands were used to detect the Phytoplankton abundance [7]. It means that the reflectance of RGB (red, green, and blue) spectrum can identify the existence of object with chlorophyll content.

Similar to Phytoplankton, the leaves of rice crops (paddies) contain also chlorophyll cells which can be sensed by the reflectance values in the RGB spectrum. These values represent the amount of chlorophyll in the leaf. Different chlorophyll content in the leaf leads to the different values of reflectance in the RGB spectrum [8]. The chlorophyll content also indicates the greenness of the leaf [9]. Therefore the leaf with different greenness level will impact to the different reflectance values in the RGB spectrum.

Camera especially digital camera is often used to record the image of the researched object based on the reflected light. The digital image from camera can be extracted into RGB layers and the calculated the reflectance values using computer software such as MATLAB. Moreover, the reflectance values can be analyzed to identify the characteristics of the objects.

Furthermore, we can apply the reflectance values that indicate the chlorophyll content in the leaf to classify the age of paddy. Different age of paddy shows the different amount of chlorophyll [2]. The research to identify the growth stage of paddy through the analysis of reflectance values in the RGB spectrum has not been done. The yielding time can be predicted if we can monitor the age of paddy in the rice farm and also we can calculate the harvesting area. This research is important to support the agricultural data which is useful to know the total

production of paddy in a year based on the production data in the certain harvesting seasons.

II. REVIEW OF LITERATURE

A. Paddy Plantation

Rice plants are very easy to find, especially in rural areas. Paddy fields are filled with rice crops. Rice is a plant belonging to the genus of *Oryza* L. which includes approximately 25 species, spread over the tropical and subtropics regions, such as Asia, Africa, America and Australia. The current species of paddy is a result of cross-breed of *Oryza officianalis* and *Oryza sativa* F. Spontane [10]. The recent cultivated paddies have undergone many changes not only the outer form or morphological, but the physiological aspects also change. These morphological changes include leaves; the number of leaves becomes more numerous. The leaves dimensions are become longer, bigger and thicker. The other changing are the number of tillers grew, the branch began to form in accordance with the number and development of the seedling, and the branch began to become more. Physiological changes in rice include: the rate of growth of plants to be faster, as well as the rate of growth of seedlings; Seed dormancy becomes shorter [10]. The view of paddy plantation in the field is shown in Fig.1 below.



Fig.1: Paddy plantation in the field [10]

B. Interaction of light and matter

There are two reflection models when light strikes the object i.e. specular reflection and diffuse reflection. The specular reflection occurs at the medium with flat and smooth surface where the reflected rays are all parallel to one another. The other type of reflection is a diffuse reflection, where the reflected rays travel in random directions because the light hits the rough surface. A surface behaves as a smooth surface as long as the surface variations are much smaller than the wavelength of the incident light [11]. Every surface of the object undergoes diffusion and speculative reflection. Most surfaces experience more speculative reflection, but some experience diffuse reflections [12].

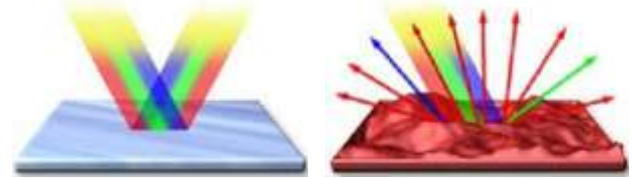


Fig.2: Reflection on the objects (a) specular reflection (b) diffuse reflection [12].

C. RGB Color Model

RGB is a color model consisting of three layers called basic colors that are red, green, and blue. They are combined in forming a wide array of colors. Each basic color, for example red, are composed in 8 bit value range with the smallest value is 0 and the largest value is 255.. The 255 scale option is based on how to reveal the 8 digit binary numbers used by computer machines. In this way, the possible combination colors produced with these three layers are $256 \times 256 \times 256$ or equal to 16,777,216 colors. In the 3 dimensional Cartesian coordinate, a type of color can be imagined as a point in 3-dimensional space vector normally used in mathematics. So, a color can be written as a point vector of (0,0,0) until (255,255,255). Each axis in the Cartesian coordinate represents layer Red, Green, and Blue of RGB model..The RGB point of (0,0,0) meant to the values of red=0, green=0, blue=0 or the color of black. Meanwhile the RGB point of (255,255,255) describe the values of red=255, green=255, blue=255 or the color of white. The other colors are represented by various combination values of red, green, and blue with range values from 0 to 255 for each layer [13]. The picture of layer Red (R), green (G), and blue (B) in the 3 dimensional Cartesian coordinate is shown in Fig.3.

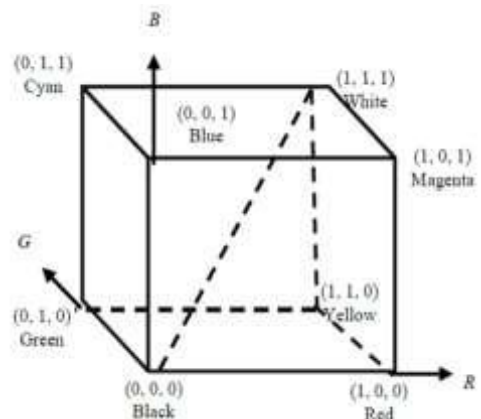


Fig.3: RGB color model in the three dimensions of cartesian coordinates [13]

D. Normalization

The magnitude of reflectance as a characteristic of an object is difficult to measure by the photograph images. But we can choose the normalization values to represent the reflectance values. We can assume that white paper

will reflect all light which strike it. Thus we can indicate the reflectance value of the object in the RGB spectrum by comparing the digital number of the object and the digital number of white paper in term the object and white paper are shoot in the same time and place. The normalization values of the spectrum can be calculated by:

$$d_r = \left(1 - \left(\frac{K_r - D_r}{K_r} \right) \right)$$

$$d_g = \left(1 - \left(\frac{K_g - D_g}{K_g} \right) \right)$$

$$d_b = \left(1 - \left(\frac{K_b - D_b}{K_b} \right) \right)$$

Where:

d_r, d_g, d_b = normalized digital number in red, green, and blue layers

K_r, K_g, K_b = averaged value of digital number of paper in red, green, and blue layers

D_r, D_g, D_b = averaged value of digital number of paddy in red, green, and blue layers

III. RESEARCH METHODS

The data collection was performed by taking pictures of rice plants in the field using digital cameras that is Nikon DSLR D700. The data in this study was collected on 3 age groups of rice plants, each of them consisting of 3 various age classes. The first group is rice aged of 10 days to 30 days with the age classes variation of 10 days, 20 days and 30 days. The second group is rice at age 50 days to 70 days with the variation of age classes 50 days, 60 days and 70 days. The third group is 80 to 100 days of age with variation of 80 days, 90 days and 100 days. So, all the research data are divided into 9 age classes. The number of images which are taken in each age classes are 10 images or we will have 90 images from this data collection process.

All the retrieved images are then cropped into two parts i.e. paddy and white paper. In this case, white paper is used as a reference of ideal object which reflect all incident light. These two cropping images are then extracted into digital number in red, green, and blue layers. This extracting step is applied to all existing images and all values resulted are written in the data table.

The next process is calculating the normalized values of each image in red, green, and blue layers and the results are recorded in the separate table. Based on this data, we can plot the values as a point in the 3 dimensional Cartesian coordinate and therefore we get 90 points which represent every image characteristic for every age classes. Finally the analysis is conducted according to this plot resulted.

IV. RESULTS AND DISCUSSIONS

In this study, each retrieval image is cropped to be two images of rice plant and white paper as shown in Fig.4a and Fig.4b. Those cropping images act as representation of analyzed paddy and white paper as an ideal white object.

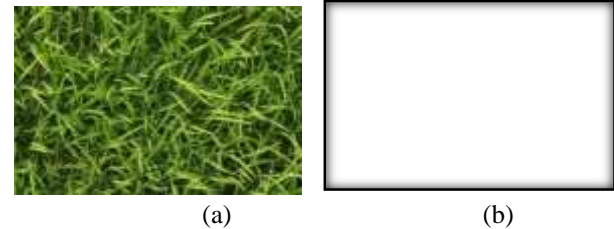


Fig.4: The cropping images of (a) paddy and (b) paper

Each cropping image is then sliced into RGB layers and from each layer is read the Digital Number (DN) value every pixel and calculate the average value. For example from Fig.4a we get the average value of layer R = 81,203, G = 109,193, B = 31,878 and from Fig.4b we get the average value of layer R = 254,986, G = 254,985, B = 254,990. The same step is done on each photo obtained and the values are written in

Table.1. The sample of RGB values in Table.1 refer to the cropping images in Fig.4a and Fig.4b. Based on these data, the normalized values is then calculated so we can draw a point from these values. The normalized red value is drawn in red axis, the green value is drawn in green axis, and also the blue value is drawn in blue axis.

Table.1: RGB values example of cropping image of paddy and white paper

File Name	R value	G value	B value
Paddy	81.203	109.193	31.878
paper	254.986	254.985	254.990

It has be mentioned that the processes of image cropping, extracting the digital number, normalizing, and plotting in 3 dimensional Cartesian coordinate are applied to all captured images. Every normalization value of an image is represented in one point inside the plot frame. All data point are drawn in one plot and the result is shown in Fig.5. The detail of normalized values of all research data are given in the appendix tables. In this figure we can see that there are 9 groups of points as representation of 9 classes of data i.e. 10, 20, 30, 50, 60, 70, 80,90, and 100 days of paddies ages.

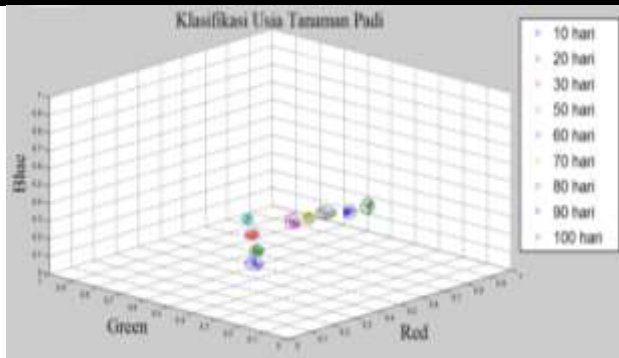


Fig.5: Plotting all normalized data in 3 dimensional Cartesian coordinate

The result of normalization values in the plot illustrates that every age classes of paddies plantation are located in different positions. Every position of classes can be considered as position's vector in the dimension of red, green, and blue (RGB) axis. In the plot we can see that the position's vector is changing following the growth age. However, the trend of changing can be analyzed better when we provide the position's vector in 2 dimensional coordinates as shown in Fig.6 to Fig.8 below.

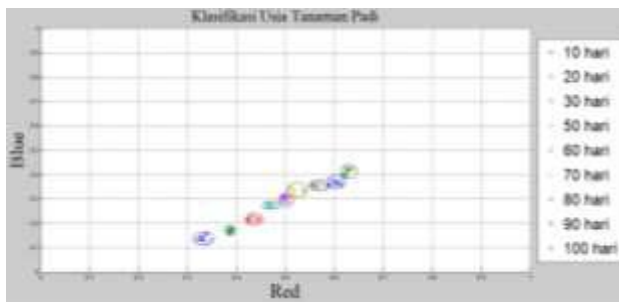


Fig.6: Projection of plotting data in 2 dimensional (red and blue) Cartesian coordinate

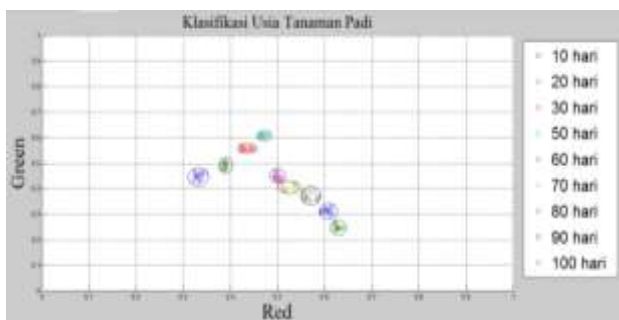


Fig.7: Projection of plotting data in 2 dimensional (red and green) Cartesian coordinate

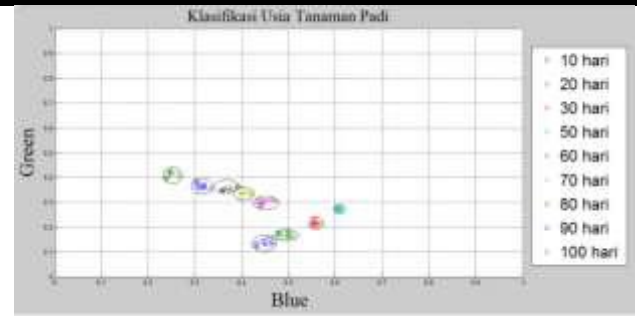


Fig.8: Projection of plotting data in 2 dimensional (green and blue) Cartesian coordinate

The last three pictures show clearly the changing trend of vector of normalized values of paddies reflectance. The values in red and blue axis are consistently increasing along the increasing age of paddy. However the trend of vectors in red and green plane projection shows different pattern. Reflectance in green axis increase from paddies with 10 days to 50 days, but the values decrease from 60 days to 100 days along red axis. The opposite direction of pattern occurs in the green spectrum reflectance along the blue axis. In the green and blue plane projection, the reflectance values in green spectrum decrease in time of increasing age of paddies.

In conclusion we have not get yet the results of position's vector in a single axis of color spectrum to characterize the age of paddies based on their reflectance values. But we must express the position's vector of paddies age in three axis of color spectrum RGB. If the unit vector in the red, green, blue axis are written as \hat{r} , \hat{g} , and \hat{b} respectively, we get the position's vector of paddies in the age of 10 to 100 days as the mathematical expressions below.

- a. $U_{10} = 0,331 \hat{r} + 0,448 \hat{g} + 0,137 \hat{b}$
- b. $U_{20} = 0,387 \hat{r} + 0,491 \hat{g} + 0,169 \hat{b}$
- c. $U_{30} = 0,433 \hat{r} + 0,556 \hat{g} + 0,217 \hat{b}$
- d. $U_{50} = 0,469 \hat{r} + 0,607 \hat{g} + 0,273 \hat{b}$
- e. $U_{60} = 0,499 \hat{r} + 0,447 \hat{g} + 0,301 \hat{b}$
- f. $U_{70} = 0,525 \hat{r} + 0,406 \hat{g} + 0,335 \hat{b}$
- g. $U_{80} = 0,568 \hat{r} + 0,369 \hat{g} + 0,355 \hat{b}$
- h. $U_{90} = 0,604 \hat{r} + 0,313 \hat{g} + 0,367 \hat{b}$
- i. $U_{100} = 0,627 \hat{r} + 0,249 \hat{g} + 0,415 \hat{b}$

V. CONCLUSION

The age classification of rice plants in 3 age groups, 10-30 days, 50-70 days and 80-100 days, has been successfully performed based on the basic RGB color spectrum with 3-dimensional Cartesian coordinate position's vector method. The vectors represent points of normalized reflectance values of paddy compare to white paper. The images data are retrieved using digital camera Nikon DSLR D700.

Vectors of paddies reflectance values in each age class place different location or in other words the position's vector of paddies in different classes be be distinguish obviously. The patterns of changing position of data vector are projected into 2 dimensional Cartesian coordinate to make it easy to analyze. The values in red and blue axis are consistently increasing along the increasing age of paddy. Reflectance in green axis increase from paddies with 10 days to 50 days, but the values decrease from 60 days to 100 days along red axis. In the green and blue plane projection, the reflectance values in green spectrum decrease in time of increasing age of paddies.

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Microstructural Modifications of As-Age Hardening 7071 Aluminium Alloy using Friction Stir Welding

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Abstract— Objective: Friction stir welding (FSW) is a relatively new solid state welding technique for similar and dissimilar materials, especially on current interest with Aluminium 7071 to Aluminim 7071.
Method/Analysis: The present paper discusses the process parameters followed by mechanical properties and microstructures which affect the weld strength.
Findings: Mechanical properties-Tensile strength attained with different process parameters and Microstructures are obtained by Optical Metallurgical Microscopy (MET SCOPE-1) and a Scanning Electron Microscopy equipped with an X-radiation detector EDS
Conclusion/Application: In this study Similar FSW between Al 7071 to Al 7071 plates with thickness 6mm were performed. The future research will contain creep tests and microstructural investigations using aluminium 7071 alloy using TEM microscopy (Transmission Electron Microscopy). It is demonstrated that FSW of aluminium to aluminium alloys is becoming an emerging technology with numerous commercial applications.
Keywords— FSW; Aluminium alloy, Similar, Mechanical properties, Microstructures, SEM.

I. INTRODUCTION

A rotating High Speed Steel pin advances into the workpiece, creating a highly deformed, plastic zone which flows around to its trailing side. No melt occurs, and the weld forms by solid-state plastic flow at elevated temperature. There is no porosity and other fusion weld-type defects associated with the weld zone if the rotational speed (R) and travel speed (T) are optimized. In this study, we have used light metallography (microscopy) (LM) and Scanning electron microscopy (SEM) to characterize the microstructures in the friction stir weld zone and compare them with the original 6061 aluminium alloy work-piece microstructures. We have

also measured the associated micro hardness profile extending from the work-piece and through the weld zone. The aim of this paper to present a very brief but comprehensive microstructural overview of this process and illustrate corresponding hardness profiles associated with these microstructures.

II. EXPERIMENTAL DETAILS

7071 aluminium alloy plate (nominally 6mm thick) was used in friction-stir welding experiments to be reported. A series of simulated weld in solid plate sections were conducted, as illustrated schematically in fig 1, at rotational speeds (R) ranging from 500-1000 rpm, and travel speed of 100 mm/min. The high speed steel welding pin fig.2 was used. Welded cross-sections were ground, polished, and etched with Keller's reagent (150ml distilled water, 3ml nitric acid, 6ml hydrochloric acid at room temperature) for optical metallography. Instrumental (digital) Vickers micro hardness measurements were also made throughout the weld zone and into the initial aluminium alloy plate using a 100gf load.

MATERIAL SELECTION & MATERIAL COMPOSITION

Aluminium alloys have steadily increased in aerospace applications because of their excellent strength to weight ratio, Good ductility, Corrosion resistance and cracking resistance in adverse environments.

Chemical Composition of AA7071

Si 0.41	Mg 2.5
Cr 0.17	Fe 0.50
Zn 5.1-6.1	Ti 0.18
Al balance	Cu 2.0
Mn 0.3	

Table.1: Mechanical Properties of AA7071

Yield Strength (MPa)	Ultimate strength (MPa)	Elongation (%)	Reduction in cross-sectional area (%)	Hardness(HN)
302	334	18	12.24	105

Table.2: Physical Properties of AA7071

Density (g/cm ³)	Melting Point(°c)	Modulus of Elasticity (GPa)	Poison ratio
2.7	580	70-80	0.33

Welding Parameters

In this study, downward force and welding speed are kept constant, only the tool rotation speed is varied. The welding parameters are given in Table 1.

Table.3: Welding parameters

Downward force (Tones)	40
Tilt angle (Degrees)	2°
Plunge Depth (mm)	3
Travel speed (mm/min)	100
Tool Rotation speed (rpm)	500, 700, 900, 1000

Tool Parameters:

Straight Cylindrical tool was used as shown in figure. The tool is made up of M2 high speed steel and which was tempered and hardened to 60 HRC. The tool material composition is given in Table 2.

Table.4: Tool Parameters

Material	C	Cr	W	Mo	V	Fe
M2	0.85	4.0	6.0	5.0	2.0	Remaining

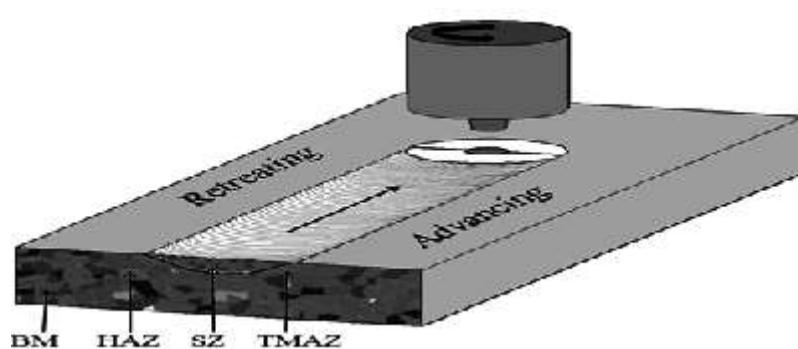


Fig.1: Schematic Drawing of Friction stir Welding



Fig.2: a FSW Tool

Tapered tool made up of HSS, its
 Tool probe or pin length = 4.8mm
 Pin diameter = 4mm
 Shoulder diameter = 25mm
 Shoulder length = 26mm

Weld trails

Four sets of welding trails were made at the base material AA7071, only by varying the tool rotation speed and keeping downward force, travel speed, plunge depth and tilt angle as constant, the values of the parameters are given in Table 3.

Table.5: Weld trails

Specimen Code No.	S500	S700	S900	S1000
Downward force (Tones)	40	40	40	40
Tilt angle (Degrees)	2°	2°	2°	2°
Plunge Depth (mm)	3	3	3	3
Welding Speed (mm/min)	100	100	100	100
Tool Rotation speed (rpm)	500	700	900	1000



Fig.3: Schematic drawing of FSW



Fig.4: Macrograph of the welded part under 700rpm

Tensile tests were performed to determine the tensile properties of the weld material such as tensile strength and percentage of elongation. One specimen of each was tested at S500 and S700 condition were measured and reported. The tensile tests specimens were cut as per the ASTM 8 standard size on the 6mm thick plate. Tensile tests were conducted on FIE/UTN-40 machine.

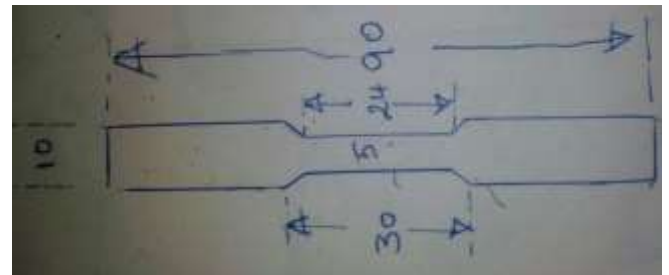


Fig.5: Dimension of the tensile specimen

III. RESULTS AND DISCUSSIONS

3.1 Tensile test

Table.6: Tested specimen results

S.NO	Specimen Code	Breaking load KN	Tensile Strength MPa	Elongation %	Fracture position
1	S500	16.200	136.778	2.740	Weld nugget
2	S700	25.42	180.92	2.90	Weld nugget
3	Base Metal (ASTM Hand book, Vol.9)	----	330	18	-----

3.2 Microstructure:

The microstructure of the different regions of the welded similar material is shown in fig 6&7. Though the weld undergoes considerable amount of the thermal cycle, there is no significant changes in the microstructure of the base metals. The conclusion of the given sample had grain size number as per ASTM E 112 has 5.5 at nugget zone and 5.5 at heat affected zone.

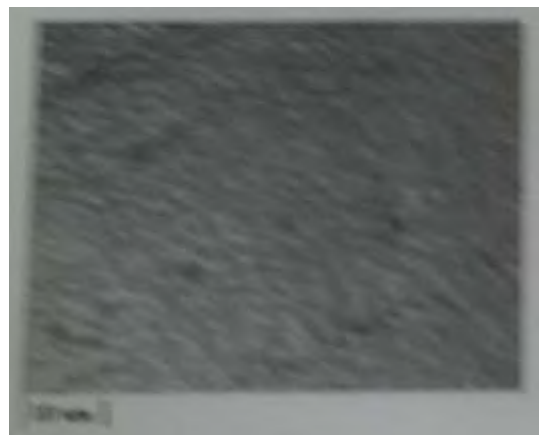


Fig.6: Optical Metallography of Aluminium-Aluminium at Nugget zone Grain Size analysis: Results summary

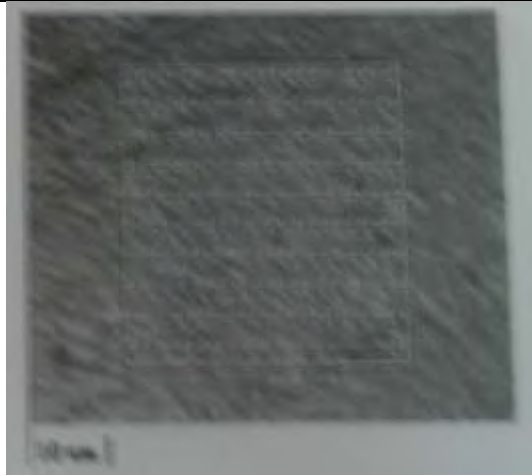
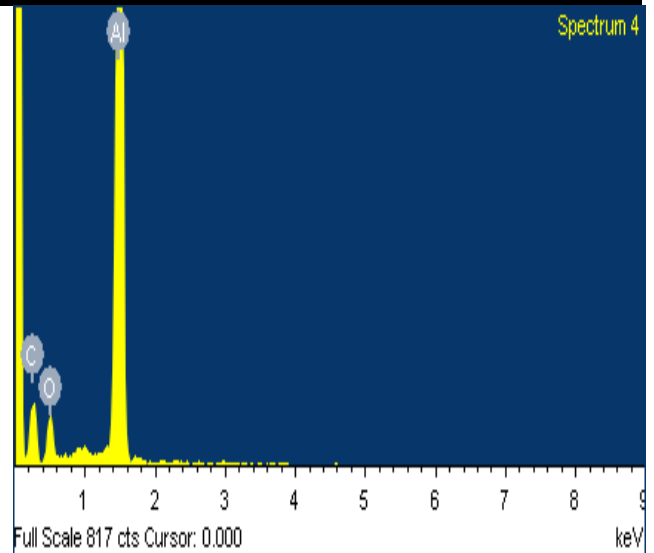


Fig.7: Optical Metallography of Aluminium- Aluminium at HAZ



Fields measured : 1
 Analyzed Area : 5005 sq. mm
 Standard used : ASTM E 112

At NZ	Grain size#
Grain size	5.5
Intercepts	139
MeanInt.length (um)	50.9
Std dev.	.
95% CI	.

At HAZ	Grain size #
Grain size	5.5
Intercepts	157
Mean Int.length (um)	45.1
Std dev.	.
95% CI	.

3.3 SEM and EDX analysis:

Elemental analysis of the macro regions in weld zone was performed using a scanning electron microscope (SEM) equipped with an EDX system. This analysis was conducted to gauge the distribution of alloying elements in the FSW zone. SEM image was analyzed at a magnification of 50X. EDAX was taken at the center of the weld zone as shown in the fig.8 Presence of Al (57.58%), C (33.76%) and O (8.66%) were prominent in that region.

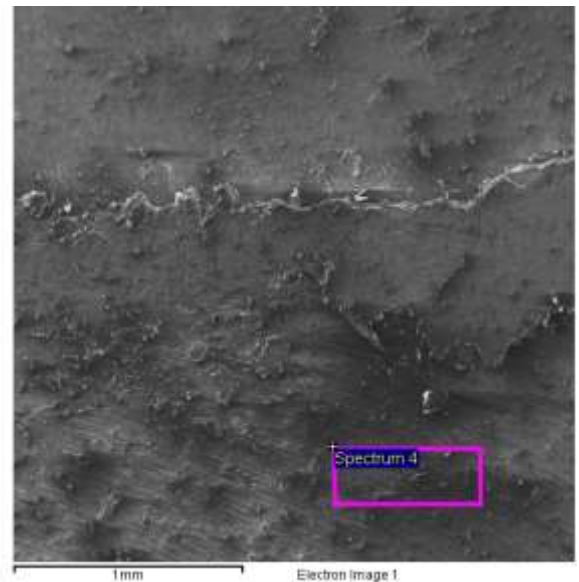


Fig.8: SEM and EDAX analysis

3.4 Hardness:

Vickers hardness tests were conducted across the regions of the weld spacing of (0.25mm) Average hardness value of 420 HV was obtained across the weldment for tapered pin.

IV. CONCLUSION

The FSW process parameters were optimized with respect to mechanical and metallurgical properties of the weldments. Tensile strength for S700 has more value than S500 also at nugget zone and HAZ the grain size is 5.5 the future research will contain creep tests and microstructural investigations using aluminium 6061 alloy using TEM microscopy (Transmission Electron Microscopy).

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Weldability of Friction Stir Welding using Aluminium Alloy with Pure Copper

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Abstract—Recently many reports on Friction Stir Welding (FSW) of various dissimilar systems such as Aluminium to Copper been reported. FSW of Aluminium, Copper has captured important attention from manufacturing industries, such as Shipbuilding, Automotive, Railway and Aircraft production. Copper and its alloys are widely used in industrial applications due to their excellent electrical & thermal conductivities, good strength, corrosion & fatigue resistance. The aim of present study was analogy of the microstructures and mechanical properties of friction stir welded joint of Aluminium to Copper plates in 4mm thickness.

Keywords— Aluminium 6061, Pure Copper, Dissimilar Materials, Microstructure, Micro hardness and Mechanical Properties, FSW.

I. INTRODUCTION

Friction Stir Welding (FSW) is a unique welding method and new invention for the welding technology world. FSW will not change the microstructure of the metal diverse unlike the conventional welding. It also can reduce the cost if compared to the conventional welding cost. It involves the joining of metals without fusion or filler materials. It is used already in routine, as well as critical applications, for the joining of structural components made of Aluminium, Copper. Since FSW is essentially solid-state, i.e. without melting high quality weld can generally be fabricated with absence of solidification cracking, porosity, oxidation and other defects typical to traditional fusion welding. Friction stir welding was used to control properties in structural metals including aluminium and the other nonferrous alloys. The pin may have a diameter one-third of the tapered tool shoulder.

In friction stir welding process a non-consumable rotating tool with tapered pin and shoulder is inserted into abutting edges of plates. A non-consumable spinning tool bit is inserted into a work piece. The rotation of the tool creates friction that heats the material to a plastic state. As the tool traverses the weld joint, it extrudes material in a distinctive flow pattern and forges the material in its wake. The resulting solid phase bond joins the two pieces into one.

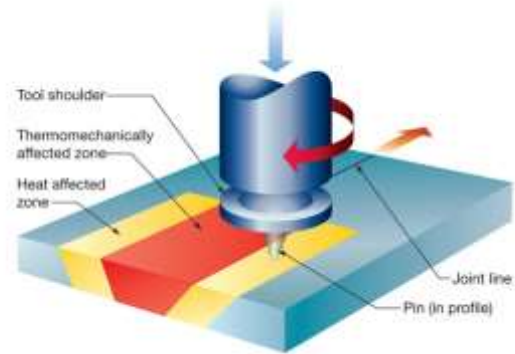


Fig.1: A Schematic Friction Stir Welding

II. EXPERIMENTAL PROCEDURE

Vertical milling machine of 9Kw is used to join the dissimilar plates. The plate size of Al6061 and pure copper are having 100mm length, 70mm width and 4mm thickness. In the present work H13 tool is used. The tool is having tapered shoulder and pin. For micro structural evaluation samples prepared by RAGHAVENDRA SPECTRO METALLURGICAL LABORATORY, Hyd and microstructure were measured on Optical Metallurgical Microscope (MET SCOPE-1). The micrographs were taken at 100x magnification. The Vickers micro hardness was measured by using HARDWOOD HWMMT-X7 micro hardness tester.

Table.1: H13 tool dimensions

Shoulder diameter(SD)	Pin diameter(PD)	Pin length (PL)
25mm	6mm	3.6mm

Table.2: Chemical composition of 6061 Aluminium, Pure Copper

6061 Al	Si 0.80 Fe 0.70 Cu 0.40 Mn 0.15 Mg 1.2 Cr 0.35 Zn 0.25 Ti 0.15 Al balance
Copper	Bi 0.001 O 0.04 Pb 0.0005 Cu rest

Table.3: Process parameters

	Unit	Experiment 1
Rotation Speed	Rpm	710, 900, 1120
Transverse speed	mm/min	10-60
Offset	mm	1
Plunge depth	mm	3

After welding the specimens were prepared by using Wire EDM to test the mechanical properties such as ultimate tensile strength, yield strength, % elongation and Hardness. Tilt angle as 1 degree, offset were kept constant.

Input Data

Material	Dissimilar
Thickness	4mm
Length	100mm
Width	70mm
Rotational Speed	710,900 and 1120 rpm
Feed	15-30 mm/min
Experiment 1	Aluminium to Copper

III. RESULTS AND DISCUSSIONS:

The following results were obtained after conducting the mechanical tests on FSW of Aluminium - Copper metals.

3.1 Output Data for Experiment 1 (710, 900 & 1120 rpm)

For 710 rpm	Ultimate Tensile strength	37.69
N/mm ²		
	Yield Strength	29.808
N/mm ²		
	% Elongation	0.42%
For 900 rpm	Ultimate Tensile strength	55.89
N/mm ²		
	Yield Strength	40.5
N/mm ²		
	% Elongation	0.62%
For 1120 rpm	Ultimate Tensile strength	76.80
N/mm ²		
	Yield Strength	60.6
N/mm ²		
	% Elongation	0.81%

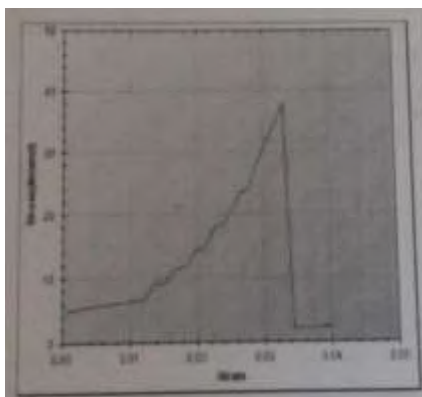


Fig.2: Graph for Al-Cu at 710rpm

3.2 Microstructure Analysis:

For Experiment 1: Microstructure of weld taken at centre of weld with or without filler materials. At the centre of weld a line mix region of aluminium and copper were found. Microstructure consists of uniformly

distributed fine intermetallic particles in a matrix of aluminium solid solution. Cracks and porosity are seen. Lack of fusion more a length of the root.



Fig.4: Microstructure Distribution at centre of Weld at 100x for 710rpm

3.3 Microhardness:

The Microhardness test is evaluated by Vickers shown below.

For Experiment 1:

For 710 rpm	372HV
For 900 rpm	400HV
For 1120 rpm	460HV

IV. Conclusion

Friction Stir Welding is performed to join 4mm thick plates of 6061 Aluminium to Pure Copper with varied parameters (like, tool rotation speed (rpm), welding speed (mm/min) and the joining conditions are characterized. All welds were defect free. Microstructure of weld and Microhardness were shown at centre of weld. Tensile strength was good and Aluminium to copper. high strength

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The Role of Innovation: Enforcement Smart Mobile Application (SSMEYEs)

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Abstract— *The aim of this article is to present the findings of the role played by a Division under Companies Commission of Malaysia (“CCM”) to create an added value on its routine activity through innovations. CCM has initiated a new enforcement project by using smart phone application to monitor all business entities in Malaysia. The usage of internet and smart phones on this modern world, brings a lot of benefits to most parties in various aspects. Therefore, usage of a customized smart phone apps by enforcement officers of CCM on their daily working activities especially to monitor the compliance level of companies and business entities in Malaysia will simplify the Standard Operating Procedures (“SOP”) and will increase the number of inspection as a whole. Primary data were obtained through original project documents, interviews and email reviews which were carried out at CCM and evaluated using some data analysis and comparison methods. The effective practice of this smart phone Apps by enforcement officers of CCM, will help them to monitor business entities in Malaysia to enhance the compliance level of Companies Act 2016 (“CA2016”) and Business Act 1956 (“BA1956”). The conclusion of this article is CCM find that, it is important to innovate and support an innovative culture in their organisation.*

Keywords—*smart phone application , inspection, Standard Operating Procedures (“SOP”), Companies Act 2016, Business Act 1956.*

I. INTRODUCTION

21st century has long been agreed as the time that emphasised more on knowledge, information and innovative economy (Bartes, 2009; Hamel & Green, 2007; Senge, 2007; Barták, 2006; Collinson, 2005). The success of an organisation is depends on its employees’ knowledge, experience, creative activity and qualification and emphasis is placed on continuous learning and research and development.

Malaysian Prime Minister in his speech entitled “Pekerja Kreatif Pencetus Inovasi” mentioned the theme chosen for the National Labour Day celebration for year 2017 is

Creative Workers are the Trigger of Innovation (Najib Razak.com, 2017). This indicate that the employees of an organisation, plays a major roles in creating the innovation in an organisation (2016). The index of innovation and creativity is a core that will be used as a guidance to determine how far the country is transformed into the top 20 countries in the world by 2050, said by Datuk Seri Najib Razak.

Enforcement and compliance monitoring will create a positive and competitive environment among the business traders on current business world which is undergoing a significant transformation globally. Hence, effective compliance and oversight activities by a particular regulatory bodies will play an important role in establishing a high level of compliance among business traders in the market. (The Star, 2015)

Companies Commission of Malaysia (“CCM”) or known as Suruhanjaya Syarikat Malaysia (“SSM”) is the only one government agency who register and monitor all kind of businesses and companies in Malaysia. Basically, CCM govern several Acts which is related to all type of businesses and companies to comply with proper regulation. All those regulations are monitored by Compliance Division, CCM.

Enforcement Division of CCM, is currently moving towards into virtual monitoring and enforcement activities rather than conducting classical way of monitoring especially on business entities who registered and incorporated in Malaysia. Tremendous growings among the business entities and industries in market causing a vast difficulty for an enforcement officer to perform their monitoring activities. We believe that, the presence of technologies and gadgets in market will ease the monitoring process of enforcement officers as a whole. Therefore, a customized mobile application which enable the CCM’s stakeholders to lodge reports on business entities who failed to comply the provisions under the CA2016 and BA1957 will bring a revolution to this enforcement activity as well.

The aim of mobile apps is to focus on non-compliance by business and company entities who fail to follow the

regulation sets under CA2016 and BA1957. This is to enable the officers to act against those who failed to comply those provisions and at the same time it will create a self-awareness among related entities to comply with rules and regulation. On the other hand, this scenario called as balanced enforcement.

Following are the objectives of the mobile apps:

- To be an information supply platform for SSM employees;
- To access and transmit information without limitation at any point of time;
- To allow the users to take pictures and upload through app upon identify the offences; and
- To record, store, retrieve, submit & search status / result of complaints.

1.1 Problem Statement

One of the major routine operation of Compliance Division of CCM is conducting an inspection on companies and business entities to evaluate their compliance level especially on provision under the CA2016 and BA1956 . There are approximately 1 millions of companies and 6 millions of business entities on market. The number of eligible enforcement officers throughout the nation is around 250 only. The above mentioned situation caused the following problem to CCM as a regulatory agency to control the compliance level of companies and business entities in market:

- Lack of monitoring on business entities due to high volume on number of existing companies and businesses;
- Low compliance rate among the existing companies and businesses; and
- Lack of trust among stakeholders on CCM's supervision

Comparing with the number of existing companies and businesses VS number of enforcement officers in CCM, the probability of inspecting all of them are very little. Statistic shows that, the division's achievement for the past 3 years since 2013 - 2015, less than 1% of inspection conducted throughout the nation by CCM enforcement officers. This result indicate that, by using the classical way of monitoring system, the organisation definitely will not able to achieve a high level of number of inspection on those entities and the figures shows that there are more than 99% of existing companies and businesses entities are remain uninspected. Additionally, the number of companies and businesses is growing rapidly in the market.

1.2 Aims of the Paper

The aim of this article is to present the outcomes of a study which was targeted at innovation activity of Compliance Division of CCM. The ultimate goal is to identify the elements of innovation occurred in the organisation. In order to meet the goal of the project, the following statement considered as an objectives of the study as well:

- To study the relationship between the employee and their innovative ideas; and
- To investigate the effectiveness of innovative project (SSMEYEs Apps) launched by Compliance Division of CCM

The paper presents the results of the research focused on innovation and discusses the importance of innovation at organisation. The first part contains the literature reviews on this area. The next part describes the methodology of the survey according to which was processed, analyzed and evaluated obtained by primary data. The results is divided into the four parts which focus on summarizing the results of original document reviews, the evaluation of results, the verification of results and on the importance of innovation project in an organisation. The part discussion and conclusion includes the summary and specifies the preconditions to gain innovativeness in the organisation.

II. LITERATURE REVIEW

The term "innovation" as such was used for the first time by Schumpeter at the beginning of the 20th century. His ideas and research have been developed by a number of other authors. Schumpeter defined innovations as product, process and organisational changes that do not necessarily originate from new scientific discoveries (Zizlavsky,2011), but may arise from a combination of already existing technologies and their application in a new context (Zizlavsky, 2011). Innovation also originates from public research (Autant-Bernard, 2001). It is therefore possible to summarise that according to these definitions innovations do not cover only technical and technological changes and improvements, but in particular practical application and particularly originates from research.

Human capital and creative research work are according to Zemplerova (2010) and Autant Bernard (2001) considered the most important determinants of innovation. The human factor is an indispensable element in the process of innovation. Based on analyses of external and internal conditions, people generate ideas that might help an organisation gain a competitive advantage and thus distinguish it, at least for a certain period of time,

from its competitor. Innovation capability of an organisation according depends closely on its intellectual and/or organisational knowledge assets and on its ability to employ these assets.

An innovation at organisation, contributes to achieving a competitive advantage in several aspects. The most important characteristics of innovations include:

- A strong relationship between work performance and new project.
- New project improve the productivity.
- Will lead for career enhancement of an employee
- Will lead to production time shortening and speed up current working process in organisation.

If an organisation is not capable of introducing innovations on an ongoing basis, it risks that it will lag behind and the initiative will be taken over by other entities. Schumpeter (in Tidd et al.,pp. 8, 2006) asserts that entrepreneurs attempt to use technological innovation – a new product or service or perhaps a new process in the course of their production – provided they thus gain a strategic competitive advantage.

According to Vodafone Institute’s report, Mobile application management covers solutions that relate to the administration, protection and procurement of mobile applications for corporate IT. It also includes the development and enforcement of rules and policies, which apply to the usage of mobile applications within the organization.

Innovation is one of the most important concerns of each organization and its role in the development and coordination of the market is inalienable. Innovation in all human areas is applicable from product development, methods of management, ways of doing works and etc. In all of definition used for innovation, changing or improvement of the process or product are common. Innovation is a process that begins with introduction to plan of an idea and will become a new function and so it different from creation. The main point is that innovation is different from creativity. In this paper the important of innovation and its crucial role in growth, survival and success of organizations is discussed.

2.1 Conceptual workflow & design

SSMEYE’s App was designed with the consideration of monitor the compliance level of companies and business entities in malaysia which targeted will simplify the Standard Operating Procedures (“SOP”) and increase the number of inspection as whole. SSMEYE’s Mobile App promotes a efficient solution which provides a total mobility and real-time connectivity between the enforcement officers and the business entities.

2.2 Conceptual workflow

This conceptual workflow was developed to tackle issues highlighted by Compliance Division in CCM as follows:

- i. Lack of monitoring on business entities due to high volume on number of existing companies and businesses;
- ii. Low compliance rate among the existing companies and businesses; and
- iii. Lack of trust among stakeholders on CCM’s supervision

By using SSMEYE’s App enable the officers to act against those who failed to comply those provisions and at the same time it will create a self-awareness among related entities to comply with rules and regulation.

Figure 1 shows the process flow of SSMEYE’s Application.

Figure 1: Process Flow of SSMEYE’s Application

III. METHODOLOGY

Emory & Cooper (1991), suggested that for the research objective to be obtained and for the empirical evidence to be discovered, the overall programmed and the structure of the issue under investigation is planned by using the research design. Therefore, the selection of research methodology being engaged depends on the research’s features, nature and background. The investigation is targeted on the existing development of value management in the organization and to discover the value management application level in the organization. Thus, discussion on factors such as cost, time, information associated to the enforcement division is involved that will provide a holistic view of its consequences internal to the organization. Basically data can be divided into 2 types of data.



They are primary and secondary data. Primary Data According to Naoum (2003), primary data is regarded as the

first hand data collected by the researcher through reports, records, survey, questionnaire, and etc. Secondary Data Again described by Naoum (2003), secondary data is referred as data obtained from the desk of study method. Secondary data actually means that the data is not collected by the researcher him or herself, but collected from another different source.

For this research, Statistic of the physical inspection and monitoring on companies and business entities in Malaysia by CCM’s enforcement officers was obtained to compare the result of SSMEYE’s Apps with classical way of inspection. Primary data were obtained through original project documents, interviews and emails reviews which carried out at CCM and evaluated using some data analysis and comparison methods. Data gathered from mobile app and records from compliance division is regarded as the primary data source and literature review is regarded as the secondary data source, which is relevant as it being conducted by quantitative approach. The analysis was carried out using the Microsoft Excel 2007 and SPSS programmes.

IV. FINDINGS

The section presents and evaluates the outcomes of the statistic gathered fro SSMEYE’s Application on the number of inspection done by CCM

Results of survey focused on number of inspection done after the implementation of the mobile app. Based on the data obtained from the quantitative survey and its evaluation, it is possible to state that at present style of inspection is more effective way for compliance unit to perform their job and make the business entities comply with the organisations objective. Table 1 shows the increasing number of inspection in compliance unit.

Table.1: Number of Inspection

Year	Inspection
2014	17,188
2015	16,977
2016	19,234
2017 (till 31 st June)	15,600

Find that the number of inspection before introducing SSMEYE’s are lesser because the ispection is carried out in a classical way by 250 compliance officers in Malaysia. In 2017 till 31st June, the number of ispection is reaching almost same as 2014 to 2016. This is because of the new way of the inspection which monitored by 1200 all employees of CCM. The compliance rate of the companies also increasing. Figure 2, shows the increasing compliance rate of the companies.

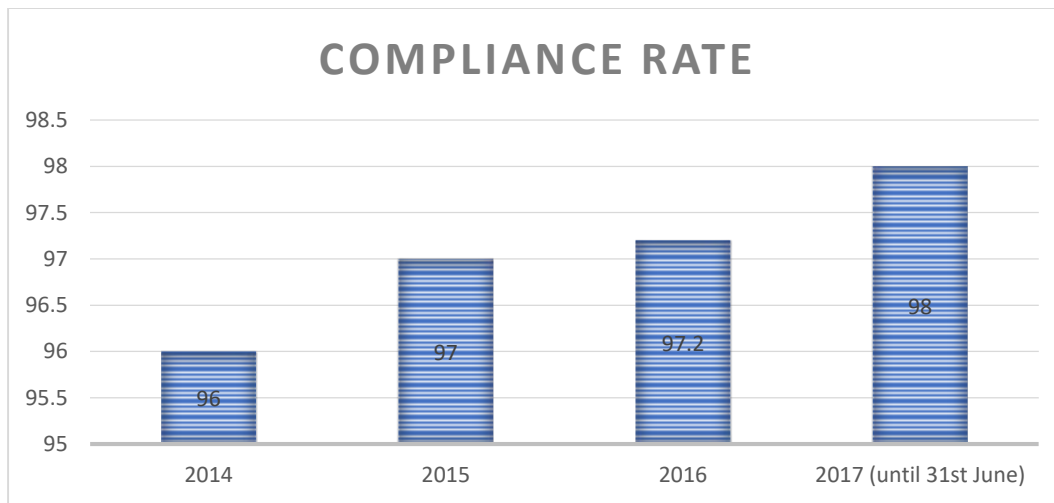


Fig.2: Increasing Compliance Rate

From the findings of the research, the value management factors which is cost, time, information are added value for the Organisation. This can be proof from the compliance rate. From 2014 until 2016 there are only classical way of monitoring done by the compliance officers. In that period, they spent much time on doing inspection using physical

papers. Checking the documents one by one. Other than that, they also spent money for travelling to the companies and printing the checklist for the inspection. All those spendings are now reduced by implementing the mobile application. The results shows that, in 2017 the compliance

rate reach 98% in 6 months. This means the innovation added value for the Compliance Division in CCM.

V. CONCLUSION

The basic approaches of the application of the SSMEYE's is to monitor the compliance level of companies and business entities in Malaysia will simplify the Standard Operating Procedures ("SOP") and will increase the number of inspection as whole. From the research we can conclude that, Innovation as we seem to know can create real, often substantial value, capable of adding significantly to the growth of organizations.

It is the growth enabler. So we need to unlock innovations prospective tangible value from its many intangible capitals that form unique and constantly evolving relationships. We need to evolve our innovation thinking, we need a more integrated approach. The more we are explicit and articulate our value creation, giving it clarity and context, the more we are treating innovation as the central point of driving our value creation management. Organizations need innovation, it is, or certainly should be unique, strategic and working at the core. Innovation has transforming power.

Whether in new ventures or in a corporate setting, what drives innovation forward is the ability to identify, prioritize, and systematically manage risks. The strategic product value management process provides a robust framework to manage risks throughout the innovation process along the product life cycle. Success requires developing three capabilities: an organizational structure that supports design to value and designed to cost.

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E-Services Effectiveness: A Case of Companies Commission of Malaysia

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Abstract— *E-Technology has become a reason for enabling more effective government through better access to services and the democratic process. Technology make both the public and private sector work more effectively by giving attention to the needs of customers while, at the same time, reducing costs, time and improving the quality of services. This paper, will discusses some of the key aspects of e-Service providing in Companies Commission of Malaysia (CCM) and the role of internal IT department and operational department to encourage the eservices in CCM to cater the drastically increasing application. Method undertaken in this study was through interviews with project sponsors and a number of other stakeholders and surveys of several focus groups of users. Data were collected using online questionnaire from CCM customers, employees and interview the stakeholders such as board of members. An online questionnaire survey of CCM employees was sent, accompanied by email imitating respondents to existing customer. This study will add more information on how to examine the value and the effectiveness of e-Services with a focus on three specific aspects of effectiveness such as the view of management and IT department; social, cultural and ethical implications; and the customers view of the usefulness and success of e-Service initiatives.*

Keywords— *E-services, e-technology, Companies Commission of Malaysia (CCM), role of internal IT department, role of operation department.*

I. INTRODUCTION

The Companies Commission of Malaysia (CCM) is a statutory body formed as a result of a merger between the Registrar of Companies (ROC) and the Registrar of Businesses (ROB) in Malaysia which regulates companies and businesses. CCM came into operation on 16 April 2002. The main activity of CCM is to serve as an agency to incorporate companies and register businesses as well as to provide company and business information to the public. CCM's vision is to be a world class corporate registry and regulatory authority that meets business needs through effective registration, information, regulation and advice.

CCM aims to achieve operational excellence in all the activities it undertakes. This requires CCM to be effective as an organization whereby resources are optimized and objectives are accomplished on a timely basis.

CCM understand that, the latest advancements in Information and Communications Technology (ICT) have been the emergence of the Internet, Web-based technologies (eTechnologies) and global networked economies. Today, e-Technologies play an increasingly significant role in our daily lives. They have fundamentally transformed the technological, economic, political and social landscapes. The recent advancement in the field of Information and Communication Technology (ICT) are allowing CCM to create and provide e-services to customer by own R&D using the support available from electronic and digital equipment such as websites, online services like bill payments and social media. ICT facilities make CCM more effectively by giving attention to the needs of customers while, at the same time, reducing costs, time and improving the quality of services. The new Companies Act 2016 which is enforce beginning of 2017 stated that e-document submission only allowed and do not use papers documentation by secretary. The highest achievement of CCM in e-services is have been recognized by the Malaysia Book of Records (MBOR) as the first government agency to implement the Digital Certified True Copy (CTC) service.1

Problem statement

Electronic government forms the foundation for digital or e-Service and depends upon a sound technology infrastructure. However, e-Service is not a technical exercise, but rather an attempt to improve the political and social environment and to drive a fundamental change in the ways in which functions are performed. Effective utilization of technology and financial stability will support CCM to adopt e-services and implement it.

E-Service initiatives inevitably need to take into consideration issues such as new models of policy formulation; alternative forms of citizenship; different patterns and trends of relationship and power; new solutions for economic development; and alternative approaches for

connecting people to the political process. CCM should do market survey about the e-services acceptance of customer before mandatory e-services in CCM. In Malaysia, we can say that not all the government agency willing to adopt e-services but most of the agency trying to develop e-services to improve their services quality.

II. LITERATURE REVIEW

A good analysis about the impact of e-services is that by Brynard (2002) described in Kuye, Thornhill &Fourie (2002). In this work, Brynard argues that “for the government institution itself: an e-government framework creates a huge potential for improving the quality of service, stimulating trade and industry and cutting costs internally. The work of employees of the institution is made more interesting because employees’ electronic work stations draw together the different information that they need. The people and organizations with which the government institution deals will benefit directly from improved knowledge, product and service offerings.”

A review of various case studies of e-Government and e-Service (e.g. Webster 2001, Radics 2001, NIC 2000, Asgarkhani 2003b, and Asgarkhani 2004) suggests that local government objectives in introducing e-Service are likely to concentrate on:

- i. Prompt, accurate service – as local governments potentially receive millions of calls per year, setting a target to resolve a high percentage of these calls the first time they occur (through establishing a customer contact center) can result in significant efficiency gains and cost savings.
- ii. Improved quality of service (by reducing redundancy in service) - One client of a local government can potentially generate up to dozens of files in different locations. Local governments are seeking to convert these to one secure and accessible file - helping to provide continuity and coordination of local government support.
- iii. Removing barriers and tackling social exclusion – Local governments are aware that many clients do not have the skills to use electronic services, yet seem keen on setting up networks of learning centers in libraries and community centers that teach people relevant Internet and Web technology skills.
- iv. Local access points – It appears (Webster 2001) that up to 20% of customer queries cannot be addressed immediately. Clients often need to meet with a “professional.” Local governments can benefit from

setting up community access points to let clients meet ‘professionals’ through online video links.

Today, e-Services appear in various shapes and forms. Typical applications (within both local and national governments) can include: providing access; connecting to a service or a process; facilitating consultation; and enabling active citizen participation

Research Objectives

The important of e-services is operational excellence which is one of the CCM corporate strategies. In this business world customer is king and all need to serve them well. It is applicable for CCM to serve their customer very well by giving excellence services and the same time compete with other government sector as well in providing services. Recently, CCM is deciding to force customer to use of e-services by mandatory e-services and cutting down manual application. It is give positive as well negative impact on customer and organization. Teamwork of each staff in the organization will bring CCM to achieve 100% Government sector who providing e-services only in Malaysia.

In this context, three general questions emerge:

1. Do e-services contribute to cost-cutting in the customer?;
2. Does e-services help customer to receive services more easily and timely?;
3. Does e-services improve the quality of service in the CCM?

III. RESEARCH METHODOLOGY

In order to study the effective of e-services in CCM various approaches were adopted. The methodology for gathering information included interviews with project sponsors and a number of other stakeholders and surveys of several focus groups of users. Data were collected using online questionnaire from CCM customers, employees and interview the stakeholders such as board of members. An online questionnaire survey of CCM employees was undertaken, accompanied by email imitating respondents to existing customer. This method had the advantages of response speed and low cost. An email was sent to the respondents explaining the purpose of the survey, how the sample was chosen and containing contact details as well as a statement that the questionnaire was confidential, anonymous and there was no obligation arising upon its completion.

There are several theories used for this study and indicates some lessons offered from literature reviewed. In this study the discussion is based on leadership theory, bureaucracy and globalization theory. All three theories help this study

to meet its objectives. They help to link issues related to effectiveness such as the view of management and IT department; social, cultural and ethical implications; and the customer’s view of the usefulness and success of e-Service initiatives. The three that concern us here are the leadership theory which is describe the role of the leader as transactional or transformational leader; bureaucracy theory which describes the roles and relations between citizens and bureaucrats; and the theory of globalization that examines the emergence of the global cultural system.

IV. FINDINGS

Once all the questionnaires, interviews and documentation had been completed, the R&D unit assigned reference numbers to questionnaires and then the process of data

analysis started. With the help of SPSS spread sheet the data analysis process was carried out and frequencies and percentages showing how respondents answered each question were generated.

The figure 1 below show that result of the questionnaire survey whereby 56% of respondent age between 18 till 30 accepts implementation of e-services by CCM. It is a big success for CCM to implement e-services and slowly make it e-services as mandatory services in CCM. Based on our objective we examine the value and the effectiveness of e-Services, social, cultural and ethical implications; and the customers view of the usefulness and success of e-Service initiatives. The table 1 below showed the effectiveness, social, cultural and ethical implications and customer view.

Table.1: The effectiveness, social, cultural and ethical implications and customer view

Concept of analysis	Results
Effectiveness	
1. Time	CCM provide fast services
2. Cost	CCM reduce operational cost via less counter operation and paperless
3. Service quality	Provide digital certificate which can access anytime and anywhere
Social, cultural and ethical implications	
1. Time	Save time of public and private sector who dealing with CCM. Do not visit to CCM to get information. The data will be timely and accurate.
2. Cost	Reduce cost of paper and go green. Reduce operational cost for public and private sector who dealing with CCM
3. Service quality	Other government agency access to CCM through collaboration. Customer do not to submit manual document to any agency
Customer view	
1. Time	Customer receives fast services and save waiting time
2. Cost	Customer reduces travelling/parking cost. Do not take off and visit counter CCM
3. Service quality	Access and receive CCM services anywhere and anytime

The main advantage of e-services introduce by CCM is for efficiency. Efficiency consists of two elements, namely time and cost.

- i. Time efficiency: as a result of work process acceleration through standardization, digitization, and automation, but also as a result of faster information processing and accelerated information procurement, ICTs tend to increase time efficiency.

Information Security - technological advancements allow CCM to collect, store and make data available online to individuals and organizations. Customer and other stakeholders expect to be allowed to access data in a flexible manner (at any time and from any location).

- ii. Costs efficiency: The introduction of ICTs in an organization generates both costs and benefits that

can be summarized as follows (Fichman 2004). On one hand, we have tangible costs for hardware, software and telecommunication services as well as costs for development, implementation and training professionals. On the other hand, there are also intangible costs such as lower morale of the employees (as a consequence of automation and less responsibility) and costs for the disruption of operations.

In addition, there are also benefits resulting from the use of ICTs: both tangible benefits such as increased cash flows, increased productivity, lower operational costs, reduced workforce, lower expenses and lower facility costs and intangible benefits such as organizational flexibility, more timely information, better decisions, organizational learning, employee good-will, job satisfaction, client satisfaction and improved corporate image.

Following that, quality is another advantage of e-services introduced by CCM. The data provided will be accurate and in a timely manner. When we compare manual work to e-services it reduces mistakes and leads to an optimization of the customer benefit through proximity and online-services, as well as to administration-internal knowledge optimization (knowledge management / knowledge sharing).

V. CONCLUSION

It appears clearly that the introduction of e-services in CCM will generate good impact for customer and Malaysia government. E-services are very important for government agency to its day to day operation to improve the service quality. CCM knows that it is the monopoly in the market to supply data of companies and business registered under the CCM. CCM is regulating 1.1 million companies and 5.6 million businesses registered with them and need to supply timely and accurate data to all stakeholders from Malaysia and other countries as well. Transformation from traditional services to e-services is necessary to CCM to improve its services and run its daily activity smoothly. By 2020, CCM aims to mandate e-services to their customers and stakeholders which will enhance CCM to improve their services according to advanced technology.

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Value Management: Implementation of Asset Life Cycle in one of Oil and Gas Service Company

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Abstract— This paper reviews the role played by a company's project asset in stimulating operational performance for oil and gas company, which is moderated by asset readiness in life cycle activities. The constructs of this paper are based on a comprehensive review of recent literature on value management, asset management and asset life cycle costing. A detailed discussion revealed effects activities on asset acquisition, asset maintenance and asset disposal. Several risks also have been identified. Implementing good asset management system will give value to an organization. It considers and optimizes the conflicting priorities of asset utilization and asset care, of short-term performance opportunities and long-term sustainability, and between capital investments and subsequent operating costs, risk and performance. "Life cycle" asset management is also more than simply the consideration of capital costs and operating costs over pre-determined asset "life" assumptions. Truly optimized, whole life asset management include risk exposures and performance attributes, and considers the asset's economic life as the result of an optimization process (depending upon the design, utilization, maintenance, obsolescence and other factors). In summary, this paper highlights the importance of Asset life cycle activities toward operational performance of PBJV Company, as well as reviews the latest literature from the perspective of value and asset management.

Keywords—Value Management, Asset Life Cycle, Asset Management.

I. INTRODUCTION

Most people today would agree that long-term profitability is the main objective of private enterprise, while the timely delivery of needed services would describe the goal of public bodies. They would also quickly point out that the products and services these entities produce should be competitively priced and efficiently provided while meeting or exceeding the performance expectations of their customers. In order to adapt to an ever-changing

environment, organizations are challenged to make better use of their most important resource, their people.

Lacking the compass of value, an organization is in danger of losing its way. Additional, if it can find its compass, it must become fluent in its use in order to interpret its meaning. All of this first requires an acknowledgment that the organization lacks the tools, training, and necessary attitude by its leaders. Developing this insight is the first step, and the greatest hurdle, to overcome. In today's economic environment, maintaining a focus on performance while controlling costs and managing risk are essential for long-term survival and sustainable growth.

Value management (VM) is a service which maximizes the functional development from concept to completion, through the comparison and audit of all decisions against a value system determined by the client or customer. Value management is an integrated, organised and structured process, led by an experienced facilitator and broken down into various stages to enhance the value of any projects, not necessarily only by cutting costs.

Meanwhile, the focus of asset management (AM) is on the strategic alignment of physical assets as an organizational resource with the organization's strategy. At the core of this is how physical assets enable those strategies and as a result add value, either commercially, socially and/or politically. As such, AM manages the linkages between the organization's strategic plan and the whole life management of physical assets, the subsequent investment decisions associated with managing those assets through time, and any related bundle of 'rights' and 'interests' that may be involved in the use of assets to create value for an organization. There is a consequent close alignment with the philosophy of asset management and that of value management (VM).

The importance of asset management for Barakah Offshore Petroleum can be seen from projects' profit recently. Barakah Offshore Petroleum Berhad ("Barakah" or "Company") was incorporated in Malaysia on 1 March 2012 as an investment holding company for PBJV Group SdnBhd (PBJV) and its subsidiary companies (collectively

referred to as “Barakah Group” or “Group”). The business of PBJV started in August 2000 in offshore pipeline services. PBJV has since grown to become one of Malaysia’s leading companies in pipeline services.

In 2012, PBJV was recognized with the Outstanding Vendor Award from PETRONAS CarigaliSdn Bhd. Being focused and committed in this ever-challenging industry and consistently striving to be the best, are the key success factors of the company. From pipeline services, PBJV expanded its business activities into offshore transportation and installation works, hook-up and commissioning, onshore construction, underwater services and chartering of marine vessels and equipment.

In 2009, as part of its expansion strategy to strengthen its offshore installation services, PBJV commissioned the construction of its 137 meter length pipe-lay accommodation barge, known as “KOTA LAKSAMANA 101”. With this barge ownership, PBJV is able to undertake bigger and more challenging offshore pipeline activities. In 2016, PBJV added another business pillar, Underwater Services involving inspection, maintenance, repair, drilling support and related services for underwater facilities. Barakah Group is poised to be a “one-stop center” as an integrated oil and gas service provider.

PBJV’s departments that need to do research is Operation Support and Asset Management Department. The objective of this department is to be the central operational-asset management function for the operation at company level, coordinating and providing inputs to asset planning, taking a role in providing: equipment and machineries to support the in-house operations, its logistics, acquiring assets, yard management and providing facilities for maintenance of assets throughout its useful life that ensures a company's assets are used in the most efficient manner and maximizing an asset's lifespan to achieve the greatest benefit at the lowest cost while enhancing its profitability.

1.1 Problem Statement

Asset management is being regarded as a key element for PBJV’s operation activities and has value to PBJV. When asset support activity is successful, it gives impact to the overall company performance. It enables PBJV to maximize value and deliver its strategic objectives through managing its assets over their whole life cycles.

Owned Asset utilization has been practiced by many oil and gas companies due its less consuming funds to be allocated by the management. Therefore, it has become the most preferred choice by many corporations. Generally, companies understand that huge amounts of money are

needed to be allocated for companies to rent asset for project support.

There has been increased in cost and risk when asset was not managed properly. Asset lifecycles activities included in procurement and asset acquisition, asset maintenance and asset disposal activities need to be measured more details.

Therefore, a company’s wise decision to use and manage their own asset should be seen as long term investment to safeguard its own business. This is yet to be revealed in order to see how effective asset utilization can play its role to be a key element in project support. To conclude, this study is important to know if it possible to put a strong emphasis that asset lifecycle activities consideration can play its role to support the delivery of an organizational strategic plan, in turn aiming to meet the expectations of a variety of stakeholders.

1.2 Aims of the Paper

The need for asset management as a recognized discipline arises from the complex technical nature (Nicholas, 2015). In recent years, a determined effort by those working in the field has resulted in the development of a formal approach to asset management systems, knowledge, and education. This led to the publication in 2014 of the International Standards Organization’s ISO 55000 series of Asset Management standards (ISO 55000, 2014). This study mainly focuses on Asset Management practices in OSAM. It studies the interrelationship between several activities in asset lifecycle. More specifically, the main objectives of the study are:

- a) To enable PBJV to realize value from its assets as it pursues its organizational objectives. Asset management supports the realization of value while balancing financial, environmental and social costs, risk, level and quality of service, and asset performance.
- b) To understand the reason for asset life cycle costing and have seen a check list of factors that go into a life cycle costing analysis. □ To improve efficiency and effectiveness by reviewing and improving processes, procedures and asset performance

The paper proceeds as follows: firstly, the researchers provide the literature review pertaining to asset lifecycle activities in global and its relation to the current practices of asset activities in PBJV. Subsequently, the concept of asset lifecycle activities is elaborated followed by a description of audit. Later on, it continues with a description of the sample, observation and potential risk. The paper ends with

a discussion and suggestions for PBJV to practice the concept elaborated in the discussion.

II. LITERATURE REVIEW

The concept of Value is based on the relationship between satisfying needs and expectations and the resources required to achieve them. According to Othman, (2012) and Che Mat (2001) the main objective for VM is to merge all stakeholders' views and to obtain the greatest balance between satisfied needs and resources.

“VM is concerned with improving and sustaining a desirable balance between the wants and needs of stakeholders and the resources needed to satisfy them (<https://ivm.org.uk/what-is-value-management>)”

Stakeholder value judgements vary, and VM merges contradictory priorities to deliver best value for all stakeholders (<https://ivm.org.uk/what-is-value-management>). VM is based on principles of defining and adding measurable value, focusing on objectives before solutions, and concentrating on function to enhance innovation. It uniquely combines within an integrated framework a value focused management style; a positive approach to individual and team motivation; an awareness of the organizational environment; and the effective use of proven methods and tools.

An asset is an item, thing or entity that has potential or actual value to an organization. The value will vary between different organizations and their stakeholders, and can be tangible or intangible, financial or non-financial (ISO 55000). The period from the creation of an asset to the end of its life is the asset life. An asset's life does not necessarily match with the period over which any one organization holds responsibility for it; instead, an asset can provide potential or actual value to one or more organizations over its asset life, and the value of the asset to an organization can change over its asset life. An organization may choose to manage its assets as a group, rather than individually, according to its needs, and to achieve additional benefits. Such groupings of assets may be by asset types, asset systems, or asset portfolios.

III. METHODOLOGY

An asset management system is used by the organization to direct, coordinate and control asset management activities. It can provide improved risk control and gives assurance that the asset management objectives will be achieved on a consistent basis. The process of establishing an asset management system requires a thorough understanding of

each of its elements and the policies, plans and procedures that integrate them.

Key elements of good practice in AM encompass the development of a physical asset strategy, which establishes the portfolio of physical assets that most appropriately, effectively and efficiently meets an organization's service delivery requirements, and in turn relates and supports directly organizational strategy (Lyons, 2004). This forces an organization to consider why it needs to invest in certain physical assets, maintain or renew others, and also consider divesting itself of other physical assets that are no longer required or are obsolete.

The organization, having established a physical asset strategy and the associated scope of its asset portfolio, needs to manage this through time on a whole life basis (TAM, 2013). Within an asset strategy, this requires consideration of the following (TAM, 2006): Capital investment and procurement costs, which would include the acquisition, renewal and adaptation of physical assets, the maintenance costs over the life of the asset, the operating costs over the life of the asset, including staffing and finally any disposal costs.

Life cycle costing (ISO 55002) is the estimation of the cost of acquiring, commissioning, operating, maintaining, and disposing. It is a “cradle to grave” cost analysis. The aim of life cycle costing is to ensure that all relevant costs are identified, and that through life costs are considered at the planning, acquisition, and budgeting stages.

PBJV need life cycle costing to assist company with the following types of asset management decisions: Acquisition decisions, with consideration of the life cycle costs of different acquisition options, life cycle asset management planning as an input into determining the operating and maintenance resources and budget for in-service assets and finally for replacement decisions.

IV. FINDINGS

Asset Acquisition

Data or findings were collected on the variables of asset lifecycles included in procurement and asset acquisition, tracking of asset movement, asset maintenance and asset disposal activities.

Additional assets can be acquired in various ways from other organization. This include purchase of assets that are already operational, or accepting the hand-over of asset constructed by others. This can either be as the owner, or contracted to manage the assets for a defined period. This first observation considers the creation, installation and commissioning of assets, including elements of approval

and release of funding, arrangements for hand-over to operations, and the monitoring and capture of ‘as-built’ costs.

Establishment of capital expenditure budgetary procedures was observed. From Limit of Authority (LOA) of company states the authorities with regards to recommend, approve and inform of budgetary activities, including preparing budget (CAPEX and OPEX). However, the company has yet to establish policies and procedures relating to preparation and monitoring of CAPEX budgets as illustrated below:

Nevertheless, for the year 2016, Operation Support Division of PBJV has prepared a New Asset Requisition Plan (NARP), to plan for asset acquisition for Pipeline Services and Hook-up Departments. The asset purchases were tracked by Operation Support Division against the NARP. In reviewing the NARP, we noted the following: requisition of new assets was omitted from NARP, approval of NARP, limitations in monitoring of NARP. Management represented that CAPEX budget for 2017 was approved as a Group-level effort and had been approved by the Board on 25 November 2016. However, the Company has yet to establish guiding procedures on budgeting activities, e.g. preparation and monitoring.

Effect of potential risk included CAPEX budget prepared may not be aligned to Company’s operation requirements and financial capabilities to finance the purchase; Inaccurate projection of CAPEX leading to in ability to assign appropriate amount of funds to various areas of expenditure and significant excess in capital expenditure may not be readily identified and the justification may not be timely provided for remedial action.

Asset Maintenance

The aim of maintenance is to deliver availability of machines and equipment to operation departments, within the envelope provided by underlying machine condition and the available resources. Maintenance management systems are often used to coordinate maintenance activities. These systems may be based on simple scheduling tools, such as card/index systems, or more sophisticated work programming and schedule optimization tools (Higgins,

2008). Second observation relating with enhancement in monitoring of maintenance of equipment.

Based on current practices, scheduled and unscheduled maintenance works are requested by appointed Maintenance Contractor using Equipment Maintenance Request Form and verified by the Asset Management Department (“AMD”). Details on work performed are reported in Equipment Repair Report which would then be verified and closed by AMD. In addition, progress of maintenance work carried out for each equipment in Miri, Paka, Puchong and Kota Kinabalu is recorded in the Master Equipment List (“MEL”) maintained by the maintenance provider, i.e. Dynamic Curve SdnBhd (“DCSB”). The MEL is submitted by DCSB on a monthly basis to AMD for monitoring purposes.

In our review of maintenance works done under the purview of AMD, we noted the following enhancement opportunities in the monitoring of machine maintenance: documentation on maintenance work reported not found, maintenance performed not reflected in Master Equipment Listing of DCSB and absence of analysis on machine condition, downtime and breakdown. The causes of machineries repair/breakdown are recorded in the Equipment Maintenance Request Forms by DCSB. However, a trend analysis on persistent problems that recur over a period of time was not reported and monitored.

Service month

Maintenance work 1 PBJV-FP-09 Flooding pump Miri May
New major service 2 PBJV-HYD-04 HydratronPaka June
FRL and check valve damage 3 PBJV-FP-23 Flooding pump Miri August
Faulty tachometer (Source: Master Equipment Listing of DCSB for the respective months)

Effect or potential risk include The lack of proper maintenance may accelerate the process of an equipment’s efficiency to diminish, which in turn may cause it to burn up energy and shorten its useful life and in the absence of equipment breakdown analysis, management would not be able to readily identify equipment that frequently fail or those that are beyond economic repair and continuously spend high maintenance costs.

Table.1.

No.	Tag ID	Equipment Type	Location	Service month	Maintenance work
1	PBJV-FP-09	Flooding pump	Miri	May	New major service
2	PBJV-HYD-04	Hydraton	Paka	June	FRL and check valve damage
3	PBJV-FP-23	Flooding Pump	Miri	August	Faulty tachometer

Source: Master Equipment Listing of DCSB for the respective months

Asset Decommissioning and Disposal

Although assets can have long lives well beyond normal business cycles, there almost invariably comes a point where they are removed from service, decommissioned and disposed. There are many factors that can drive the decommissioning of assets, including: noncompliance with changes in legislation, inability to deliver revised levels of service, obsolete technology, cost of retaining in service and excess of service capacity (Campbell, 2016).

Final observation related with delays in technical assessment of assets. In perusing the Master Equipment List ("MEL") maintained by Asset Management Department ("AMD"), we noted that a total of 49 equipment were indicated as Beyond Economic Repair ("BER") or Quarantine ("QR"), which meant that they were not in use due to their inoperable condition or obsolete technology. The NBV of the BER and QR equipment as at 30 September 2016 and their respective locations are summarized below.

In Asset Disposal Procedures states that AMD should perform inspection and maintain documentation relating to the asset and inspection performed. However, as at 22 December 2016, only nine (9) out of 49 equipment were supported with technical assessments on the condition of each equipment as well as reason and proposed method of disposal, which performed by Dynamic Curve SdnBhd ("DCSB"). We noted that there was an instruction from AMD for DCSB to perform the technical assessments on 17 September 2016 and also reiterated in the PBJV Operation Support meeting on 11 November 2016 for the disposal procedures implementation to be expedited. Potential risk may rise include undue utilization of space for storage of unusable assets.

V. SOLUTIONS

PBJV would be involved in multiple activities in asset management system when running any of their projects. The proposed improvement is as follows:

- a) To enhance the budgetary process, management should consider feasibility of incorporating CAPEX budgeting as part of the Company's annual budgetary process and to designate a particular department to plan and co-ordinate CAPEX requirements of both operational and support functions of the Company; basis of the CAPEX budget,
- b) nature and value of each purchases, should be justified by the originating/ requesting department/ division showcasing its consistency with the

Company's activities in the forthcoming year as well as condition of existing assets as far as asset replacement programs are involved;

- c) the preparers and reviewers of the CAPEX budget should provide their acknowledgment (e.g. sign-off) at the respective points of their involvement in the budget preparation stage to accord proper endorsement of the budget;
- d) collaboration with Finance should be made prior to seeking approval of the CAPEX budget for cash flow planning purposes,
- e) and at the monitoring stage as an additional check and balance function; inclusion into periodic financial reports to Management on reporting of CAPEX budget variance analysis,
- f) i.e. comparison between budgeted to actual expenditures as well as explanatory notes to justify significant variances;
- g) as the authorization levels have been provided in the LOA to safeguard interest of the Company, these should be strictly adhered to in obtaining budget approvals, including re-allocations; and establish in writing and;
- h) formalize the relevant practices into standard operating procedures to provide structured guidance to personnel involved in the CAPEX budgetary process,
- i) to address the activities involved, documentation required and roles of responsible personnel.

Management should consider implementing an asset management system which tracks the following: completion of maintenance jobs for each equipment, with comparison made against the respective equipment's planned preventive maintenance schedule; and repair/ breakdown analysis by noting the types, severity, period, duration and root causes of each breakdown occurred.

Management should also ensure that documentation on all maintenance work performed are properly kept, including the request, types of repair works carried out, verification of work performed and analysis on the causes thereof. Conducting formal diligent recording and reviewing of equipment breakdowns would assist Management in determining whether the said equipment is beyond economic repair and should be scrapped.

The information could also be used to appraise the quality of maintenance services rendered by the outsourced service provider, including the quality of parts used. The analysis on BER/ QR equipment should be expedited for asset

disposal procedures to be followed through with approvals obtained in accordance with the LOA.

VI. CONCLUSION

Asset management as the term adopted in this article encompasses the effective and efficient management of physical assets as PBJV resource. Asset Management is an extensive and robust overarching organizational capability and framework that is strategic and operational in nature, acts as an interfacing function between organizational strategy, and the strategic, tactical and operational use of physical assets to enable organizational functioning over time.

Value management has an important role to play in asset management. Its role is to understand the linkage, requirements and resolution between organizational strategies, the organization's use of physical assets, and the subsequent prioritization of investment for the creation, renewal, maintenance, disposal and management of physical assets through time (Kelly & Graham, 2015). It also has a focus on decision making interfaces along the AM line-of-sight with respect to prioritizing investment in physical assets and their role in PBJV. In short, the role of VM in asset management is to analyze, explore, develop and implement options to improve the strategic fit between an organization's strategies and its use of physical assets to maintain or enhance organizational value.

To ensure lifecycle value realization, the activities undertaken by PBJV need to balance the costs of different renewal, maintenance, overhaul and disposal interventions. It includes the methods used to ensure the best total value is obtained, by consideration of the interaction between the life cycle activities, and determination of the optimal combination, including costs, risks, performance and sustainability effects. The total value needs also to be considered at the level of asset system or asset portfolio.

In conclusion, VM has an important role to play within the discipline of asset management due to its focus on value, value for money and whole life thinking. The disciplines are complementary and self-reinforcing. In particular, the emphasis on value and whole life thinking reinforces the important role that value management can play within the AM discipline both are strategic, business and organizational strategy focused.

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Design and Implementation of Welding Mobile Robot Using a Proposed Control Scheme Based On Its Developed Dynamic Modeling for Tracking Desired Welding Trajectory

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Abstract—This paper presents a proposed control scheme that makes the combination of a kinematic controller (KC) and an integral sliding mode controller (ISMC) for a welding mobile robot (WMR) to track a desired welding path. First, a posture tracking error vector is defined and a kinematic controller is designed based on kinematic modeling to make the tracking error vector go to zero asymptotically. Second, a sliding surface vector is defined based on the velocity tracking error vector and its integral term. And then, an integral sliding mode dynamic controller is designed based on developed dynamic modeling to make velocity tracking error vector also go to zero asymptotically. The above controllers are obtained by backstepping method. The stability of system is proved based on the Lyapunov stability theory. To implement the designed tracking controller, a control system is developed based on DSP F28355 and ATmega328. A scheme for measuring the posture tracking error vector using torch sensor is presented. The simulation and experiment results are shown to illustrate effectiveness and the applicability to the welding industry field of the proposed controller.

Keywords—Kinematic Controller (KC), Integral Sliding Mode controller (ISMC), Welding mobile robot (WMR), Lyapunov Stability Theory.

I. INTRODUCTION

Over the past few decades, the sliding mode control (SMC) technique for nonlinear mechanical systems has been studied extensively by many researchers [1-15]. The main idea of using the SMC approach is to cope with the parametric uncertainties and external disturbances under matching conditions for the complex nonlinear systems exist in practical applications such as robotics manipulator, welding mobile robot,...[1,2]. Recently, many robust control algorithms using SMC [8-15] or combined with fuzzy logic [7], neural network [4,6], adaptive [3-4] have been proposed to deal with the trajectory tracking problem including system dynamics

[3-15]. Most of them, they used a control scheme of integrating a kinematic modeling into a dynamic modeling [4-7,9-14] or used only kinematic controller [8]. However, the linear velocity of mobile robot [9-12] or welding point of welding mobile robot was not keep constant velocity smoothly as desired [13-14]. Hung, et al. [15] proposes a new tracking controller that combines a kinematic controller and an integral sliding mode dynamic controller for an omnidirectional mobile platform to track a desired trajectory at a desired velocity of an OMP under disturbance and surface friction. It guarantees that the mobile robot has a good tracking performance.

To solve the problem of trajectory tracking of welding mobile robot, this research presents a proposed control scheme that makes the combination of a kinematic controller (KC) based on the kinematic modeling and an integral sliding mode dynamic controller (ISMC) based on the developed dynamic modeling considering at voltage level for the WMR to track a desired welding trajectory at a desired velocity. The above controllers are obtained by backstepping method. The system stability is proved using the Lyapunov stability theory. To implement the designed tracking controller, a control system is developed based on DSP F28355 and ATmega328. A scheme for measuring the posture tracking error vector using torch sensor is presented. The simulation and experiment results are shown to illustrate effectiveness of the proposed nonlinear controller.

II. SYSTEM DESCRIPTION AND MODELING

In this section, the system description, dc servo motor modeling, the kinematic and dynamic models of a welding mobile robot (WMR) are presented.

1. System description

Fig. 1 shows the 3D configuration of a welding mobile robot (WMR) used in this research in three sides. It consists of platform, two wheels, DC servo motors and encoders, welding torch, power supply and a electronic

control system, etc. Fig. 2 shows the 2D configuration for geometric model of the WMR. For simplifying the modeling of WMR, the assumptions are given as follows [10-14]:

- (1) Kinematic's parameters such as wheel's radius r and distance b are known exactly.
- (2) Moment of inertia of WMR is constant during welding process.
- (3) A disturbance vector exerted on the WMR consists of surface friction and slip phenomenon between wheel and the ground.
- (4) Motion surface is a smooth horizontal plane.
- (5) The WMR has two driving wheels for platform motion, and those are positioned on an axis passed through the WMR geometric center,
- (6) Two passive wheel which have zero constraint are installed in front and rear of the platform at the bottom for balance of WMR. So their motion can be ignored in the kinematic and dynamic models.

A welding torch is located to coincide the axis through the center of the two driving wheels. The radius of welding curve is sufficiently larger than turning radius of the WMR.

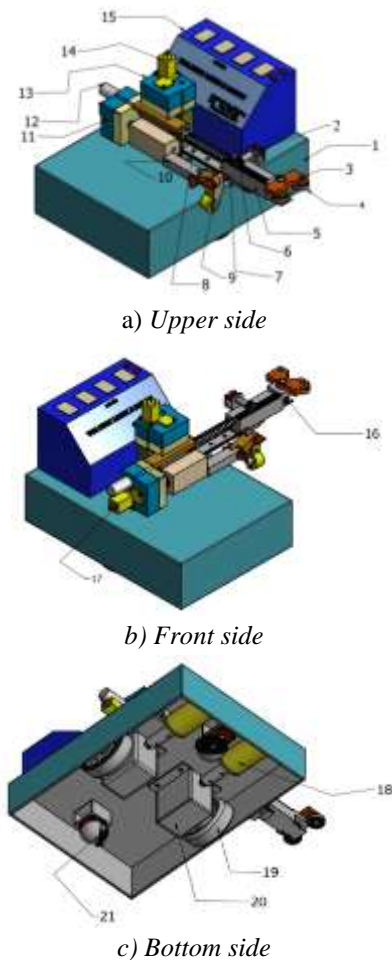


Fig. 1: 3D configuration of the welding mobile robot

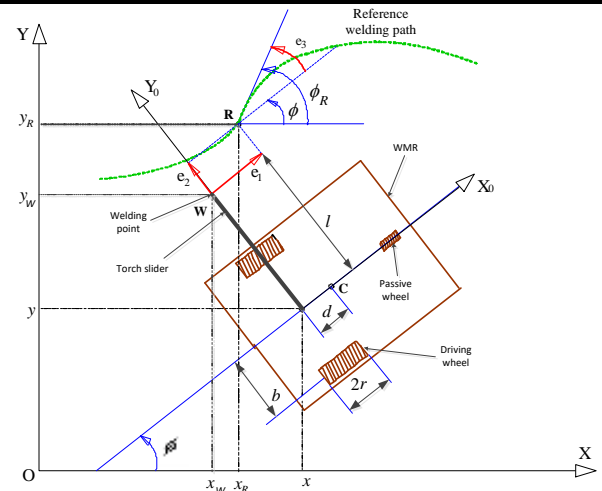


Fig. 2: Configuration for geometric model of the WMR in the Cartesian coordinates

The detailed components of the welding mobile robot are presented in Table 1.

Table.1: Detailed components of the welding mobile robot

No.	Name	No.	Name
1	Platform	11,	Gear box
2	Potentiometer	12	Encoder
3	Rotary claw	13	Gear
4	Roller	14	DC motor acting on height of welding torch
5	Straight gear	15	Display and keypad
6	Gear and bar	16	Potentiometer
7	Sliding bar	17	DC motor for controlling torch slider
8	Springs	18	DC motors acting on left and right wheels
9	Clamp mechanism	19	Left and right driving wheels
10	Welding hand grip	21	Passive wheel

2. DC Servo Motor Modeling

This section presents the modeling of DC servo motor [9]. Schematic of the DC servo motor plus wheel is shown in Fig. 3.

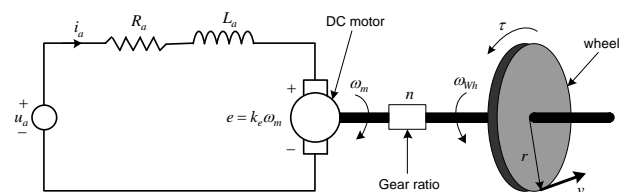


Fig. 3: Circuit schematic of the DC motor plus wheel
 The dynamics of each DC servo motor is described as follows:

$$u_a = R_a i_a + L_a \frac{di_a}{dt} + k_e \omega_m \quad (1)$$

Since the electrical time constant of the DC servo motor is very small compared to the mechanical time constant, the motor electric circuit dynamics can be neglected,

which leads to $L_a \frac{di_a}{dt} = 0$.

Eq. (1) is rewritten as

$$i_a = (u_a - k_e \omega_m) / R_a \quad (2)$$

The relation between ω_m and ω_{wh} is

$$\omega_m = n \omega_{wh} \quad (3)$$

Torque of DC servo motor is given by

$$\tau = k_t i_a \quad (4)$$

Substituting Eqs. (2)~ (3) into Eq. (4), the following is obtained

$$\begin{aligned} \tau &= k_t (u_a - k_e \omega_{wh} n) / R_a \\ &= (k_t / R_a) u_a - (k_t k_e / R_a) \omega_{wh} n \\ &= \alpha u_a - \beta \omega_{wh} \end{aligned} \quad (5)$$

where $\alpha = k_t / R_a$ and $\beta = k_t k_e n / R_a$ are motor characteristic coefficients depending on the parameters of DC servo motor.

3. Kinematic Modeling

A reference point R moving with the constant velocity of v_R , the coordinates (x_R, y_R) and the heading angle ϕ_R on the reference welding path satisfies the following equations:

$$\begin{cases} \dot{x}_R = v_R \cos \phi_R \\ \dot{y}_R = v_R \sin \phi_R \\ \dot{\phi}_R = \omega_R \end{cases} \quad (6)$$

The kinematic equations for the center point of the WMR are set up as the following:

$$\begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{\phi} \end{bmatrix} = \begin{bmatrix} \cos \phi & 0 \\ \sin \phi & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} v \\ \omega \end{bmatrix} \quad (7)$$

where $q = [x, y, \phi]^T$ is the posture vector of WMR rotating center point $C(x, y)$ in the Cartesian frame, $z = [v \ \omega]^T$ is the actual velocity vector.

The relationship between v , ω and the angular velocities of right wheel ω_{rw} and left wheel ω_{lw} is given by

$$\begin{bmatrix} \omega_{rw} \\ \omega_{lw} \end{bmatrix} = \begin{bmatrix} 1/r & b/r \\ 1/r & -b/r \end{bmatrix} \begin{bmatrix} v \\ \omega \end{bmatrix} \quad (8)$$

In Fig. 2, the kinematic equation of the welding point $W(x_w, y_w)$ which is fixed on the torch holder can be calculated from the WMR's center $C(x, y)$ as follows:

$$\begin{cases} x_w = x - l \sin \phi \\ y_w = y + l \cos \phi \\ \phi_w = \phi \end{cases} \quad (9)$$

The derivative of Eq. (9) yields

$$\begin{bmatrix} \dot{x}_w \\ \dot{y}_w \\ \dot{\phi}_w \end{bmatrix} = \begin{bmatrix} \cos \phi & -l \cos \phi \\ \sin \phi & -l \sin \phi \\ 0 & 1 \end{bmatrix} \begin{bmatrix} v \\ \omega \end{bmatrix} \quad (10)$$

where l is assumed to be constant.

4. Developed Dynamic Modeling

In Fig. 2, using the references from [10] to [14], the developed dynamic equations of the WMR considering at DC Servo motor voltage level is rewritten as follows:

$$\bar{H}(q)\dot{z} + [\bar{B}(q, \dot{q}) + F]z + u_d = u \quad (11)$$

where

$$\begin{aligned} \bar{H} &= \frac{1}{\alpha} \begin{bmatrix} \frac{r^2}{4b^2}(mb^2 + I) + I_w & \frac{r^2}{4b^2}(mb^2 - I) \\ \frac{r^2}{4b^2}(mb^2 - I) & \frac{r^2}{4b^2}(mb^2 + I) + I_w \end{bmatrix}, \\ \bar{B} &= \frac{1}{\alpha} \begin{bmatrix} 0 & \frac{r^2}{2b} m_c d \dot{\phi} \\ -\frac{r^2}{2b} m_c d \dot{\phi} & 0 \end{bmatrix}, F = \frac{\beta}{\alpha} \begin{bmatrix} 1/r & b/r \\ 1/r & -b/r \end{bmatrix}, \end{aligned}$$

$$u_d = \bar{M}(q)f, \quad u = [u_r \quad u_l]^T, \quad m = m_c + 2m_w,$$

$$I = m_c d^2 + 2m_w b^2 + I_c + 2I_m, \quad z = [v \ \omega]^T, \quad z_d = [v_d \ \omega_d]^T$$

$$, \quad f = [f_1 \quad f_2]^T \quad (12)$$

III. INTEGRAL SLIDING MODE CONTROLLER DESIGN BASED ON DEVELOPED DYNAMIC MODELING FOR WELDING MOBILE ROBOT

Problem Statement: The objective is to design a nonlinear controller so that the welding point $W(x_w, y_w, \phi_w)$ tracks to the reference point $R(x_R, y_R, \phi_R)$ moving on a desired welding path at a constant velocity v_R .

In Fig. 2, the tracking error vector $e = [e_1, e_2, e_3]^T$ is defined as the difference between the welding point W and the reference point R as follows:

$$e = \begin{bmatrix} e_1 \\ e_2 \\ e_3 \end{bmatrix} = \begin{bmatrix} \cos \phi & \sin \phi & 0 \\ -\sin \phi & \cos \phi & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x_R - x_W \\ y_R - y_W \\ \phi_R - \phi_W \end{bmatrix} \quad (13)$$

Because torch length l is controllable based on the torch slider. The first derivative of e yields

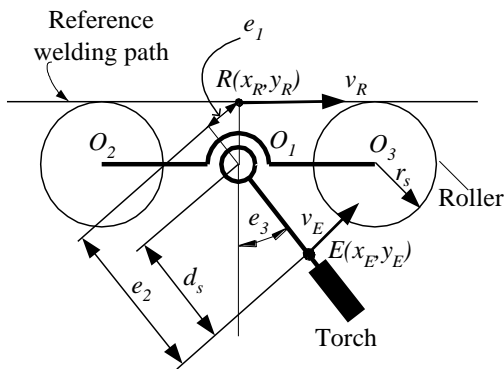


Fig. 5: Tracking errors measurement scheme

The tracking errors can be calculated as follows:

$$\begin{cases} e_1 = -r_s \sin e_3 \\ e_2 = (l_s - l) - r_s (1 - \cos e_3) \\ e_3 = \angle(O_1C, O_1O_2) - 90^\circ \end{cases} \quad (30)$$

where O_2 and O_3 are the center points of roller O_2 and O_3 respectively, O_1 is the center point of O_2O_3 , W is the point on torch holder, r_s is the radius of the roller, d_s is the length measured by the linear potentiometer, and e_3 is the angle measured by the rotating potentiometer. In Figure 5, the reference welding path is a line. When the reference welding path is a curve, Eq. (30) is also valid if the distance O_2O_3 is sufficiently small and the radius of the welding path is enough large.

2. Hardware of the system

Fig. 6 shows the control system configuration of welding mobile robot. The control system is based on the integration of microcontroller DSP F28335 and ATmega328. The microcontroller ATmega328 are used for two DC servo motor control signal of left wheel and right wheel and torch slider controller. The microcontroller DSP F28335 is used for main controller. The three servo controllers are controlled by main controller. The main controller functionalized as master links to the three servo controllers via I2C communication.

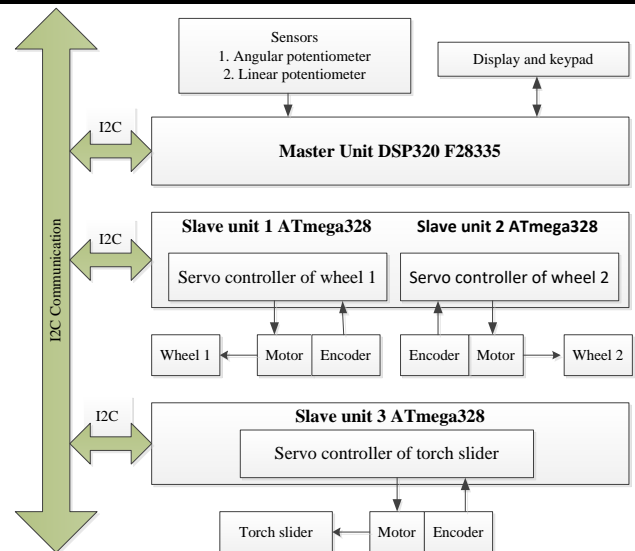


Fig. 6: Control system configuration of welding mobile robot



Fig. 7: Experimental welding mobile robot

The two A/D ports of the DSP F28335 are connected with the two potentiometers for sensing the tracking errors. The master unit send the commands to the slave controllers via I2C communication, respectively. The master unit can be used to interface other devices such as display and keypad devices for manual control. The sampling time of control system is 10ms. The slave unit integrates ATmega328 with motor drivers for the DC servo motor control. This slave controller can perform a complete servo operation with a closed loop feedback control using an encoder for velocity control of two wheels and position of welding torch. The experimental welding mobile robot is shown in Fig. 7 and its dimensions are shown in Table 3.

V. SIMULATION AND EXPERIMENTAL RESULTS

Fig. 8 shows the reference welding trajectory that has sinusoidal form. The reference welding point R moves from the start point to the stop point with a constant velocity v_R .

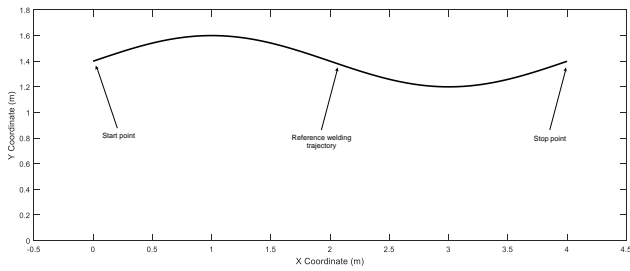


Fig. 8: The reference welding trajectory has sinusoidal form $y = 0.2 \sin(1.57x) + 1.4$

The designed parameters are as follows: $P_1 = 12.6 s^{-1}$, $P_2 = 15.3 s^{-1}$, $Q_1 = 22.5 s^{-1}$, $Q_2 = 26.4 s^{-1}$; and $C_1 = 16.3 s^{-1}$, $C_2 = 2.5 s^{-1}$ and $C_3 = 25.8 s^{-1}$, $K_{v1} = 0.3 s^{-1}$, $K_{v2} = 0.7 s^{-1}$, $f_{m1} = 0.5 N$, $f_{m2} = 0.5 N$. The numerical parameter values and the initial values for simulation are given in Tables 2-4.

Table 2. Numerical values of the DC servo motor's parameters

Parameters	Values	Units
R_a	20.5	$[\Omega]$
k_e	7.2×10^{-2}	$[Nm/A]$
k_t	7.2×10^{-2}	$[Nm/A]$
u	24	$[V]$
τ	3.1	$[kg.cm]$
n	71	$[rpm]$

Table 3. The numerical parameters values for simulation and experimental

Parameters	Values	Units
b	0.12	$[m]$
r	0.03	$[m]$
d	0.015	$[m]$
m_c	12	$[kg]$
m_w	0.3	$[kg]$
I_c	0.32	$[kgm^2]$
I_w	0.024	$[kgm^2]$
I_m	3.6×10^{-4}	$[kgm^2]$
α	0.0035	$[N.m/V]$
β	0.018	$[Kg.m^2/s]$

Table 4. The initial values for simulation and experimental

Parameters	Values	Units
x_R	0	$[m]$
y_R	1.4	$[m]$
ϕ_R	25°	$[deg]$
x_w	0	$[m]$
y_w	1.38	$[m]$

ϕ	15°	$[deg]$
v_R	7.5	$[mm/s]$
v	0	$[mm/s]$
ω_R	0	$[rad/s]$
ω	0	$[rad/s]$
l	0.145	$[m]$

The simulation results for tracking welding path are shown in Figs. 9 to 17. Figs. 9 and 10 show the movement of the WMR along the desired welding trajectory for the time beginning and full time 4000 seconds. The simulation results for error tracking vector during 5 seconds at beginning and 4000 seconds of full time are shown in Figs. 11 and 12. The errors go to zero from 3 seconds. The linear velocity of welding point is shown in Fig. 13; it is shown that the linear velocity at the welding point w of the WMR has quick change at the first time and converges to the constant velocity in the vicinity of $7.5 mm/s$ as desired after 1 second.

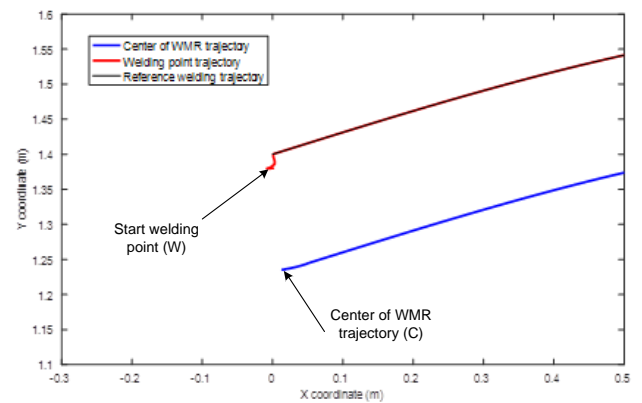


Fig. 9: Movement of the WMR at the beginning time

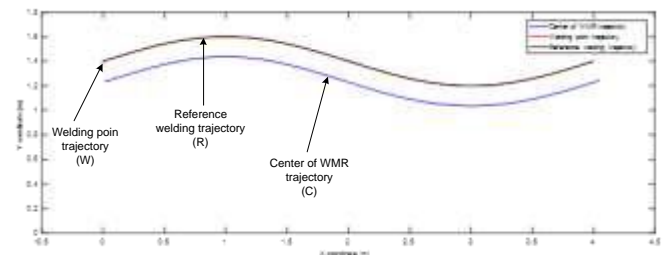


Fig. 10: Movement of the WMR for full time (4000 seconds)

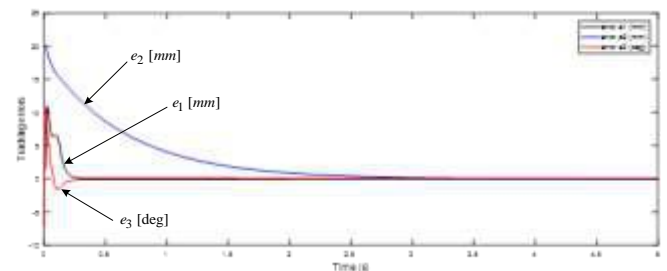


Fig. 11: Tracking errors at beginning time (5 seconds)

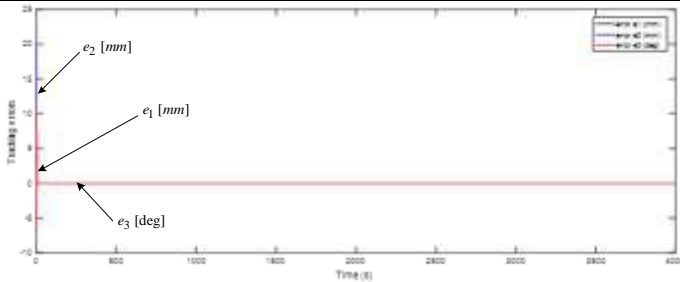


Fig. 12: Tracking errors for full time (4000 seconds)

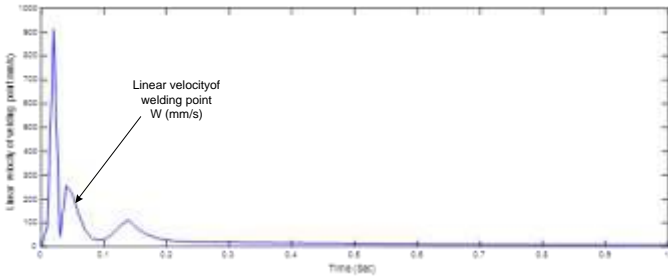


Fig. 13: Linear velocity of the welding point w

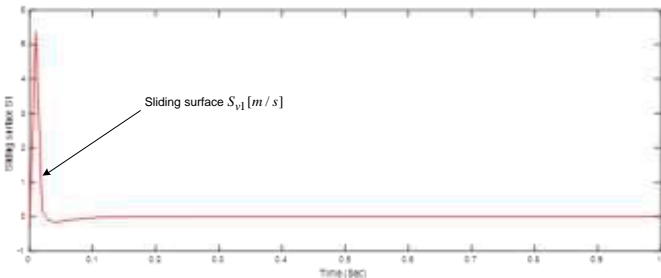


Fig. 14: Sliding surface S_{v1}

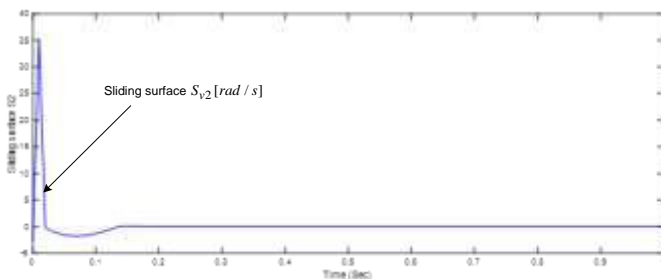


Fig. 15: Sliding surface S_{v2}

The sliding surfaces are shown in Figs. 14 to 15. They go to zero very quickly and keep zero value smoothly for full time. Fig. 16 shows the linear velocity and torch length of WMR. It goes from 145mm at initial time to 163.3mm after about 3 seconds and keeps the that value for remain time. Fig. 17 shows that the control input voltage vector u changes rapidly at the start time converges to small values from 0.3 second for the full time. Figs. 18 and 19 show the welding process of welding mobile robot and experimental welding line result respectively. The simulation and experimental results are shown that the WMR has good welding path tracking performance. It is so that the welding mobile robot can be applied in the practical welding industry field.

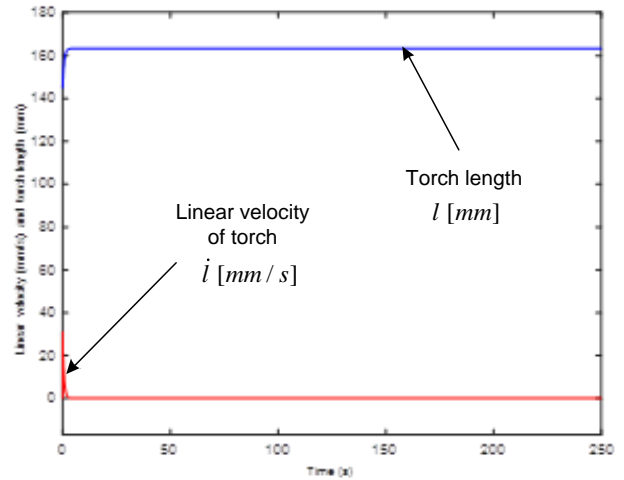


Fig. 16: Linear velocity (i) and length (l) of welding torch at the beginning 250 seconds

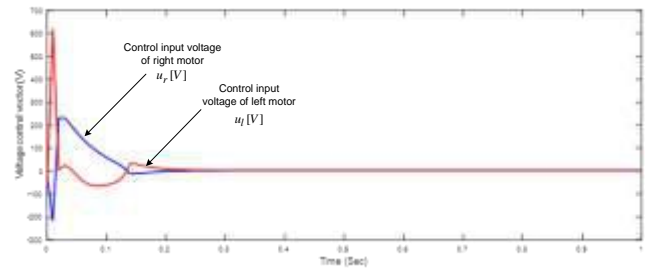


Fig. 17: Control input voltage vector at beginning time



Fig. 18: The experimental welding mobile robot



Fig. 19: Experimental welding line result

VI. CONCLUSION

This paper presents the proposed control scheme that makes the combination of a kinematic controller (KC) and an integral sliding mode dynamic controller (ISMC) based on the developed dynamic modeling for the welding mobile robot to track a desired welding trajectory at a desired velocity under external disturbances. The control laws are obtained by backstepping method. The system stability is proved based on Lyapunov theory. The control law stabilizes the sliding surface vector and makes the tracking error vector go to zero asymptotically. To implement the designed tracking controller, the control system is developed based on DSP F28355 and ATmega328. A scheme for measuring the posture tracking error vector using torch sensor is presented. The simulation and experiment results are shown to illustrate effectiveness and the applicability to the welding industry field of the proposed controller.

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Agromorphological characterization of three (3) hybrid carrot varieties (*Daucus carota*), cultivated in the commune of Korhogo, in northern Côte d'Ivoire

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Abstract— *The carrot (Daucus carota) is a biennial plant whose pivoting root plays a major role in feeding populations worldwide. Few studies have been carried out on the characterization of the agromorphological diversity of this species. Varieties were collected, in order to assess their agromorphological performances under the ecological conditions of Korhogo. The Amazonia, Pamela+, Bahia and Madona varieties were evaluated. The Amazonia variety, which is the most cultivated in the Korhogo region, was used as a control. The study was carried out using a completely randomized Fisher block system, comprising 4 treatments and 4 repetitions. The blocks were separated by a distance of 80 cm. In the same block, the elementary plots were spaced 50 cm apart. Each elementary plot consists of 6 seeding lines, spaced 25 cm, and comprising 72 plants. The measurements concerned some vegetative and agronomic characteristics. The results obtained showed that the Pamela+ variety, with a yield of 25 t/ha, was the most productive. It is also distinguished from other varieties by the length of the roots and the high number of leaves produced. The Bahia and Madona varieties showed similar characteristics and less efficient than those of the control (Amazonia). On the basis of the characteristics evaluated, the Pamela+ variety was the most efficient and adapted to the agroecological conditions of the Korhogo region. However, the evaluation of certain characteristics will confirm the results of this study.*

Keywords— *Daucus carota, varieties, agromorphological characterization, Korhogo, Côte d'Ivoire.*

I. INTRODUCTION

Agriculture is Côte d'Ivoire's main economic activity. It represents the mainstay of the Ivorian economy in that it occupies about 66 % of the working population and

generates 2 % of the State's export earnings. A great diversity of crops is practiced and vegetables occupy a prominent place, notably the carrot. The carrot sector has been identified as a strategic market and priority sector by the rulers because of its large implantation in the agrarian systems of Cote d'Ivoire.

The carrot is a biennial herbaceous plant of the family *Apiaceae*, native to the Mediterranean basin of Asia and Europe. It is mainly grown for its fleshy, edible rotating root, rich in carotene, vitamins and mineral salts. It is consumed as a vegetable (**Lecomte, 2013**). It is part of the top three of the three most purchased vegetables by households, just behind the potato and tomato. Consumption is estimated at 10 kg per person per year (**Parent and Sourdin, 2013**). Its annual world production is now estimated at more than 35.5 million tonnes (Mt). The largest producers are China, Russia and the United States, with production of 17 Mt, 1.6 Mt and 1.3 Mt respectively (**FAO, 2014**).

Very popular for its therapeutic and nutritional properties, its culture has grown not only in the temperate zones of Asia and Europe, but also in some tropical regions of Africa, including Côte d'Ivoire, and, particularly, in the north of the country. Since the 20th century, the carrot is a relatively well-established culture in the north of Côte d'Ivoire, and, thanks to its ease of cultivation and high productivity, it accompanies socio-economic diversification, Urbanization and the development of trade in vegetables.

Intended for consumption in fresh or cooked, the carrot is an important source of minerals, vitamins, proteins and sugar in the human diet. Carrot consumption contributes to a healthy and balanced diet (**Shankara et al., 2005**). The carrot is one of the most widespread cultures around the world, and particularly in Côte d'Ivoire. It is therefore an

important cash crop for smallholder farmers and resellers. However, according to FAO production estimates and compared to the situation of other market gardening crops, the Ivorian carrot sector appears to be experiencing a declining production (FAO, 2014).

This lower dynamism can be explained, among other things, by the plurality of valued vegetables, the low productivity of the cultivated varieties, a production sector requiring a wide range of inputs and degradation of pedoclimatic conditions. The major constraints, reducing productivity, are undoubtedly the degradation of climate and soils (Piéri, 1989, Sedogo 1993, Bacyé, 1993) and conservation problems that have direct impacts on national production.

Soil degradation from slash-and-burn agriculture, depletion of soil minerals are serious threats to agricultural productivity and identified as important causes of declining yields in core-based cropping systems (Henao and Baanante, 2006). One of the major constraints is linked to climatic conditions, which are currently characterized by a decrease in rainfall and an increase in water deficit, often exceeding the critical threshold.

However, under these marginal crop conditions, the carrot is almost always one of the most widely grown vegetable crops in all savannah areas, especially in the Korhogo region, which is the country's main production area.

The need to improve crop yields and productivity on existing agricultural land becomes an overarching and obvious goal. Only the selection of more productive varieties opens up perspectives in this direction. The Amazonia variety, characterized by low productivity and short root, is the most cultivated in the Korhogo region.

In this regional and national context, Côte d'Ivoire aims to increase its carrot production in order to fill the long periods of scarcity and reduce large imports. Agricultural research must accompany this ambitious sector development program, by providing producers with plant material adapted to the evolving production environment (increase in water deficit, decrease in soil fertility, land problems).

Global consumption of carrots has become very important, and for a number of years consumers have complained about the standardization of this product and the loss of taste of the carrot (Pitrat and Foury, 2003). Current research is therefore oriented towards characterization of other varieties in order to improve the production and organoleptic properties of the carrot.

These commercial and food requirements have led to the selection of other hybrids, the aim of which is to have more homogeneous, earlier, more pathogen-resistant, higher yielding and good quality (Pitrat and Foury, 2003).

The present work is in line with the search for new individuals with interesting characteristics. It aims at

comparing the agromorphological performances of three varieties of carrots compared to an old variety, commonly cultivated in the region. The objective of this research is to identify the variety of carrot that has the best agronomic potential for its popularization. Thus, the following hypotheses have been issued: (i) one of the new varieties possesses the best agronomic potential; (ii) the old variety is no longer suitable for growing conditions.

II. MATERIAL AND METHODS

Study environment

The study was carried out in the commune of Korhogo, located in northern Côte d'Ivoire, whose geographical coordinates are 9° 26' longitude north and 5° 38' west latitude. The climate of the Sudanese zone is characterized by an alternation of two seasons. A great dry season, from October to May, precedes the rainy season, marked by two rainfall peaks, one in June and the other in September. The zone is also characterized by average temperatures varying between 24 and 33° C and a monthly average humidity of 20 %. The annual rainfall is between 1100 and 1600 mm and the duration of sunshine is 2600 hours per year.

The soil is of the tropical ferruginous type, formed on granite, the more or less intense leaching of which reduces its fertility. The relief is generally flat and scattered in places of inselbergs (Koffie and Yéo, 2016).

Material

Plant material

The plant material is composed of four (4) hybrid carrot varieties (*Daucus carota sub. sp., Sativus*), all of which are kuroda-like. These varieties are known by their vernacular names. The Amazonia variety is the most cultivated in the region. It was used as a control in the present study because of these well-known agronomic characteristics. After 90 to 95 days of cultivation, the rotating roots can reach 16 to 18 cm in length (Technisem, 2017). On the other hand, the Bahia, Madona and Pamela+ varieties were chosen for the test because of their strong appreciation by the populations and their new introduction into the region.

METHODS

The trial was carried out using a fully randomized Fisher block system, consisting of 4 treatments and 4 repetitions. The study consisted of 16 elementary plots. Each sub-plot was made up of 72 plants, planted on 6 lines according to the 25 cm x 8 cm (25 cm between two lines and 8 cm between two plants of the same line) spacing and covering an area of 2 m². Elementary plots and blocks were separated by a distance of 50 cm and 80 cm respectively. The entire plot consisted of 1152 plants, covering a total area of 60 cm².

Conduct of the test

The study was conducted from December to March. Two (2) kilograms of completely decomposed chicken droppings were delivered per unit plot as a bottom fertilizer two weeks prior to sowing the core. Sowing was carried out, followed by mulching of the plots to maintain sufficient soil moisture after the watering operations.

Thinning was carried out in the 3 to 5 leaf stages, is 22 to 35 days after emergence (JAL), respectively. They aim to maintain the spacing of 8 cm between the plants on the same line. Weeding's were regularly carried out to remove weeds and ensure good aeration of the soil.

A first mineral fertilization was carried out at 46 days after sowing (JAS), with mineral fertilizer NPK of formula 12-11-18 + 2.7MgO + 8S + B + Fe + Zn + Mn, 50 g by elementary plot. A second intake of mineral fertilizer, of formula 15.4N + 25.6CaO + 0.3B, was carried out 3 weeks after the first addition, at a rate of 30 g per elementary plot. Preventive treatments against insects were carried out, once a week, from the 8-leaf stage (66 JAS), with Cypercal, at the rate of 1 l / ha. This dose is equivalent to a mixture of 6.6 ml of the product at 2.5 l of water per unit plot. The harvest started from the 90th JAS, that is to say 3 months and one week after sowing.

Measured parameters

Various parameters were measured on the 4 varieties studied in our study.

The plants height was determined by measuring the longest sheet using a tape measure.

The leaves number per plant was obtained by counting all the leaves contained in the crown.

The dry matter content of the leaves was estimated by weighing all the sheets contained in the crown after drying in the oven at 180° C.

The roots length was obtained by measuring the length of all the rooting roots, using tape measure.

The diameters of the different zones of the root (base, center and apex) were determined by measuring these different sections using a tape measure.

The weight of the rotating roots was obtained by weighing all the roots.

The yield or carrot tonnage (CT) was calculated using the following formula:

$$CT = PMC * D$$

With CT = carrot tonnage (kg/ha); PMC = average carrot weight (kg/plant) and D = planting density (plant/ha).

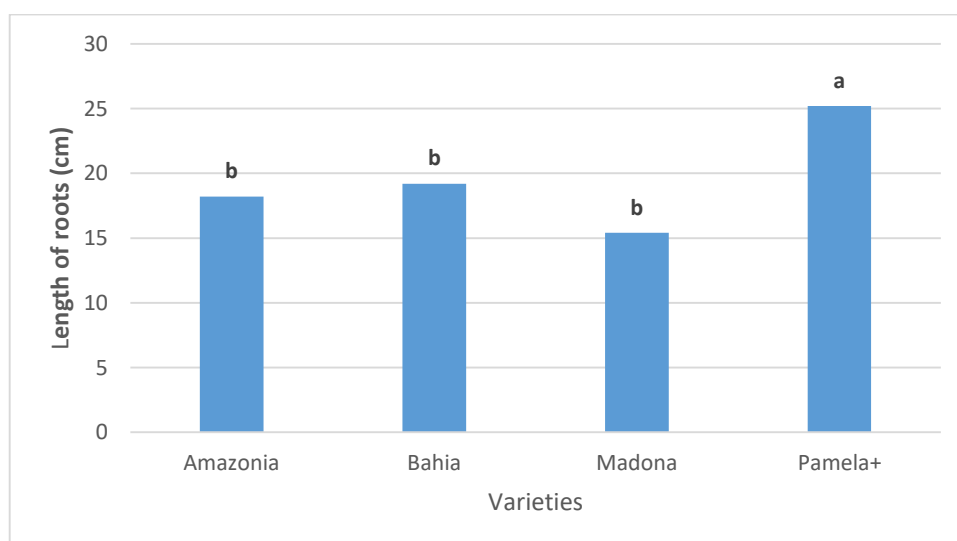
Statistical processing

The data, collected and recorded using the Excel spreadsheet, were analyzed for variance using XLSTAT software version 7.5. The Student Newman Keuls test (SNK), at the 5 % threshold, was used in case of a significant difference between the averages. Correlations followed by a Principal Component Analysis (PCA) were also conducted to determine the best varieties.

III. RESULTS

Length of carrot roots

Figure 1 shows the results obtained after measuring the length of all the roots of the different varieties studied. The analysis of the variance shows that there is a significant difference between the averages obtained. The Newman Keuls test allowed the formation of two homogeneous groups. The Pamela+ variety, with an average length of 13.4 cm, is the first group. This variety has produced the longest roots. The second group consisted of the Madona, Bahia and Amazonia varieties. These varieties yielded the shortest roots, with mean values of 11.3, 11.0 and 10 cm in length. Compared to the witness (Amazonia), only the Pamela + variety produced longer roots.

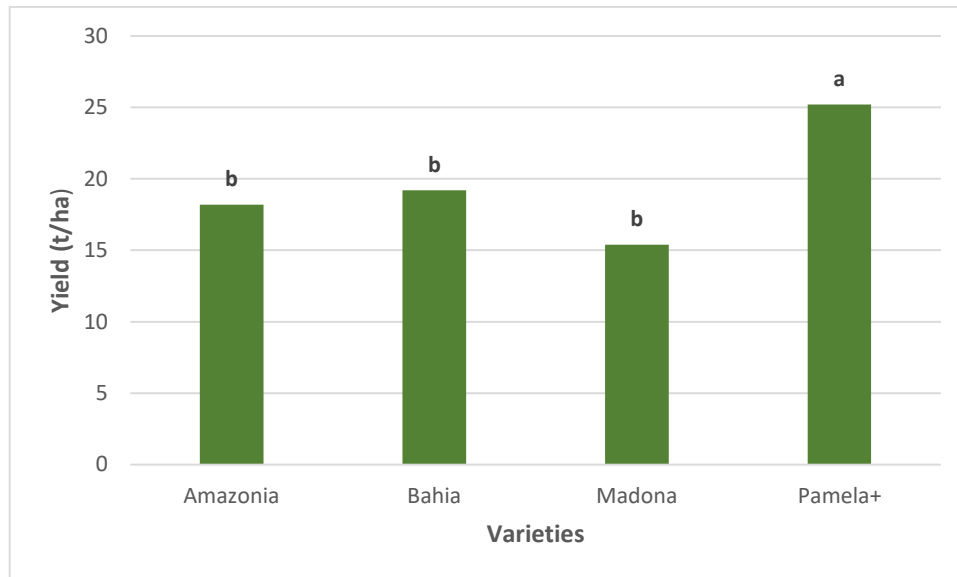


The histogram bars with the same letters are not significantly different
Fig.1: Evolution of the length of the carrot roots according to the varieties

Carrot yield

In the analysis of figure 2, which presents the results of the yields of the different varieties, the analysis of the variance revealed significant differences between the averages obtained. Two (2) homogeneous groups were constituted according to the Newman Keuls test. The first group consists of the Pamela+ variety, with an average of 25.2

t/ha. This variety produced the highest yield, compared to the control (Amazonia) and the other varieties tested, namely Madona and Bahia. The second lowest yield group was Bahia (19.2 t/ha), Madona (15.4 t/ha) and Amazonia (18.2 t/ha). The Bahia and Madona varieties produced the same yields as the Amazonia control.



The histogram bars with the same letters are not significantly different

Fig.2: Evolution of the core yield according to the different varieties

Growth parameters of different varieties of carrot

The mean values obtained on the number of leaves per plant, the height of the plants and the dry matter content of the leaves are given in Table 1. The results in Table 1 show that the number of leaves emitted per plant varied between 8.6 leaves (Bahia) and 10 leaves (Pamela+) depending on the varieties studied. The analysis of the variance revealed that the Pamela+, Amazonia and Madonia varieties gave a higher number of leaves per plant than the Bahia variety. This variety (Bahia) produced fewer leaves than the control (Amazonia).

The average height of the carrot plants varied from 33.6 cm (Madona) to 39.5 cm (Amazonia) depending on the varieties studied. The analysis of the variance (Table 1) reveals that there are significant differences between the averages obtained with the different varieties. The Madona variety, with 33.6 cm, gave a significantly lower mean height and significantly different from the other varieties (Amazonia, Bahia and Pamela+) with higher heights.

The dry matter content of the leaves, shown in Table 1, varied from 77.7 % (Madona) to 80 % (Amazonia) depending on the varieties compared. The analysis of the variance reveals that there are no significant differences between the averages obtained with the different varieties. It is clear from the above that all the varieties studied gave statistically equal averages of dry matter content.

Diameter of the different sections of the carrot roots

Figure 2 shows the diameter averages of the different sections (base, center and apex) on the roots of all the varieties studied. From the analysis of this figure, it appears that the diameter averages have been decreasing from the base to the top of the roots, passing through the center.

At the basal level, the Amazonia control, with 26.79 mm, yielded larger diameter averages than all the varieties tested. Generally, for this section, the Madona variety produces roots with the smallest diameters, with an average of 23.48 mm.

As regards the diameter at the center, the decrease in the mean from the base was less marked in the Pamela + variety. The mean diameter was higher in this variety (Pamela+), with mean values of 23.40 mm. The average recorded with the Madona variety is always the lowest.

For the averages obtained at the top of the roots, the analysis of figure 2 shows that the Pamela+ variety recorded the highest diameter values compared to the other varieties. On the other hand, the Bahia, Madona and Amazonia varieties produced roots of similar diameters. The decrease in diameters from the base to the top was significantly more marked in the Amazonia control compared to the varieties tested.

Table.1: Summary of the growth parameters of the different varieties of carrots

Varieties	Leaves number	Plants height (cm)	Dry matter content of the leaves (%)
Amazonia	9,64 ab	39,55 a	80,05 a
Bahia	8,61 b	37,31 a	79,25 a
Madona	8,96 ab	33,68 b	77,74 a
Pamela+	10,00 a	36,89 a	78,84 a

Means followed by the same letter in the same column are not statistically different at the 0.05 by Newman Keuls test

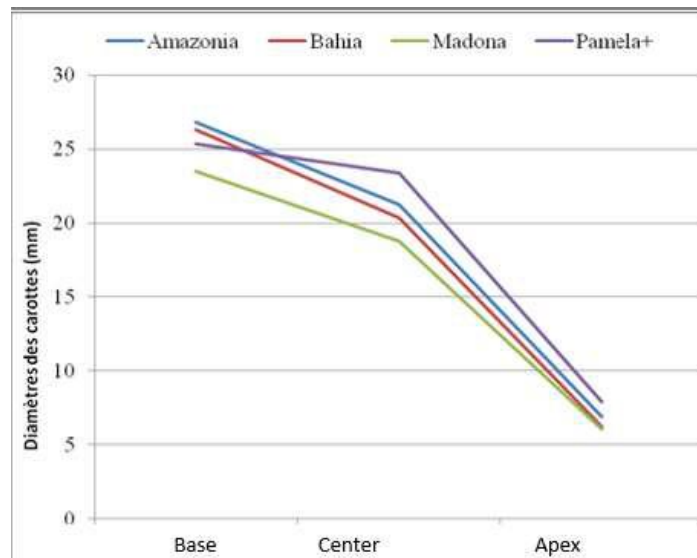


Fig.3: Evolution of the carrot diameter according to the different sections

Study of correlations

The correlations between the different parameters for the four varieties were studied. Table 2 presents the matrix of correlations between these parameters. The analysis of this table reveals the existence of positive and significant correlations between the parameters for the varieties studied. These correlations are as follows:

- the dry matter content of the leaves and the height of the plants ($R^2 = 0.994$);
- the diameter at the base of the carrots and the height of the plants ($R^2 = 0.965$);
- the diameter at the base of the cores and the dry matter content of the leaves ($R^2 = 0.975$);
- the diameter at the top of the cores and that of their center ($R^2 = 0.968$);
- yield and diameter at the center of the cores ($R^2 = 0.955$).

Correlations between the parameters studied in the different varieties

Explaining nearly 94.07 % of the variability expressed, the first two axes of the principal component analysis were taken into account (Table 3 and Figure 3). On axis F1, which absorbed the greatest percentage of variability

(58.28 %), it is the diameter variables at the center and at the top, the yield and the number of leaves emitted that contribute to the formation of this axis. These parameters were positively correlated to the F1 axis. The second axis, which absorbs nearly 35.78 % of the variability, is defined on the positive side by the length of the core and the negative side by the dry matter content of the leaves (Table 3). The diameter at the base and the height of the plants were correlated positively with the axis F1 and negatively with the axis F2.

According to the Biplot plan (Figure 3), each of the four varieties studied is represented in a quarter of a plane, drawn by the first two axes. The plan quarters representing the Madona and Bahia varieties do not have any studied parameters. The Pamela+ variety and some parameters, namely root length, diameter at the center and top of the root, yield and number of leaves per plant belong to the same quarter of the Biplot. Figure 3 shows the proximity between the Pamela+ variety and these parameters. As for the Amazonia variety, it is in the plan quarter containing the parameters as plant height, dry matter content and diameter at the base of the carrot roots.

Table.2: Correlations between the parameters studied

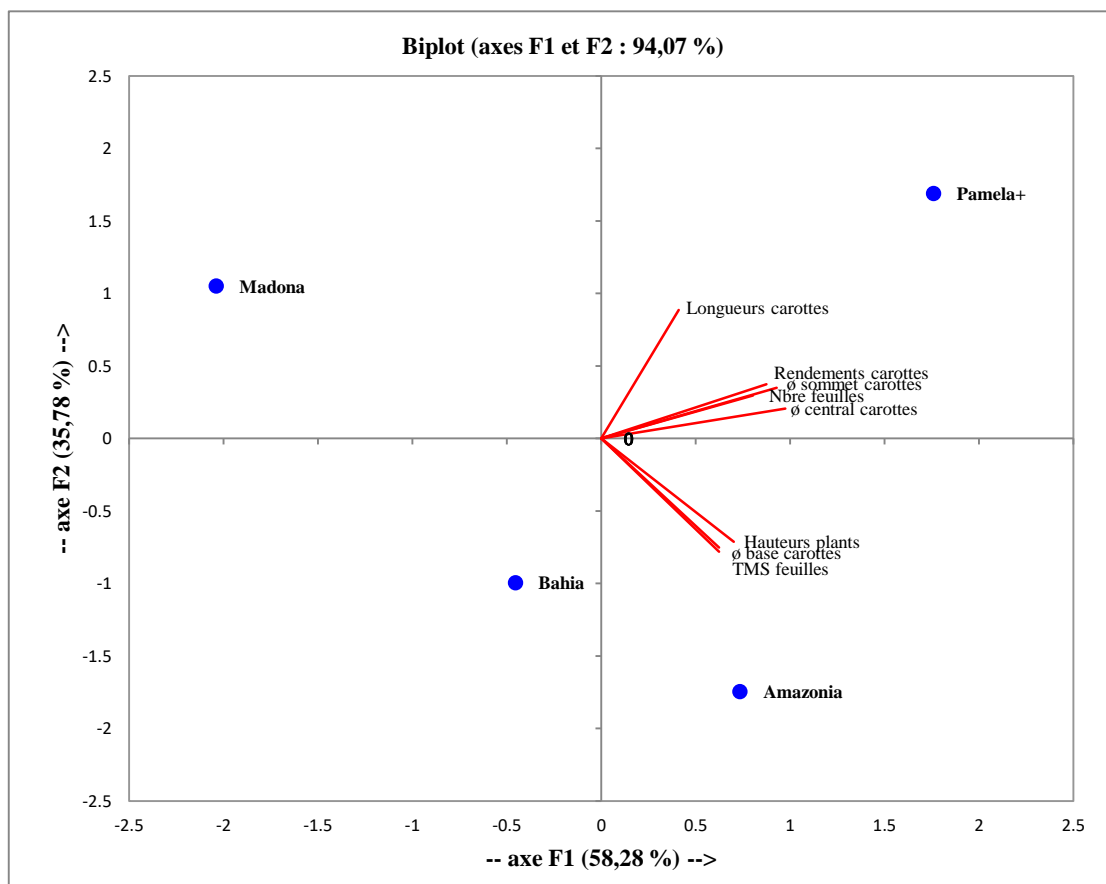
Parameters studied	Leaves number	Plants height	Dry matter	Roots length	Diameter base	Diameter centre	Diameter apex	Yield
Leaves number	1							
Plants height	0,372	1						
Dry matter	0,275	0,994	1					
Roots length	0,482	-0,352	-0,439	1				
Diameter of base	0,169	0,965	0,975	-0,365	1			
Diameter of center	0,806	0,534	0,446	0,600	0,469	1		
Diameter of apex	0,915	0,406	0,306	0,664	0,288	0,968	1	
Yield	0,657	0,336	0,251	0,757	0,329	0,955	0,904	1

In bold, significant values (off diagonal) at the alpha threshold = 0.05 (bilateral test)

Table.3: Coordinates of the parameters along the axes F1 and F2

Parameters studied	F1	F2
Leaves number	0,804	0,297
Plants height	0,701	-0,712
Dry matter	0,624	-0,782
Roots length	0,410	0,886
Diameter of base	0,623	-0,753
Diameter of center	0,975	0,206
Diameter of apex	0,928	0,350
Yield	0,875	0,374

Ø: diameter; TMS: dry matter content of leaves



Longueur carottes (Roots length); Rendement carottes (Yield); Nombre de feuilles (Leaves number); Hauteur des plants (Plants height); TMS feuilles (Dry matter); Ø base (Diameter of base); Ø central (Diameter of center); Ø sommet (Diameter of apex)

Fig.4: Distribution of the studied parameters according to the different varieties

IV. DISCUSSION

Knowledge of genetic variability is essential in breeding. The identification of genetic variability for certain morphological characteristics is the first necessary step in the description of genetic resources (Radhouane, 2004). Analysis of the agromorphological diversity of the local varieties of carrots grown in Côte d'Ivoire revealed significant differences between the characteristics analyzed, indicating a strong phenotypic heterogeneity between the four varieties. This morphological diversity was structured into 3 groups that differed in plant height, root length, number of leaves, base, center and top diameters, dry matter and yield. The first group consists of the Madona and Bahia varieties, which have no better agronomic characteristics. The second group is Amazonia, whose best agronomic potential is plant height, diameter at the base and dry matter content. The Pamela+ variety, which is the third group, has the best agronomic characteristics: root length, number of leaves, diameter at the center and at the top and yield. This Pamela+ variety presented an agronomic performance that the other varieties studied.

For the morphological and agronomic characteristics studied, the Pamela+ variety proved to be the most efficient. Thus, this performance results from the production of a high number of sheets and productivity. This structure of the morphological diversity of these varieties shows that in carrots, morphological differentiation is often based on agronomic traits (Sanou, 1996; Hidayat *et al.*, 2008). The yield performance of a variety is therefore related to vegetative characteristics. These results, which reflect a more efficient photosynthetic activity at the level of the Pamela + variety, are in agreement with the work of many authors (Laure, 1993, Péron, 2006, Lebas, 2012). According to Lebas (2012), leaves are the seat of photosynthesis in plants, a mechanism allowing the synthesis of fructose and glucose. At the level of the carrot, the roots correspond to the site of photosynthetic reserves. This assertion corroborates our results, which allowed us to establish a relationship between vegetative trait and yield in the Pamela+ variety. For Laure (1993) and Peron (2006), the development of carrot foliage ensures the migration of photosynthesis products to the pivotal root. This would explain high leaf production and yield of carrot roots in the Pamela+ variety. At the core level, selection was also made on the foliage (Gry, 1993). The development of the mechanical cultivation of the carrot has given rise to new demands. Harvesting the carrot is done by pulling on the foliage and not on the root.

Phenotypic selection based on perceptible characteristics (phenological, vegetative, yield) could explain the contribution of these variables to the structuring of variability. According to Louette (1994), vegetative traits

(leaves number, roots length, plants height) and agronomic (yield) appear to be the main criteria used by farmers to identify many varieties. In the carrot, according to Parent and Sourdin (2013), the objective is to increase the commercial yield that is the quantity of marketable carrots, after sorting and sizing. This is why homogeneity is paramount. This characteristic is also found in the Pamela+ variety. Indeed, this variety has roots whose diameters of the different sections (base, center and apex) decrease less in comparison with the others. The current standard of preference is the cylindrical shape that is pushed because it occupies less space on the ground and is well placed in crates, bags, trays or stalls. The Pamela+ variety is the one that conforms to these characteristics. Unlike the latter, the excessively cylindrical cores make it possible to optimize the filling of the soil and the packaging. They have the disadvantage of being more sensitive to breakage during handling (Parent and Sourdin, 2013).

For the vegetative and agronomic characteristics studied, the Pamela+ variety shows the best performances. On this basis, it therefore seems the best to be recommended for popularization instead of the Amazonia variety, formerly the most cultivated in the region of Korhogo.

However, for Gry (1993), the choice of a variety of carrot, intended for popularization, must depend on several criteria. For the finalization of a choice and the popularization of another variety, in replacement of the Amazonia variety, certain morphological, behavioral, biochemical and pathological characteristics must be taken into account and studied. Thus, the main characteristics that must be sought are summarized as follows:

- storage capacity or conservation possibilities in the field;
- resistance to certain diseases or fungi;
- adaptation to a wide range of climate and soil type;
- the precocity of the variety;
- the ability to quickly color and its resistance to the rise of the seed;
- the organoleptic quality of the variety to be sought.

The results of these studies will allow the identification of the best varieties of carrot adapted to the region and for extension to growers.

V. CONCLUSION

Preliminary results on the diversity and agromorphological structuring of the carrot grown in the Korhogo region clearly show that the varieties analyzed show a variation for all the characters used, particularly those related to phenology, architecture and yields. This observed genetic variability between varieties is an asset for selection work. The study revealed the formation of three groups of varieties. The different characteristics of these three groups have been described. The group formed by the Bahia and Madona varieties exhibits less efficient agromorphological characteristics. As for the Amazonia variety, the control, it

shows performances, in a few vegetative characters, in particular, the height of the plants and the dry matter content. Pamela+ is the variety with the highest variability. This variety showed much better agromorphological characteristics. It has therefore given the best vegetative characters, in particular, the leaves number and the roots length and productivity. On the basis of the characteristics studied, the Pamela+ variety appears to be the best and to be recommended for extension in the Korhogo region. However, this agromorphological characterization should be supplemented by further, in particular biochemical and agronomic studies. Thus, the use of other varieties and an appropriate technical route will increase the production of carrots.

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Performance Analysis Vapour Absorption Refrigeration Chiller Run by Solar Thermal Energy

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Abstract— Over the past few decades, energy is the backbone of technology and economic development. In addition to men, machines and money, 'energy' is now the fourth factor of production. The objective of this paper is to design and study an environment friendly ammonia water vapour absorption refrigeration system of unit capacity using Ammonia (R717) as a refrigerant and water as a absorbent working fluids and run by exhaust water Solar Thermal Set Up. The system is designed and tested in Thermal Engineering lab of Agnos College of technology RKDF University Bhopal Madhya Pradesh for various operating conditions using hot water as heat source. In this paper, performance of the fabricated system is outlined with respect to various operating conditions related to heat source, condenser, absorber and evaporator temperatures. The solar heating unit remains idle in the summer months. Also the solar potential is at maximum in the summer other months of year.

Keywords— Vapour Absorption Refrigeration, solar Thermal set up, environment Friendly.

I. INTRODUCTION

Solar energy is a very large, inexhaustible source of energy. The power from the sun intercepted by the earth is approximately 1.8×10^{11} MW which is much more larger than the present consumption rate on the earth of all commercial energy sources. Thus, in principle, solar energy could supply all the present and future energy needs of the world on the continuing basis. This makes it one of the most promising of the unconventional energy sources. In addition to its size, solar energy has two other factors in its favour. First unlike fossil fuels and nuclear power, it is an environmental clean source of energy. Second, it is free and available in adequate quantities in almost all parts of the world where people live. However, there are many problems associated with its use. The main problem is that

it is a dilute source of energy. Even in the hottest regions on earth, the solar radiation flux rarely exceeds 1 kWh/m^2 and the total radiation over a day is best about 6 kWh/m^2 . These are low values from the point of view of technological utilization. Consequently, large collecting areas are required in many applications and this result in excessive costs. A second problem associated with the use of solar energy is that its availability varies widely with time. The variation in availability occurs daily because of the day-night cycle. In addition, variation occurs at a specific location because of local weather conditions. Consequently, the energy collected when the sun is shining must be stored for use during periods when it is not available. The need for significantly adds to the cost of the system. Thus, the real challenge in utilizing solar energy as an energy alternative is to address these challenges. One has to strive for the development of cheaper methods of collection and storage so that the large initial investments required at present in most applications are reduced. Flat plate collectors Flat plate collector is an insulated weather proofed box containing a dark absorber plate under one or more transparent or translucent covers.

II. LITERATURE SURVEY

Energy systems are complex as they involve the consideration of economic, technical and environmental factors. There is a dearth of thermally driven absorption refrigeration machines on the market which provide small-capacity cooling for domestic applications, as stressed upon by Velmurugan V et al. [1] this paper presents a description of a new solar refrigeration system using three fluid ammonia-hydrogen/water ($\text{NH}_3\text{-H}_2/\text{H}_2\text{O}$) vapour absorption systems. This technique uses solar energy to produce the desired cooling effect and without polluting the environment. According to Celina Maria Cunha Ribeiro et al.[2] the circulation of the working fluids is accomplished

via a bubble pump, its action depends significantly on the mass transfer in the evaporator and the absorber. Also Joshua Folaranmi Leonardo [3] has described a new method for using a focusing collector, where heat from the sun is concentrated on a black absorber located at the focal point of the reflector where water is heated to a very high temperature. He also describes a solar tracking system by manual tilting of the bar at the support of the parabolic dish. The setup is mounted on a frame supported with a lever for tilting the parabolic dish reflector to different angles enabling capturing solar energy during different periods of the day. The influence of operating conditions such as ammonia fraction in inlet solution and tube diameter on the functioning of the bubble pump was presented and discussed by Ali benhmide et al. [4]. It was found that, the liquid velocity and pumping ratio increase with increasing heat flux, and then it decreases. Optimal heat

flux depends namely on tube diameter variations. Ali benhmide et al. [5] found that the optimum heat flux can be correlated as a function of the mass flow rate and tube diameter, while the minimum heat flux required for pumping can be correlated as a function of tube diameter. The effects of hot water inlet temperatures on the coefficient of performance (COP) have been studied by V Mittal et al. [6]. S. Gabsi et al. [7] designed and simulated an absorption diffusion refrigerator using solar energy for domestic use. The climatic conditions and the cost due to technical constraints for various components such as the solar generator, the condenser, the absorber and the evaporator limits the system's application for small scale purposes. Mass and energy conservation equations showed that the new absorption cycle could produce viable amounts of cooling for domestic applications. [8]

III. EXPERIMENTATION SET UP

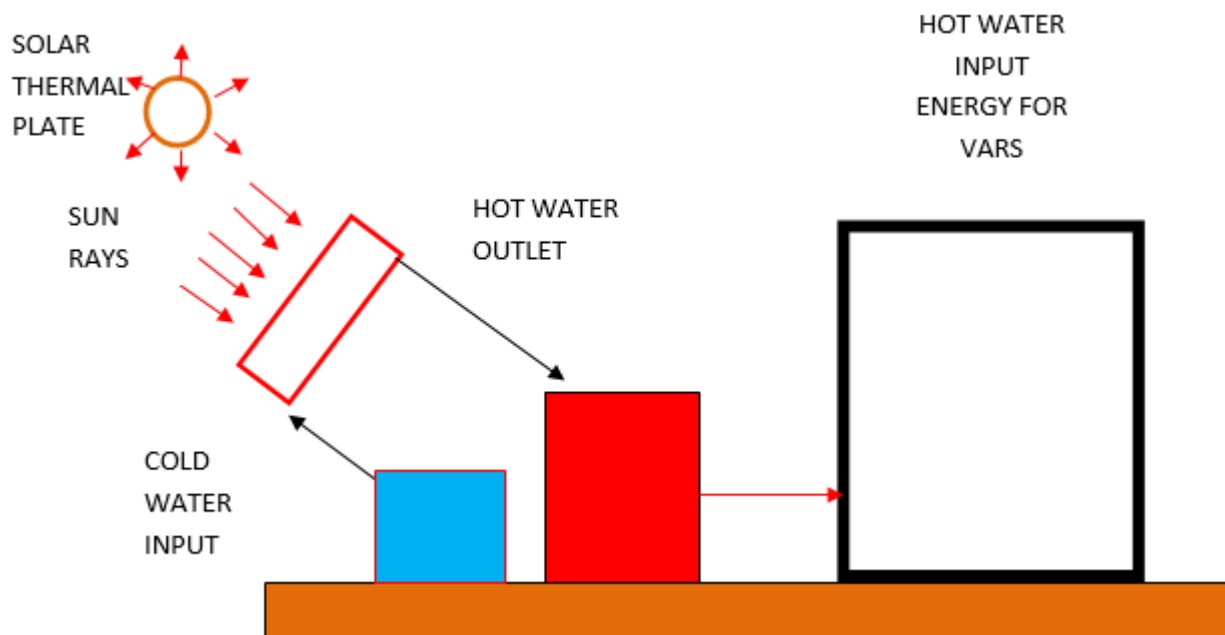


Fig.2: Solar water heater

IV. DESIGN OF PARABOLIC THROUGH COLLECTOR

Assume Maximum Temperature at $T_g = 95^\circ\text{C}$

Solar Constant $I_{SC} = 1388 \text{ W/m}^2$,

Outer space radiation $= 1367 \text{ W/m}^2$

Geographical Location of the place where the solar collector is installed Bhopal Madhya Pradesh India.

Latitude Angle (Φ) = the latitude of a location on earth's surface is the angle made by radial line, joining the given

location to the center of the earth, with its projection on the equator plan.

Latitude Angle (Φ) = 23°

Longitude Angle (γ) = It is the angle between inclined plane surface, under the line due south and the horizontal projection of normal to the inclined plane surface

Longitude Angle (γ) = 77°

Angle (Hour (G)) =the hour angle at any moment is the angle through which the earth must turn to bring the meridian of the observer directly in line with sun's rays.
Angle Hour (G) =0

$$=1089.65 \cos (2.562^\circ)$$

$$I_h =1088.56$$

W/m²

Number of days for six months taken

$$n=183 \text{ days}$$

Declination Angle (δ) =It is define as the angular displacement of the sun from the plane of earth's equator. It is positive when measured above equatorial plane in the northern hemisphere.

$$\text{Declination Angle } (\delta) =23.45 \sin \left[\frac{360}{365} (284+n) \right]$$

$$\delta =23.45 \sin \left[\frac{360}{365} (284+183) \right]$$

$$\delta =23.04^\circ$$

Zenith Angle (Z) =It is the angle between sun's ray and perpendicular(normal) to the horizontal plane

$$\text{Cos } Z = \sin \Phi \sin \delta + \cos \Phi \cos \delta \cos G$$

$$\text{Cos } Z = \sin (23^\circ) \sin (23.04^\circ) + \cos$$

$$(23^\circ) \cos (23.04^\circ) \cos 0^\circ$$

$$\text{Cos } Z = 0.999$$

$$Z=2.562^\circ$$

Available radiation intensity (I_z)

$$I_z = I_{sc} e^{-c \sec z}$$

$$C=0.357, S=0.678$$

$$I_z = 1388 e^{-0.357(\sec 2.562^\circ)^{0.678}}$$

$$I_z = 1089.65 \text{ w/m}^2$$

The value of radiation on a horizontal surface (I_h)

$$I_h = I_z \cos Z$$

Total solar radiation intensity=200MW/m²

Reflected Intensity R_i=Reflectivity of material × Solar radiation intensity

Reflectivity of aluminum sheet=0.9

$$\text{Thus } R_i = 0.9 \times 200 = 180 \text{ MW/m}^2$$

Therefore; Heat required at collector

$$Q_i = m C_p \times \Delta T$$

$$Q_i = 4 \times 4.178 (95-45) / 3600$$

$$Q_i = 0.2326 \text{ KW}$$

Area of parabolic through collector (A_d)

$$A_d = \frac{\text{Heat required at collector}}{\text{Reflected intensity}}$$

$$A_d = \frac{Q_i}{R_i}$$

$$= 232 / 180 = 1.288$$

$$A_d = 1.288 \text{ m}^2$$

Depth of parabolic collector (h)

$$h = 0.25 \text{ m}$$

Surface area of collector (A_s)

$$A_s = \frac{\pi}{6} \times \left[\frac{r}{h^2} \right] \times \frac{r^2}{4h^2} \times \left(\frac{1}{2-r^3} \right)$$

$$1.288 = \frac{\pi}{6} \times [r / 0.25] \times [r^2 / 4 \times 0.25] / (2-r^3)$$

$$r = 0.4196 = 0.42 \text{ ---}$$

Focal length (F)

$$(F) = \frac{r^2}{4h}$$

$$0.42^2 / 4 \times 0.25$$

$$F = 0.1746 \text{ m}$$

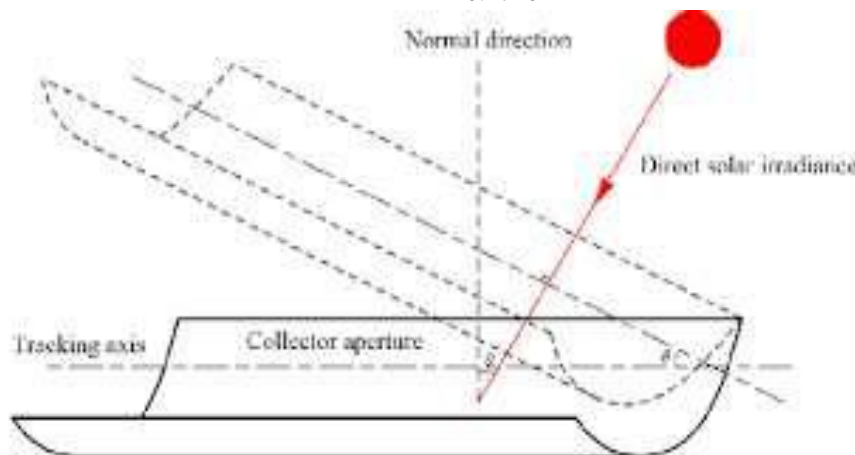


Fig.3: Parabolic trough collector

DESIGN OF GENERATOR

Flow rate of refrigeration.

$$Q = \frac{\text{capacity}}{\text{time}}$$

$$Q = \frac{4 \text{ liter}}{3600}$$

$$Q = \frac{4 \times 10^{-2}}{3600} = 1.11 \times 10^{-6} \text{ m}^3/\text{sec}$$

Heat transfer rate at generator ;

(i) Length of coil attach on outer side of generator,

$$L = 0.51 \text{ m}$$

(ii) Inner diameter of coil

$$D_i = 0.016 \text{ m}$$

(iii) Outer diameter of coil

$$D_o = 0.022 \text{ m}$$

Therefore

$$D_m = 0.022 - 0.016 = 0.006 \text{ m}$$

Assume;

Ambient temperature $T_a = 27.40^\circ\text{C}$

Collector fluid temperature $T_g = 90^\circ\text{C}$;

Bulk temperature $T_f = (27.40 + 90)/2 = 58.7^\circ\text{C}$

Taking properties at

$$T_f = 58.7^\circ\text{C}$$

$$\mu = 0.4708 \text{ N sec/m} \quad \rho = 0.478 \times 10^{-6} \text{ m}^2/\text{sec}$$

$$P_r = 3.020 \quad K = 0.6513 \text{ W/mK} \quad \rho = 985 \text{ kg/m}^3$$

Thus,

Reynolds Number (R_e)

$$R_e = \frac{\mu \times D_m}{\rho}$$

$$= \frac{0.4708 \times 0.006}{0.478 \times 10^{-6}} = 5909.623$$

Since the flow is force convection ,therefore using monrad and peloton equation;

$$N_u = 0.02(R_e)^{0.8} \times (P_r)^{0.33} \times [D_o/D_i]^{0.53}$$

$$N_u = 0.02(5909.62)^{0.8} \times (3.020)^{0.33} \times [0.022/0.016]^{0.53}$$

$$N_u = 35.47$$

Thus, **Heat transfer coefficient (h);**

$$h = \frac{N_u \times K}{D_m}$$

$$h = 3.47 \times 0.6513 / 0.006$$

$$h = 3850.26 \text{ W/m}^2\text{K}$$

Thus heat load generator (Q_g)

$$Q_g = hA (T_g - T_s)$$

Where,

T_s = Surface temperature

$$Q_g = 3850.26 \times \pi \times 0.006 \times 0.51 \times (95 - 92)$$

$$Q_g = 111.04 \text{ watt.}$$

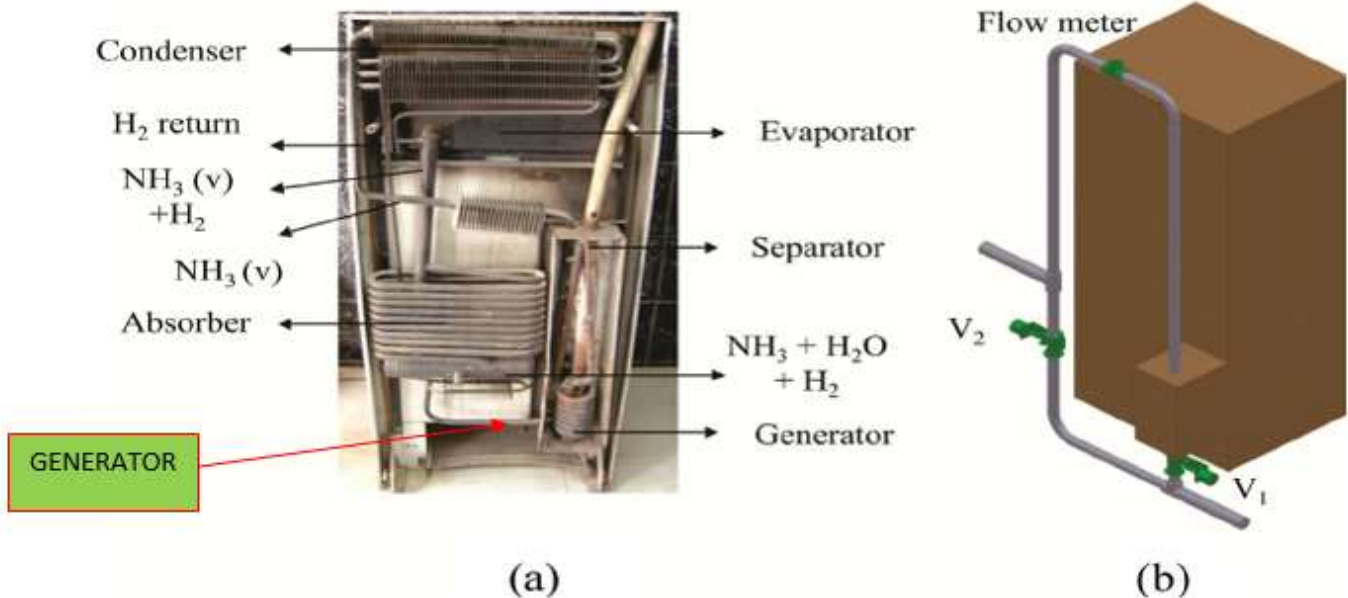


Fig.5: Generator with heating coil

DESIGN OF EVAPORATOR

Mass flow rate of refrigerant from condenser
 $= 17.5 \times 10^{-3} \text{ kg/sec}$

Ambient temperature $T_a = 45^\circ\text{C}$

Cooling unit temperature $T_e = 15^\circ\text{C}$

Heat load at evaporator $Q_e = m_r (h_a - h_e)$

As aqua-ammonia flow through out system enthalpy at above temperature

From refrigerant table
 At 45°C, $h_a = 396.81 \text{ kJ/kg}$
 At 15°C, $T_e = 251.44 \text{ kJ/kg}$

$$Q_e = 17.5 \times 10^{-3} \times (396.81 - 251.44)$$

$$Q_e = 2.543 \text{ Watt}$$

$$\text{COP} = \frac{Q_e}{Q_g} = 2.543 / 111.04 = 0.0229$$

$$\text{COP} = 0.0229$$

Hence by putting above values, we get
 Heat load on evaporator

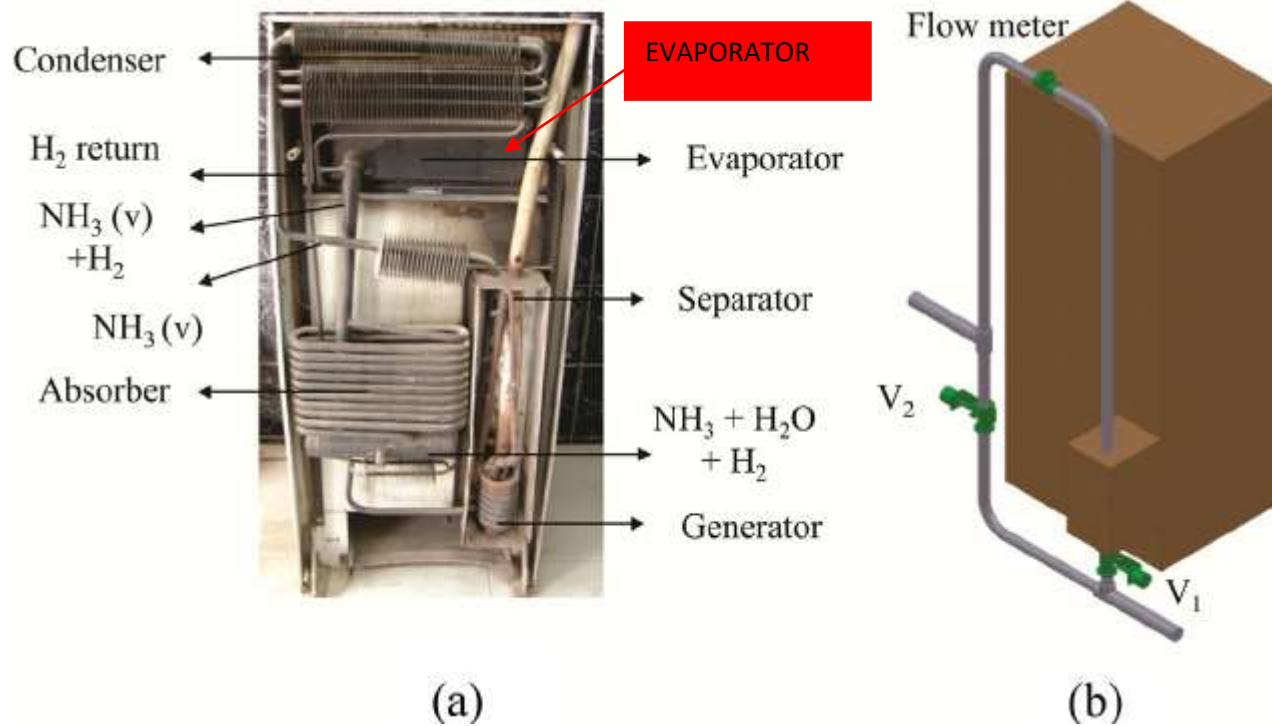


Fig.6: Shell and tube type evaporator

V. EXPERIMENTAL CIRCUITS

In this system there are the circuit which are describe one by one

5.1 HOT WATER CIRCUIT

First the available cold water is filled in the entire circuit of collecting tank, solar panel's riser pipes, header pipes & generator coils. Then the entire system is placed in open atmosphere to receive solar radiation. The radiation received by the absorber plate is transferred to the water in the riser pipes. As a result the water gets heated and the density decreases. As the hot water is less dense than cold water it automatically rises up and enters the collecting tank. The relatively cold water from collecting tank replaces the hot water in the riser pipes and the procedure repeats. The collected hot water then circulates in the coil placed in the generator where the hot water gives off its heat to the refrigerant. So in the hot water circuit the water receives heat in the solar panel and gives off the heat in the generator.

5.2 REFRIGERANT CIRCUIT

The refrigerant gets separated from the aqua ammonia solution in the generator by absorbing the heat from the hot water in the generator coil. The ammonia after getting vaporized flows through the circuit and enters the condenser. In the condenser the refrigerant Vapour gives off its heat to the surrounding air and gets converted into liquid ammonia. So the refrigerant gives off its latent heat in the condenser. The liquid refrigerant then enters the capillary tube where the pressure drops to the evaporator pressure. The low pressure low temperature liquid refrigerant then enters the evaporator receives heat and produces the refrigerating effecting in the evaporator cabinet. The refrigerant gets converted into Vapour after receiving the heat. The Vapour refrigerant is absorbed by the water present in the absorber. This is due to the chemical affinity of the water towards ammonia. This is the motive force for the refrigerant. In the absorber the ammonia Vapour mixes

with water and results in aqua ammonia solution. This solution is pumped to the generator pressure by a fractional HP pump. In the generator the ammonia gets vaporizes and separates from the solution. If any amount of ammonia remains in the solution it is sent back to the absorber through capillary tube. Thus the cycle repeats.

After the system is reached to steady state the following readings are taken

1. Collecting tank water outlet temperature
2. Temperature of the refrigerant before evaporator
3. Temperature of the refrigerant after evaporator

VI. RESULTS AND DISCUSSION

The experiment test trails are conduct about five hours per day for 183 days. The temperatures are noted at particular intervals of time. The temperature variations are shown in Fig 7..As the temperature of hot water supplied to the generator from the single flat plate solar collector increases, the evaporator temperatures at inlet and outlet are decrease. It is also observed from the Fig.8 the difference between evaporator temperatures at inlet and outlet marginally increases as the time of operation increases. The temperature drop is found that in the range of 7 to 80C. Almost after two hours of operation there is no further drop is observed and it may be due to there is no change in supply water temperature to the generator. The maximum COP is in the range of 3 to 3.5 and actual COP is found in the range of 0.75 to 0.79

Table.1: Collector Fluid Temperature with Local Time Temperature in Bhopal

SNo.	Local Time(inHrs)	Ambient Temperature(°C)	Collector Fluid Temperature(°C)
1	9:00	26.40	40
2	10:00	28.60	70
3	11:00	31.20	100
4	12:00	31.90	120
5	13:00	33.70	126
6	14:00	34.50	123
7	15:00	34.80	115
8	16:00	32.00	110

Every one an hour the parabolic dish was adjusted manually to path the movement of the sun. From the testing done it was noted that the lowest temperature achieve was 25°C. It was noted that the cabin temperature increased for a definite period and then drop

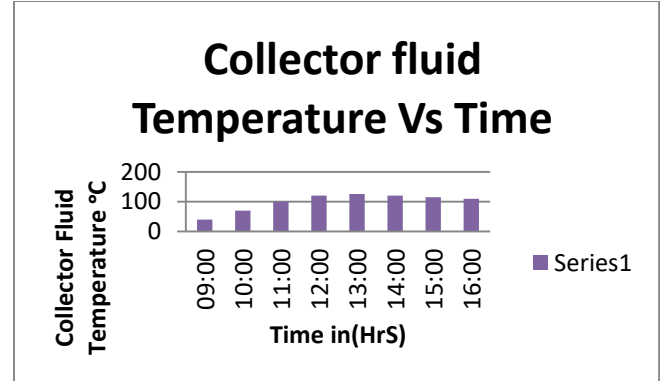


Fig.7: Variance of Collector fluid temperature with local time in Bhopal

The C.O.P of the system was obtain from the calculations as 0.0229 The result was noted that the collector fluid temperature increased with time but only up to a certain period. It can also be noted that the fluid temperature increases till 13:00 to a temperature of 120°C nd then starts reducing. Now a second set of data is analyze. Here cabin temperature variance is consider with respect to time. A digital thermometer was used for the purpose. It was noted that the cabin temperature reduces up to 13:00 hrs and then

Table.2: Cabin temperature with local time temperature in Bhopal

SNo.	Local Time (inHr)	Cabin Temperature (°C)
1	9:00	27.50
2	10:00	26.20
3	11:00	25.10
4	12:00	24.30
5	13:00	23.50
6	14:00	23.70
7	15:00	24.60
8	16:00	26.00

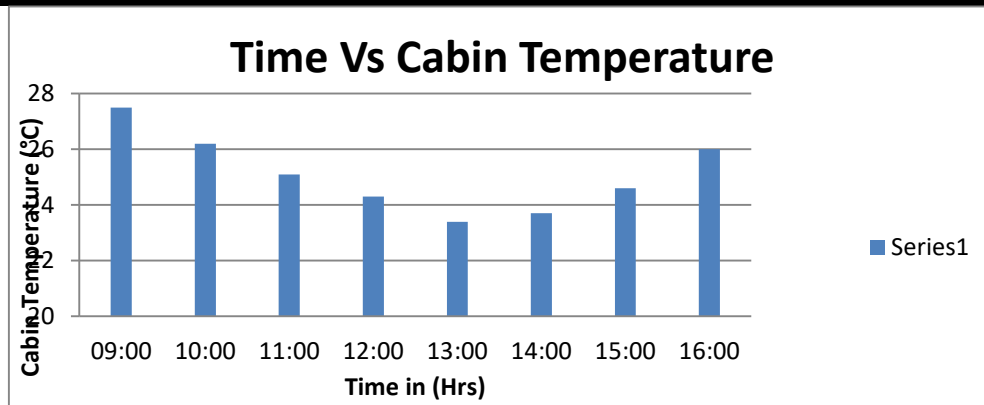


Fig.8: Variance Cabin temperature with local time in Bhopal

Table.3: Collector Fluid Temperature with Local time temp. in Bhopal

SNo.	Local time(inHrs)	Atmospheric Temperature(°C)	Collector Water Temperature(°C)
1	9:00	27.50	27.50
2	10:00	29.40	41.00
3	11:00	34.30	59.00
4	12:00	35.60	78.00
5	13:00	36.20	89.00
6	14:00	38.70	80.00
7	15:00	37.10	91.00
8	16:00	35.50	82.00

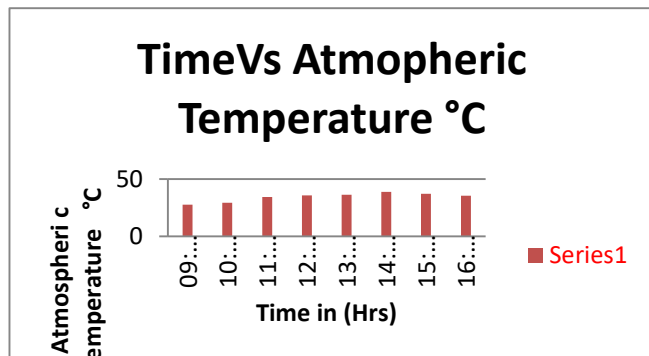


Fig.9: Atmospheric temperature with local time in Bhopal

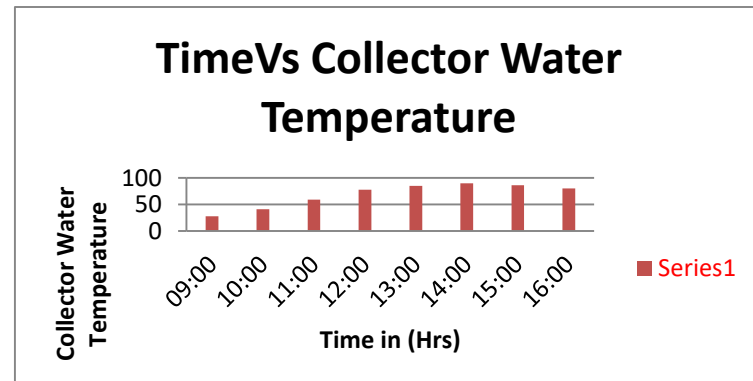


Fig.10: Collector water temperature with local time in Bhopal

VII. CONCLUSION

The following conclusions can be made from the present investigation

1. The Solar flat plate collector Water Heater (SWH) can be effectively used in summer to produce refrigeration effect using Vapour absorption refrigeration cycle.
2. The amount of refrigeration effect is based on the temperature of the hot water supplied to the generator.

3. The maximum drop in the temperature at the evaporator in the present work is estimated to be 7 to 80C.
4. The COP (Coefficient of Performance) of the system is about 0.78 against the maximum COP of the system
5. The additional cost of the refrigeration cycle is very low.

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Mitigating Global Warming and Climate Change with Design of Super Efficient Greenhouse

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Abstract—This study was conducted to design Super Efficient Greenhouse (SEG) and covers all aspects from growing food, combating global warming and climate change to regenerating environment. Today, many sustainable solutions can replace old unsustainable methods of building greenhouses and their unsustainable operation. SEG offers better growing conditions, less energy consumption, less chemical inputs and above all, lower operating costs for greenhouse growers. This article presents our study on alternative greenhouse design, energy systems and construction options. Moreover, our basic model for backyard growers is publicly accessible which is our contribution to the implementation of the Paris Agreement.

Keywords—Agriculture, Climate change, Design, Greenhouse, Permaculture, Sustainability.

I. INTRODUCTION

After adoption of the Paris Agreement at the COP21 on 12 December, 2015, in Paris, the whole world is urging to find solutions against climate change. United Nations agenda on climate change (goal 13 from Paris Agreement) includes listed facts about CO₂ emissions that increased by almost 50 per cent since 1990. Another fact is that emissions grew much quicker between 2000 and 2010 than in each of the three previous decades. [1]

To reach the goals of the Paris Agreement as soon as possible we have to be innovative and change practices. Sustainable designed Super efficient greenhouse meets a lot of those aims.

1.1. Energy

Greenhouses are used for year-round food production in temperate climates. If we combine data from Cornell University Agricultural Experiment Station and International Greenhouse Vegetable Production Statistics, we can see that greenhouse vegetable producers have energy consumption of 5208 TWh of energy for heating and lighting in a year. This results in carbon emissions that are equal to those produced by driving around the world for 112 million times. It would take an area of

healthy forest the size of India to offset that amount of CO₂. Moreover, approximately 1.18 Giga metric tones of CO₂ emissions are produced every year. And statistics show that greenhouse area for vegetable production is expanding. [2],[3]

Many factors define energy consumption in the greenhouse, such as design, construction, materials used for construction, energy source used for heating, heating methods, crops grown inside. Considering these factors we can have major impact on energy consumption and global greenhouse gas emissions. [4] If we also add regenerative agricultural practices, we can even offset greenhouse gas emissions. [5]

On the other hand, energy costs of running greenhouses all year round are the third highest costs for the vast majority of greenhouse growers behind labor costs and plant materials. For example, energy costs represented over 10% of product sales in 2009 in the USA. This number will increase because of rising energy costs in the future, unless we do use better options. Heating energy of typical greenhouse growers represents around 75% of total energy consumption used for operating greenhouse production business. [4]

Within this study, a greenhouse design model was developed for commercial and noncommercial growers. It provides technical solutions that growers can benefit from, mitigate yearly expenses and offset CO₂ emissions.

1.2. Pest control

Greenhouse growers cope with the problem of pests in greenhouses. Pests are becoming more and more resistant to pesticides. On the other hand, we have environmental problems with overuse of phytopharmaceuticals. So a lot of growers are leaning toward natural solutions. For example, for insect pests they are starting to apply natural predators in their greenhouses. [6]

1.3. Environment

Due to the climate change, we are coping with harsher and harsher weather conditions. Hail storms can result in the loss of all products. Lost crops have also economic impact on farmers. [7]

1.4. Plant quality improvement

Plants grown in closed greenhouses get lower quantities of sunlight radiation as those grown outside or without any kind of roof on top of them. In addition, almost all greenhouses filter UV radiation. [8] UV light pushes plants to synthesize secondary metabolites that protect plants from sunburn. Most of them are antioxidants (such as vitamins). More of antioxidants in the plant body more of them in our food. [8],[9]

Photosynthesis uses light to convert CO₂ and water into sugars and O₂. Greenhouses are built to be as sealed as possible. When plants photosynthesize, CO₂ levels drop and production sinks as well. That is why growers have to add CO₂ to offset production losses. That is the other expense to consider. [4]

1.5. Renewable construction materials

Most greenhouses are made from steel and concrete. These two construction materials have large embodied energy. [11] To offset that we should use alternative construction materials as much as possible. [11],[12]

II. LITERATURE SURVEY

A lot of new alternative solutions can be found in literature to solve the problem, so we do not need to use old techniques and energy intense methods. However, there is not yet a single commercial solution to cope with all the problems.

2.1. Energy

Greenhouse growers can benefit and conserve some energy by simply having the greenhouse in the shape of a cube because cube's shape has the second smallest surface area for a given covered area and is also commercially interesting. The smallest surface area for a given covered area has hemisphere which is unfortunately not commercially practical to use. Greenhouse the shape of a cube has from 15 to 20% less surface area than freestanding longitudinal greenhouse for the same covered area. [4]

Furthermore, Sanford (2011) made a comparison of glazing material properties. If you use double-glazed solution, then polyethylene film with IR coat has the lowest heat loss characteristics (U-value of 0,5). Another great advantage of poly film covered greenhouses is that they can be better sealed than other types of greenhouses, according to Sanford (2011). That means lower infiltrations rates and lower energy losses. [4]

Unfortunately, greenhouses with lower infiltration rates result in shortages in CO₂ concentrations. [4] In such situations, growers add CO₂, as Sanford (2011) writes. [4] However, this means extra energy consumption for growing and extra costs for growers.

A simple step towards conserving energy is a method of heating the floor (or growing beds) under plants. This

saves equivalently as much energy as if you turn down the thermostat for 2.5 to 5°C. [4]

In addition, energy can also be produced by compost and applied to different applications among which is greenhouse seedbed heating. [12] Smith and Aber (2014) claim that "The bio-oxidation of organic material that occurs during composting is an exothermic reaction that continually releases heat,...". [13] A large quantity of thermal energy is produced by composting but unfortunately, it is not used and it is lost in the surrounding environment as heat. [14] Recovery of different compost heat recovery systems was reviewed by Smith et al. (2016) who came to the conclusion that recovery rates averaged from 1895kJ/hr (1159kJ/kg DM) for lab scale systems to 204907kJ/hr (7084 kJ/kg DM) for commercial ones. [14] Compostpower.org (2017) estimated that you can get 30000kJ/hr from 30m³ of shredded bark mulch composting mound. [12]

Sanford (2011) reports that 25% of heating needs can be offset by active solar or subterranean heating. [4] Indeed, active solar heating can increase average soil temperatures during the coldest time of the year for 5 to 8°C. The optimum temperature difference between air temperature at the top of greenhouse and at the soil surface is 11°C in order to get the best results out of the subterranean heating system. [15]

To conserve energy inputs into greenhouse floor, you have to insulate foundations around greenhouse to about 1m depth. Moreover, Bill (1988) recognizes floor and earth beneath as critical heat store for cold month nights. He also explains that most of the subfloor heat escapes through surrounding soil and most of that loss occurs in the first 0.5m of soil depth. [16]

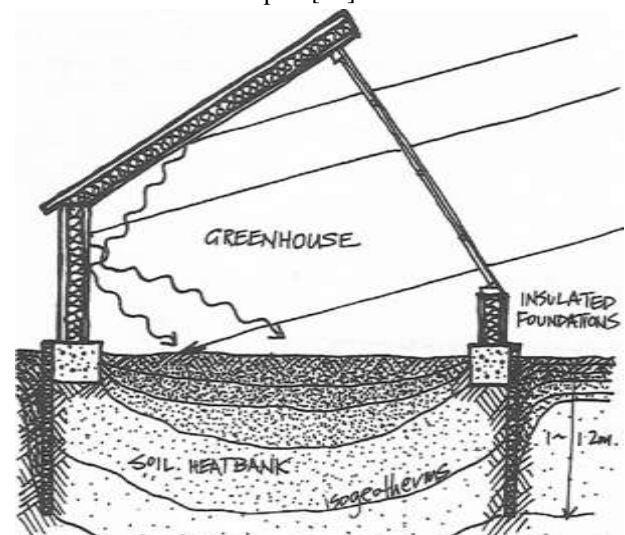


Fig.1: Difference in isogeotherms inside and outside greenhouse with insulated foundations (Bill Mollison, 1988: 416).

2.2. Pest control

After Second World War growers in Europe have used a lot of chemistry inside greenhouses to eliminate pests and diseases. However, many authors, among them Lenteren (2000) claims that in our present time we have lots of possibilities to control pests with their natural enemies. [6]

Furthermore, another effective technique to combat pests and disease problems uses sunlight. In a study conducted by Nyeleti, et al. (2004), an effect of sunlight on the survival of *Salmonella* on surfaces conclusions were made, that sunlight exposure has the significant decrease in numbers of *Salmonella* on surfaces. [17] Another research proves sunlight to be effective disinfectant against tuberculosis and *E. coli*. [18]

In addition, Rodale Institute (2014) has outstanding findings. If compost is used as soil amendment, it increases soil biodiversity which suppresses soil born diseases and pests and helps with nutrient cycling. This soil benefits also improve productivity while reducing water and fertiliser needs. [5]

2.3. Environment

In 10-year trial Rodale Institute (2014) has proven that crop fields on which compost replaced synthetic fertilizer sequestered more than two metric tons of carbon, while conventional farming system lost carbon. [5]

In Slovenia, hail storms occur every year and the total devastation made between 1994 and 2008 was estimated at 260 million euros. [7] To get an idea how small Slovenia is, its surface area is only 20,273 km². [19]

2.4. Plant quality improvement

If plants are exposed to direct sunlight or the whole spectrum (especially UV-B radiation) they increase the amount of active substances in their tissues. Among those active substances are also phenolic chemicals according to Gabersčik et al. (2014) which have beneficial biological functions as antiviral, antibacterial, anti-allergic, anti-inflammatory, anti-carcinogenic, immune system-stimulating actions and other beneficial characteristics. [8] Moreover, human health can also benefit from these active substances because they lower the risk for cancer formation and cardiovascular diseases. [9]

Kitaya et al. (1998) find out that higher concentrations of CO₂ can compensate for lower light intensities. [20] As Singh et al. (2005) state, CO₂ is released throughout the whole composting process. [21]

2.5. Renewable construction materials

Wood as a building material is sustainable and renewable. Hanley (2015) states that 16% of all the fossil fuel in a year is used for manufacturing of concrete, steel, aluminum and brick from raw substances to construction products. [11] If we substitute these construction

materials by using wood instead, we will save from 14 to 31% of global CO₂ emissions. [10]

III. SUPER EFFICIENT GREENHOUSE DESIGN

Our Super Efficient Greenhouse (SEG) embodies our research and work at Permaculture Institute Maribor. The design combines all known sustainable practices and some of our own research and findings.

We designed SEG to have least possible edge area to volume. The floor dimension of our basic model for backyard growers is 4.5m x 6m and it is 3m high. The basic model for professional growers can be prolonged and/or connected with side walls, so you get gutter connected one.

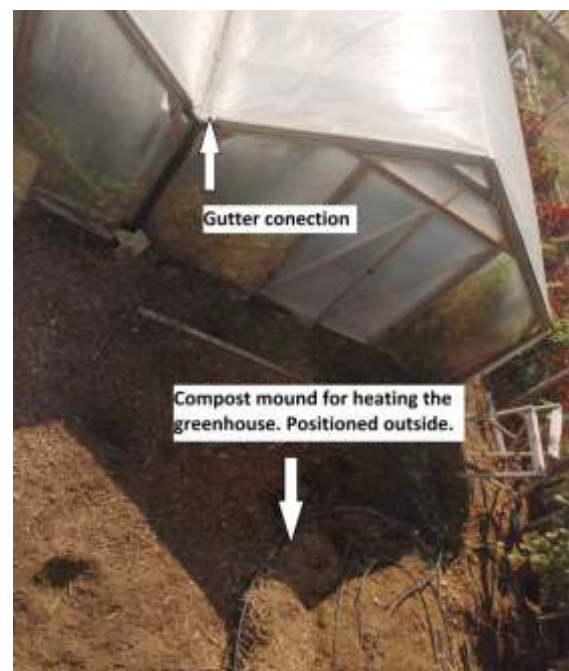


Fig.2: Gutter connected greenhouse at our research facility.

Structural beams of SEG are all made from wood.

Double-layer poly film is used for roof and side walls. The foil consists of one continuous piece on each side. This enables growers to open their SEG all the way to the rooftop. On the upper end, a double-layer poly film is connected to roof ridge with foil fixation profiles and on the bottom end, it is clamped on steel tubing. This steel tubing can be rolled up the walls and up the roof all the way to the roof ridge. Both foils are welded together on side ends, so that air can be blown in between the foils. Air is pushed into steel ridge tube with the help of a ventilator. This tube is perforated on the sides where the foil is attached and through that perforation air is blown in between double-layer poly film.

In addition, a layer of insect netting is placed underneath the double-layer of poly film. This netting is fastened the

same way as the double-layer foil and can be also rolled up and down.

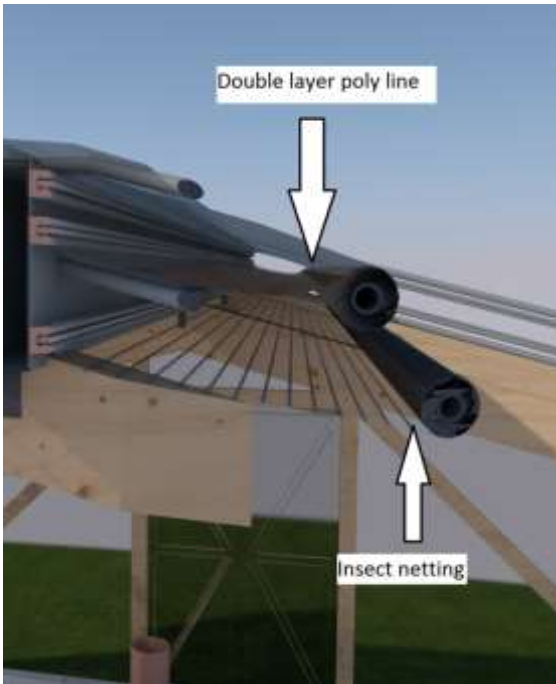


Fig.3: Double layer poly line and insect netting for roof and side coverage.

Furthermore, the front and back face of SEG is also glazed with a double-layer poly film which is also applied to the doors. In order to have a bigger entrance, doors can be folded.

A 10cm thick layer of insulation should be buried 1m deep all around the perimeter of the SEG.

Likewise, beneath the SEG floor, two types of tubing are buried underground. One type of tubing is 10cm perforated drain tile, located at two levels. Three of them are placed 30cm underneath the floor and other four are positioned 60cm underneath the floor. They are all connected to two 25cm tubing that goes vertical out of the floor. One of 25cm tubing is located at the front face of SEG and rises up to the ceiling of SEG. This one has also ventilator attached that blows hot air from the ceiling into the ground through buried tubing. Another 25cm tubing rises out of the ground beside back face of the SEG. This one looks out of the ground only by 50cm in height. This is the exhaust pipe of the subterranean heating system.

Another type of tubing are 16mm pipes for floor heating. They are located beneath the growing beds 20cm deep in the ground. Every growing bed has its own pipe loop and distribution cupboard is located on the side of the compost heap. All pipe loops are connected to this distribution cupboard and from here on one pipe loop goes into the composting heap. Flow pump which drives this system is installed inside distribution cupboard.



Fig.4: SEG alternative heating system.

Composting heap area is located at the front left face inside the SEG. The perimeter of the heap area is covered with wire mesh. The area devoted to compost heap is between two beams and measure 1,5m x 1,5m. The height of the perimeter wire mesh goes to 2m.



Fig.5: SEG from inside with composting heap.

IV. DISCUSSION AND CONCLUSION

In general, greenhouse production is expanding, so we have to use at least sustainable, if not regenerative solutions to overcome climate change. SEG design can cope with a lot of factors that defines energy consumption in greenhouse production. As energy consumption decreases, growers can expect lower operating costs, meaning faster refund of investment and higher living standard.

SEG construction is designed to be made from wood. So we encourage and prefer builders of SEG to use wooden beams. Beams made from wood can be made by anyone who has or learns few skills of carpentry. What is more, wood is available almost anywhere where greenhouses are used and it is renewable. During SEG lifetime enough wood can grow to replace its structural beams over time, especially if durable wood will be used such as *Robiniapseudoacacia*.

Our personal observations and research on how much space does one family of four need to produce year-round vegetables, we designed our basic SEG model to be practical to use and as close to the shape of a cube as possible. We would like to minimize surface area to volume ratio to conserve energy losses with poor shape design.

The whole SEG is covered in double-layer poly film envelope to conserve energy losses compared to one layer glazed greenhouses. Poly film is used also because it can be rolled around round tube which serves to open side walls and rooftop. Additionally, our observations in practice show that inflated two-layer film greenhouse stands harsh weather conditions better than single poly film ones. According to studied literature, poly film greenhouses are also better sealed which conserves energy losses to outside environment as well.[4] This could have negative effects on plant growth because during photosynthesis CO₂ concentrations can decline inside the enclosed environment. This has been elegantly solved by putting compost heap inside SEG construction. During microbial decomposition of organic matter, CO₂ is released from the compost heap. In winter months with lower light intensity, higher concentrations of CO₂ can have positive effects, which can be seen in increased crop production.

Even more benefits are recognized by positioning compost heap inside the greenhouse. If you are using compost heat to warm your greenhouse, some heat is escaped directly from the surface of the heap. If it is positioned outside the greenhouse, the heat goes to surrounding environment. Also, some heat losses occur during transport of heated fluid in pipe lines going from compost heap to greenhouse floor heating system. The heap inside helps you to conserve such losses. Another thing to consider is finished compost that is used as growing amendment in the SEG and therefore should be as close to growing beds as possible. You conserve energy of transporting the medium. The compost is also rich in life and carbon. With amending more living creatures to your grow beds, you enhance soil health, plant health and eventually human health. Agricultural wastes are used to construct compost heap and not burnt or discarded in waste streams. By doing so, you put carbon in soils and decrease carbon emissions into the air. However, compost heap occupies some space in the greenhouse which can be otherwise used by growing. This could be mitigated if growers use the surface area of compost heap as vertical growing space, for example, to grow strawberries in pots on heap sides. Composting heap sides are in wire mesh which functions to contain composting material from falling off the sides of the heap.

Primarily compost heap is used to heat SEG growing beds. Growers have the advantage to grow different crops on different growing beds because every growing bed has its own pipe loop. This way temperature underneath each crop can be adjusted to desired range. More research has to be conducted at this point to see if you need an extra heating source for growing in the coldest months of the year or there is enough to use heating with compost heat and subterranean heating system in SEG.

Subterranean heating system is another alternative heating system in SEG. It uses excess solar heat trapped in SEG and puts it into the ground. Because the ground is insulated on the perimeter of SEG, earth inside it acts as a thermal battery. Over the day you charge the battery with heat and over the cold nights, the heat is slowly released, to heat SEG space. The ground in the SEG is insulated to minimize heat losses to surrounding outer soil. Without a subterranean heating system, you have to ventilate greenhouse to push excessive heat outside of it, which consumes extra energy.

In summer months when you do not need to heat greenhouses and a subterranean heating system is also not enough to cool down inside temperatures, SEG is designed to open its side walls and rooftop. With that characteristic, the whole hot air from inside the SEG goes out. Also, beneficial UV radiation can hit the inside surface of SEG. So, there are again some positive effects of the open roof. Less energy is used for ventilation, less sanitizing chemicals have to be used because of the sanitizing effects of UV light, fewer chemicals used for combating with pests and diseases because of health-boosting effects of UV light on plants and as so, fewer pollutants in groundwater, plants synthesize more secondary metabolites which means healthier food for humans.

An open greenhouse is also an invitation for outside insect pests to come inside. Some growers use insect predators as the control of insect pests. But those predators could escape if the greenhouse is opened. To cope with both problems SEG has the second layer over the roof and sides which can be opened and closed as desired and consists of insect mesh. This mesh can also be used as hail storm protection in summer months and as shading cloth.

Our further research would be in regenerative agriculture practices, gathering of real data from operating SEGs in fields and calculating the energy consumption of SEG operation. A lot of climate problems can already be addressed with SEG design. Furthermore, SEG design and regenerative agricultural practices could help to reverse climate change.

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Stress Analysis on a “L” shape Truss Optimization

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Abstract—The metal construction market in Brazil has grown significantly over the past few years. The weight reductions and performance increase of mechanical pieces obtained by using optimization techniques are significant to the point that currently its use is critical to define that competitiveness of the metal-mechanical engineering industries, and its undeniable importance in reducing costs. The optimization applied in the mechanical part design consists of using computational methods for dimensions, shape or optimal topology of parts. This study aims to propose a study methodology to analyse the stress distribution through the use of mathematical software and photoelasticity techniques, to propose a new structural profile, lighter and more efficient, which may be used as solution to overcome the current constructive limitations.

Keywords—Structural optimization, Stress analysis, Equal legs angles, Photoelasticity.

I. INTRODUCTION

The constructive method based on the use of metallic profiles was diffused from the 18th century in Europe, when construction of bridges and buildings based on this technology began. The method has been growing significantly in Brazil over the last few years. The use of metal structures has significant participation in situations where large spans are needed and to achieve advantages such as quickness in project execution time and waste reduction. Sustainable development is an essential theme in our daily lives, and the construction industry has a fundamental role in this field. According to (Grigoletti, [1]) industries have been searching to optimal structures development more than ever, that is, structures with higher structural performance, lower weight and manufacturing cost.

The geometry of the metal profile in which this work focuses is the 'L' angle. Because they are lightweight and have high tensile and compressive strength, the angle profile is used mainly in the construction of electric power towers. This profile is composed of two flaps that form a 90 degree angle between them, and according to (Bonatto, [2]) it is widely used due to its constructive simplicity and versatility.

This paper proposes to make a study about the angle profile "L", seeking to develop a lighter and more efficient structure, through the use of mathematical simulation software and structural optimization techniques.

II. STRESS ANALYSIS

2.1 PHOTOELASTICITY

The Photoelasticity Technik is according to (Shiavon, [3]) a method that uses optical effects allowing the stress analysis in a fast and qualitative way. As a necessary instrument is there the polariscopy, composed by 2 polarized lens that by adjusting the phase angle exhibits on the piece, colored lines showing the path made by the stress lines. It is possible to see the change at this lines by modifying the request conditions in which the section is exposed, allowing inclusive the prediction of spots of stress convergence.

At this research work, this method played a significant role to validate the finite element method. The pieces were formed by a blend of resins, which gives them the necessary characteristic to be evaluated through this method. According to (Shukla and Daylly, [4]) the major discrepancy between the elasticity modulus of the model and prototype does not influence significantly errors through a photoelastic 3D model since the deformations remains small. The results are by two images exposed: The first one is the regular profile available on the industry and the second one is the processed structure, considered optimized.

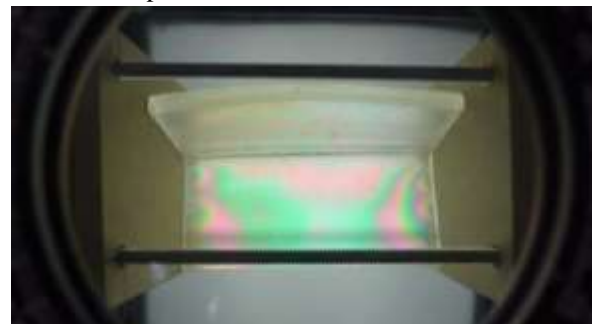


Fig.1: Regular profile

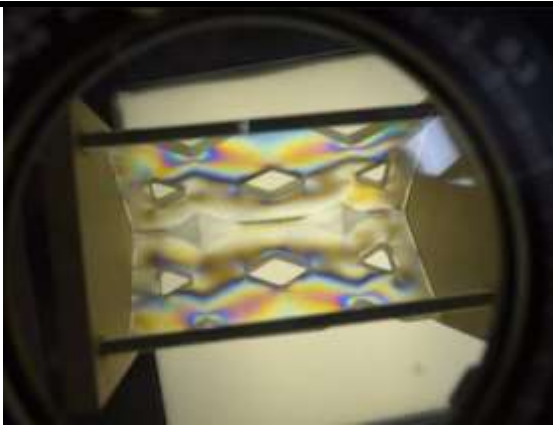


Figure 2: Optimized Profile

III. FINITE ELEMENTS METHODS

The method used for the virtual analysis was made through the finite element software Ansys. The work on the software was done using the Static Structural tool. It is possible to simulate numerous situations with this leading tool, thus predicting the behaviour of tensions, stress, deformation, among others reactions throughout the structure.

In this research, the Ansys was used for the analysis of tension in an angle "L" acting under compression forces at one end, and the other end beam. The aim of this study was to analyze the distribution of stresses under the profile, and do not test it to the limit of its resistance. The forces used for virtual analysis were higher than those used during the photoelastic mode tests. The variation of these forces will not affect the obtained results, because according to the theory of elasticity, the equations of equilibrium tension do not contain elastic constants, in this way, the tensions are independent of the modulus of elasticity E of the model's material, and at most may depend only on the Poisson coefficient.

In Figures 3 and 4 below, it is possible to see the initial configuration of the tests, for both angles (optimized angle and base angle).

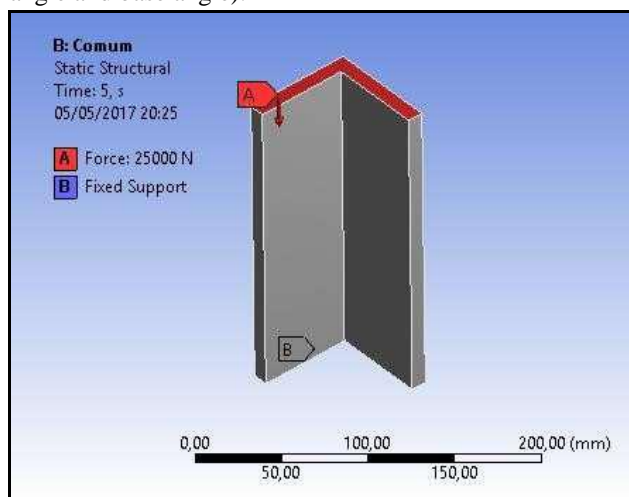


Fig.3: Initial configuration of test for base angle

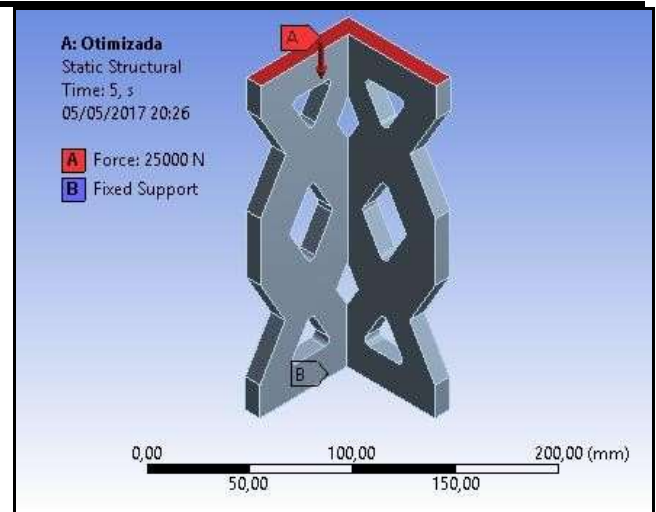


Fig.4: Initial configuration of test for optimized angle

Through the simulation performed in the Static Structural tool, they indicated for the base model a maximum equivalent stress (Von-Misses) of 45.7 MPa and a minimum of 8.7 MPa for . The base model angle has a mass of 2,041 kg. The optimized angle had a maximum equivalent stress (Von - misses) of 230,86 MPa and a minimum of 0,09 MPa and a mass of 1,55 kg. The images 5 and 6 below shows the stress distribution as well as the results obtained.

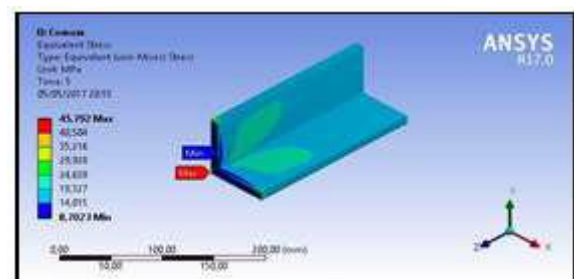


Fig.5: Static stress analysis result for base angle

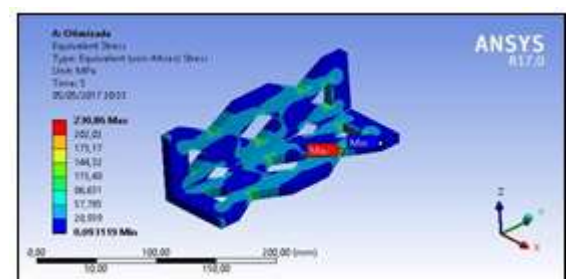


Fig.6: Static stress analysis result for optimized angle

It is possible to verify for image 5 that there is concentration of the stresses at the base of the base angle. The angle considered optimized (figure 6) presented a more homogeneous distribution of tensions along the profile.

The images 7 and 8 below present an analysis of the deformation generated by the loading in the profiles.

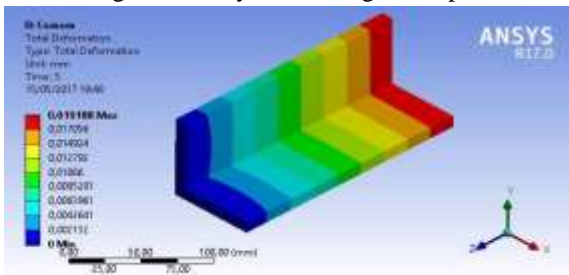


Fig.7: Deformation analysis result for base angle profile when under loading

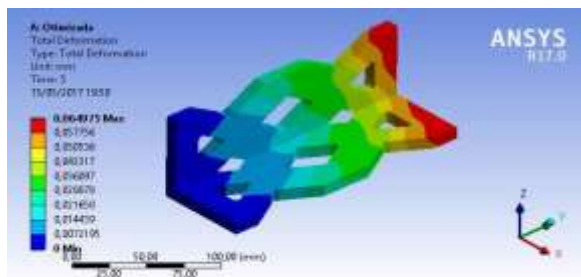


Fig.8: Deformation analysis result for base angle profile when under loading

It is possible to verify that the base angle reached a maximum deformation of 1.9×10^{-2} mm, while for the optimized angle, with a maximum deformation of 6×10^{-2} mm.

The table below shows a summary of the results obtained.

	Base Angle	Optimized angle
Maximum stress (MPa)	45,70	230,86
Minimum stress (MPa)	8,70	0,09
Mean stress (MPa)	20,00	40,00
Max. Deformation (mm)	1,90E-02	6,00E-02
Mass (Kg)	2,04	1,55

IV. CONCLUSION

From the obtained results, it is possible to notice that although the optimized angle has higher stress points compared to the base angle, the mean stress distribution along on its surface was around 40 MPa, whereas for the base angle it obtained an average of 20 MPa. However, there is a greater homogeneity of the stress distribution along the optimized angle, due to the rebated made along the profile. Another important point observed during the simulation was in relation to the deformation, for the base angle, the maximum deformation was 1.90×10^{-2} mm while for the optimum angle the deformation was 6×10^{-2} mm. Despite the disparity between the results, it is

considered extremely satisfactory, since both tensions remain considerably below the steel flow stress, around 210 MPa, and the mass reduction obtained in the models was approximately 25%. For the deformations, the values are considered insignificant, since maximum deformation was obtained in the studies of 6 hundredths of a millimeter. The results indicated a lighter structure, and as efficient as the base structure studied, reinforcing the need to carry out studies on obtaining optimal structures.

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The Iteratively Regularized Newton Method for Reconstructing Image of Microwave Tomography

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Abstract— The iteratively regularized Newton method has been investigated to obtain stable solutions of Microwave Tomography inverse problems. The problem is presented in term of minimization of the difference between measured scattered field and the guessed field which is calculated from initial guess of the exact solution. The iterative sequence is defined based on the Newton method, in which, decreasing sequence of positive number regulates the ill-posed operator of the nonlinear problem. The method proposed is tested using numerical example and compared with non-iterative regularization method.

Keywords— iteratively regularized, inverse problem microwave tomography.

I. INTRODUCTION

The image of Microwave Tomography (MT) can be produced by illuminating a dielectric body with a microwave field in different directions, and measuring the scattered field around the object at each illumination. The data of the measured scattered fields are processed using image reconstruction algorithms to produce the electric property distribution of the object. The reconstructions are completed in two steps: forward and inverse problems.

Numerically the forward problem which is also well known as direct scattering problem can directly be solved accurately. On the other hand, the inverse problem is a highly nonlinear system and suffers from ill posed, thereto, regulated inverse method is needed to solve the problem. Currently, the Newton based methods are popular techniques to solve the MT inverse problem for speed reason. The Newton Kantorovich method [1], Inexact Newton Method [2], Quasi-Newton method [3] [4] and Gauss-Newton inversion [5] had been intensively applied to the MT inverse problem. The results show that the regulator is essential to stabilize the reconstruction process.

Thikonov regularization is probably the most recognized regulator in MT which is applied in [1] [3] [4], beside the filter method in the form of Truncated SVD. Multiplicative and Additive regulator has also been applied in MT inverse problem [2]. Nevertheless, the last regulator need second derivative of the cost function which increases the computational burden. Furthermore, the iteratively regularized Gauss-Newton method has been proved that it

can be used to provide stable solution of non-linear ill-posed problem [6]. In this paper the method is applied to solve the MT inverse problem and tested using synthetic data.

II. FORWARD PROBLEM

Direct scattering problem is presented in electric field integral equations (EFIE) under TM polarization. The incident field inside the domain object is stated as domain equation as follows

$$E_z^i(x, y) = E_z^t(x, y) + \frac{k_0 \eta_0}{4} \iint J_z(x', y') H_0^{(2)}(k_0 r) dx' dy'$$

Where total electric field may be replaced by the current source $J = j\omega\epsilon_0(\epsilon_r - 1)E$. The scattered fields are computed using data equation, which is stated as

$$E_z^s = -\frac{k_0 \eta_0}{4} \iint J_z(x', y') H_0^{(2)}(k_0 r) dx' dy'$$

The equations are solved using the method of Moment. The object is divided into N number of cells with equal in size, then the $J(x, y)$ can be approximated by superposition of Pulse Basis function. The integral in (1), (2) are evaluated analytically with the assumption that all the cell are circles [7] and written in matrix equations (4) and (5). To avoid singularity at background medium the contrast of dielectric is stated as :

$$\chi_\epsilon = (\epsilon_r - 1)/\epsilon_r$$

and the integral equations are written as:

$$\chi \mathbf{E}^i = \left[\chi \mathbf{Z}_N - \frac{\eta_0}{k_0} \mathbf{I} \right] \mathbf{J} \quad \text{domain equation} \quad (4)$$

$$\mathbf{E}^s = -\mathbf{Z}_M \mathbf{J} \quad \text{data equation}$$

$\mathbf{Z}_N, \mathbf{Z}_M$ is $N \times N$ and $N \times N$ matrix sequentially, where

$$Z_{mn} = \begin{cases} m \neq n, & \frac{\eta_0 \pi a_n}{2} J_1(k_0 a) H_0^2(k_0 \rho) \\ m = n, & \frac{\eta_0 \pi a_n}{2} H_1^2(k_0 a_n) \end{cases}$$

Once the χ is given in (4), the \mathbf{J} is easily computed using domain equation. Furthermore, the electric fields can be determined using the data equations (5), in which the cells size is determinant to the level of accuracy.

III. INVERSE PROBLEM

The MT inverse problem can be stated as the operator equation which is continuous and differentiable at $D(\mathcal{F})$. If \mathbf{E}_p^i are illuminated to the dielectric object from P number of

projections, then the operator equation for MT inverse problem is written as

$$\mathcal{F}(\chi) = -\sum_{p=1}^P [\mathbf{Z}_M [\chi \mathbf{Z}_N - I]^{-1} \chi \mathbf{E}_p^i] \quad (6)$$

The target solution, which is measured data is stated as:

$$y = \sum_{p=1}^P [\mathbf{E}_{mea,p}^s] \quad \square \square \square$$

The inverse problem determines the unknown physical quantity χ from set of data measurement. In practical situation only approximated data (y^δ) are available. However, to simplify the experiment, in this paper the data used are synthetic which are free from noise. Thus the problem in term of operator equation is written as

$$\square \mathcal{F}(\chi) = y \quad \square \square \square$$

The well known classical regularized solution (χ_α) of (8) which is non-linear and ill-posed are gained by minimizing the problem using Tikhonov regularization as follows:

$$\chi_\alpha^\delta \in \operatorname{argmin} [\|\mathcal{F}(\chi) - y\|^2 + \alpha \|\chi - \chi_0\|^2] \quad \square \square \square \quad \square \square \square$$

where α is a positive real number and χ_0 is the initial guess of the solution of (8). In practice, solving (9) using Newton method will face two main problems, which are determining the value of Tikhonov regulator α and determining direction of iteration. Both variables, which are hard to be found, directly influence the stability of the inverse problem. Therefore, stable solution of (8) sometimes difficult to obtain.

To overcome the instability of the solution of (8), the iteratively regularized Newton method is proposed. It solves $\chi_{\alpha_k}^\delta \in \operatorname{argmin} [\|\mathcal{F}(\chi) - y\|^2 + \alpha_k \|\chi - \chi_0\|^2]$ where α_k is dynamic over the iteration.

The iterative sequence of solution ($\chi_{\alpha_k}^\delta$) is stated as

$$\chi_{\alpha_k}^\delta = \chi_{\alpha_{k-1}}^\delta + d \Delta \chi_{\alpha_k}^\delta \quad \square \square \square \square$$

where $d < 1$, and $\Delta \chi_{\alpha_k}^\delta$ is the step of iteration.

The step of iteration (11), in which the iteratively regularized Newton method is applied, is calculated using Gauss-Newton algorithm as follows:

$$\Delta \chi_{\alpha_k}^\delta = -[\mathcal{F}'(\chi_{\alpha_k}^\delta)^* \mathcal{F}'(\chi_{\alpha_k}^\delta) + \alpha_k I]^{-1} (\mathcal{F}'(\chi_{\alpha_k}^\delta)^* (\mathcal{F}(\chi_{\alpha_k}^\delta) - y) + \alpha_k (\chi_{\alpha_k}^\delta - \chi_0)) \quad \square \square \square \square$$

where $\mathcal{F}'(\chi_{\alpha_k}^\delta)$ is Frechet differential of (6) at $\chi_{\alpha_k}^\delta$ which is defined as

$$\mathcal{F}'(\chi) = \sum_{p=1}^P [\mathbf{Z}_M [\chi \mathbf{Z}_N - I]^{-1} [\mathbf{E}_p^i + \mathbf{Z}_N \mathbf{J}_p]] \quad \square \square \square \square$$

Some authors apply the algorithm by considering iteratively regularization with the number of iterations $n_\delta = N$ being fixed [6]. In this paper, α_k plays the role of the regularization parameter. The α_k is a positive real number that sequentially updated along the iteration. Therefore, the sequence of the α_k and the initial value of $\alpha_{k=0}$ are considered to build stable solution.

The stable approximated solution with initial guess $\chi_0 \in D(\mathcal{F})$, is obtained as $\chi_{\alpha_k}^\delta \rightarrow \chi$ and $\|\mathcal{F}(\chi_{\alpha_k}^\delta) - y\|$ decreases to 0 for $k \rightarrow \infty$. Therefore, the proposed iteratively regulator is a sequence that follows

$$\frac{\alpha_k}{\alpha_{k+1}} = r \quad \square \square \square \square$$

where r is a real positive number bigger than 1, which is determined in the experiment.

Furthermore, the starting value of the iteratively regulator is iteratively determined. Initially, the value is set as a small positive real number, which is $\alpha_0 = 0.0001$. Then it is iteratively increase to keep the solution inside the domain $\chi_{\alpha_k}^\delta \in D(\mathcal{F})$. The sequence of α_0 follows

$$\alpha_0 = \alpha_0 + \frac{1}{2} \alpha_0 \quad \square \square \square \square$$

and ends as the following condition satisfied

$$\|\mathcal{F}(\chi_{\alpha_0}^\delta) - \mathcal{F}(\chi_{\alpha_1}^\delta)\| < tolerance \quad \square \square \square \square$$

The tolerance is a positive real number less than 1, which is defined at the experiment.

Once α_0 and r are determined, the algorithm (12) can be executed. The algorithm is controlled by stopping index of iteration n_δ , which is selected according to

$$\|\mathcal{F}(\chi_{n_\delta}^\delta) - y^\delta\| \leq c\delta < \|\mathcal{F}(\chi_{\alpha_k}^\delta) - y^\delta\| \quad \square \square \square \square$$

where $c > 1$ and $0 \leq k < n_\delta$

IV. NUMERICAL EXPERIMENT

The research design is numerical experiment. The measured data are synthetic which are obtained from forward problem (4)(5). The data are reconstructed by the iteratively regularized Newton algorithm (12). Comparative study is used to analyze the stability of the solutions. The images resulted by iteratively regularization Newton method are compared to the images resulted from classical Tikhonov regularization (9). The degree of reconstruction difficulty is determined by the complexity of the object.

Two difference object are used to test the algorithm. Two dielectric circular cylinders and four similar dielectric circular cylinders are placed inside the object domain. The object domain is illuminated using TM signal at 4 GHz from 16 antennas at data domain sequentially. At each illumination, the scattering field data are gained at 16 antennas around the object domain. Then, all 16 projection data are reconstructed using method proposed. The results of reconstruction are shown in fig 1.

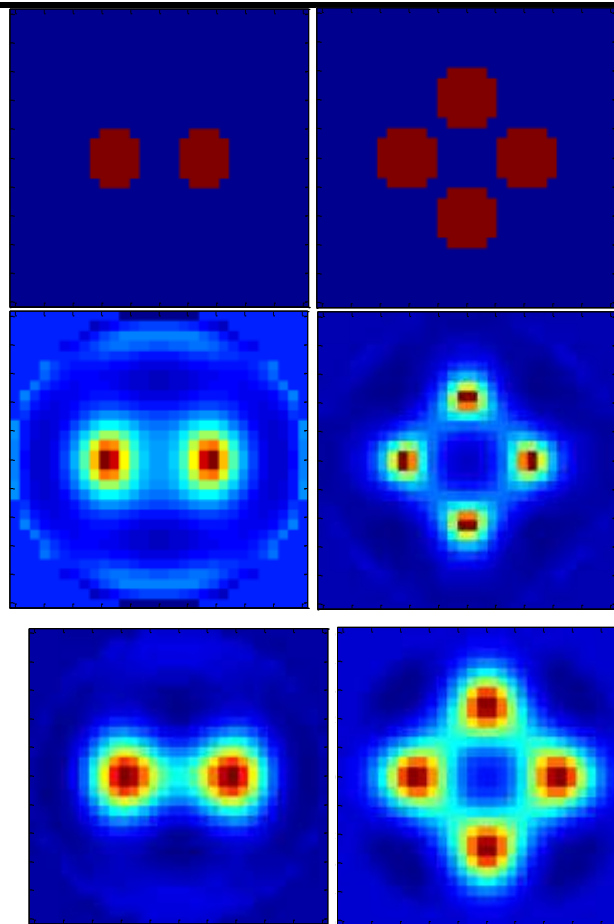


Fig.1: The image of original object (top), reconstructed using Tikhonov regularization (center) and reconstructed using iteratively regularized Newton method (bottom)

It can be seen that iteratively regularized Newton method produces a stable solution. The number and the shape of the dielectric object can be clearly distinguished, while the other regulator produces less quality image. The proposed method capable in eliminating the background material. Thus the error of the solution is lower than the error of solution of classical Tikhonov regularization. The sequence of the α_k and its initial guess selection stabilize the solution.

The geometric series of α_k with ratio in between 1.5 to 3 is selected as the sequence of the regulator. It brings established solution of (10) for both cases tested as seen in the fig 1. The $r = 2$ seems to be acceptable value to set for this type of problem. Furthermore, the decreasing of the regulator is different from [6], which is cq^k with $q < 1$. Thus further studied need to be done to see the effect of regulator series to the speed and stability of solution of MT inverse problem.

The procedure for defining the initial value of the regulator α_k ensures the solution stay at object domain. This eliminates the difficulty in selecting regulator and direction at classical Tikhonov regularization. Experimentally the tolerance is in between 0.2 to 0.5.

V. CONCLUSION

The results of the numerical experiment reveal that the iteratively regularized Newton method combined with the applying geometric series of regulator and setting initial value of regulator produce stable the solution for MT image inverse problem. The optimal solution are gain when the regulator is sequentially decreased of optimal order for $r = 2$ and the initial value of regulator equal is set that produce the norm of sequential operator equation $\mathcal{F}(\chi)$ equal to 0.4.

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Using of some novel derivatives of thiourea for Synthesis of pharmaceutical compounds of 5-Arylidene-2-imino-4-thiazolidinones and their medicinal properties study as anti-inflammatory agents

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Abstract— *Thiazolidinone belongs to important groups of heterocyclic compounds. Recently this compounds displays activities such as antioxidants, anti-inflammatory, anti-virus and tuberculostatic. In this project we reported an effective reaction to synthesis of novel thiazolidinone-4-one in the presence of deep Eutectic Solvent as catalyst by Aldol condensation, derivatives of thiourea asymmetric and aldehydes. The primary derivatives phenyl thiourea were obtained by the reaction of derivatives Aniline with Ammonium thiocyanate and HCl in refluxing free solvent and Next reaction between derivatives phenyl thiourea and chloro acetyl chloride in refluxing ethanol. Subsequent synthesis of 5-Arylidene-2-imino-4-thiazolidinones was performed by condensation of amino thiazolidinone with aldehydes in the presence of catalysts Deep Eutectic Solvent.*

This method have several advantage such as synthesis free solvent, short duration of action, the use of catalysts deep eutectic solvent, being environmentally friendly and simple procedure. The structure of synthesized compounds (3f-h) characterized by infra-red spectroscopy (FTIR), ¹H Nuclear magnetic resonances, and ¹³C Nuclear magnetic resonances.

Keywords—*5-Arylidene-2-imino-4-thiazolidinones, thiourea asymmetric, Aniline derivatives, Ammonium thiocyanate, Deep Eutectic Solvent.*

I. INTRODUCTION

Ionic liquids (ILs) are a new chemical compounds that have revolution in the chemical industry in recent years. These compounds, which are "green chemicals", as solvents, play a very important role in reducing the use of harmful, toxic and harmful compounds to the environment. Ionic liquids can replace many common solvents in the pharmaceutical industry. One of the

reasons that has intensified research on ionic liquids today is that scientists are looking for a suitable alternative to volatile organic solvents in the industry. Volatile organic solvents are the most important source of environmental pollution in the chemical and pharmaceutical industries. This new compound are non-toxic towards the environment, inexpensive and biodegradable[1,2].

Thiourea derivatives is an organosulfur compound [3]. It is structurally similar to urea, except that the oxygen atom is replaced by a sulfur atom, but the properties of urea and thiourea differ significantly.

Thiourea occurs in two tautomeric forms. In aqueous solutions the thione form predominates. The thiol form which is also known as an isothiourea, can be encountered in substituted compounds such as isothiuronium salts [4,5]. The thiazolidinones are heterocyclic compounds with a broad spectrum.

Thiazolidinones and their derivatives display a large variety of pharmacological activities including antihistaminic [6], analgesic [7], inflammatory[8], anti-microbial[9], anti-HIV[10] and anti-cancer[11].

The most common synthetic pathway is the coupling reaction between a phenyl thiourea with ammonium thiocyanat in the presence of strong mineral acid afforded.

The strong mineral acid afforded the phenyl imino thiazolidinone derivatives[12,13].

II. EXPERIMENTAL

General

All chemicals or solvents used were purchased from standard commercial suppliers (Sigma Aldrich and Merck) and used as received without further purification. All reactions were monitored by TLC (Thin-Layer

Chromatography) , silica gel F254, made by Merck, Germany. The melting points were measured with a Electrothermal melting point apparatus and are uncorrected. The IR spectra were recorded using KBr disks in a Shimadzu FTIR 300 spectrophotometer, in units of cm^{-1} . The ^1H and ^{13}C NMR spectra in 1d were recorded on a Bruker 300 MHz spectrometer in DMSO as a solvent chemical shifts were given in ppm in DMSO-d6 using TMS as an internal standard.

Preparation of product (1) and (2):

1.1 2-Methoxy phenyl thiourea (1)

In a vessel 1mmol anisidine, 1mmol ammonium thiocyanat and few ml. of concentration Hydrochloric acid were charged with stirring & then the mixture was heated on water bath to 100°C for 1 hours. The reaction mixture was separated by filtration, it was dried and the precipitate re-crystallized from ethanol.

Yield 94%, m.p: 155-157°C; FT-IR (KBr, cm^{-1}): 3330 (NH), 3167 (CH), 2049 (C=S), 1600 (C=C), 1266 (C-O). $^1\text{HNMR}$ (DMSO-300MHz) δ ppm: 12.06 (s, 1H, NH_{BRS}), 9.08 (s, 2H, NH₂ BRS), 7.01-7.50 (m, 4H, Haromatic), 3.60 (s, 3H, OCH₃).

1.2 2-Methoxy phenyl imino thiazolidin-4-one (2)

The white solid of (0.182 g, 1mmol) of 2-methoxy phenyl thiourea (1) obtained from the previous step with 1mmol of chloro acetyl chloride was put at reflux in ethanol (10ml) for 4 hours while stirring. The resulting solid was filtered and then dried. The precipitate re-crystallized from ethanol [14]

Yield 97%, m.p: 150-152°C; FT-IR (KBr, cm^{-1}): 3437(NH), 2839(CH), 1682(C=O lactam), 1629(C=N), 1498(C=C). $^1\text{HNMR}$ (DMSO-300MHz) δ ppm: 12.18 (s, 1H, NH_{BRS}), 6.84-7.39 (m, 4H, H aromatic), 3.88 (s, 3H, OCH₃), 3.51 (s, 2H, CH₂).

1.3 5-(Orto chloro benzylidene)-2-methoxy phenyl imino thiazolidin-4-one (3f)

0.222 gr (1mmol) of 2-methoxy phenyl imino thiazolidin-4-one (2) obtained from the previous step and 1mmol of 2-chloro benzaldehyde was put at refluxing ethanol(10ml) for 4hours while stirring.then 7 drops of catalysts deep Eutectic was added. The reaction mixture was filtered and then dried. The precipitate re-crystallized from ethanol.

Yield 88%, m.p: 193-196°C; FT-IR (KBr, cm^{-1}): 3418(NH lactam), 3191(CH), 1679(C=O lactam), 1613(C=N), 1544(C=C), 744(C-Cl). $^1\text{HNMR}$ (DMSO, 300MHz) δ ppm: 12.18(s, 1H, NH_{BRS}), 6.57-8.05 (m, 9H, Haromatic), 3.73 (s, 3H, OCH₃).

1.4 5-(Orto nitro benzylidene)-2-methoxy phenyl imino thiazolidin-4-one (3g)

1mmol (0.222gr) of 2-methoxy phenyl imino thiazolidin-4-one (II) obtained from the previous step and 1mmol of 2-nitro benzaldehyde was put at refluxing ethanol(10ml) for 5 hours while stirring.then 7 drops of catalysts deep Eutectic was added. The reaction mixture was filtered and then dried. The precipitate re-crystallized from ethanol.

Yield 91%, m.p: 212-215°C; FT-IR (KBr, cm^{-1}): 3329 (N-H lactam), 3214 (C-H), 1680 (C=O lactam), 1605 (C=N); 1524 (C=C); 1339 (N=O); 1242 (C-N). $^1\text{HNMR}$ (D₂O, 300MHz) δ ppm: 12.18(s, 1H, NH_{BRS}), 7.82-8.16 (m, 4H, Haromatic), 7.69 (s, 1H, C=CH), 6.51-7.39 (m, 4H, Haromatic), 3.71(s, 3H, OCH₃).

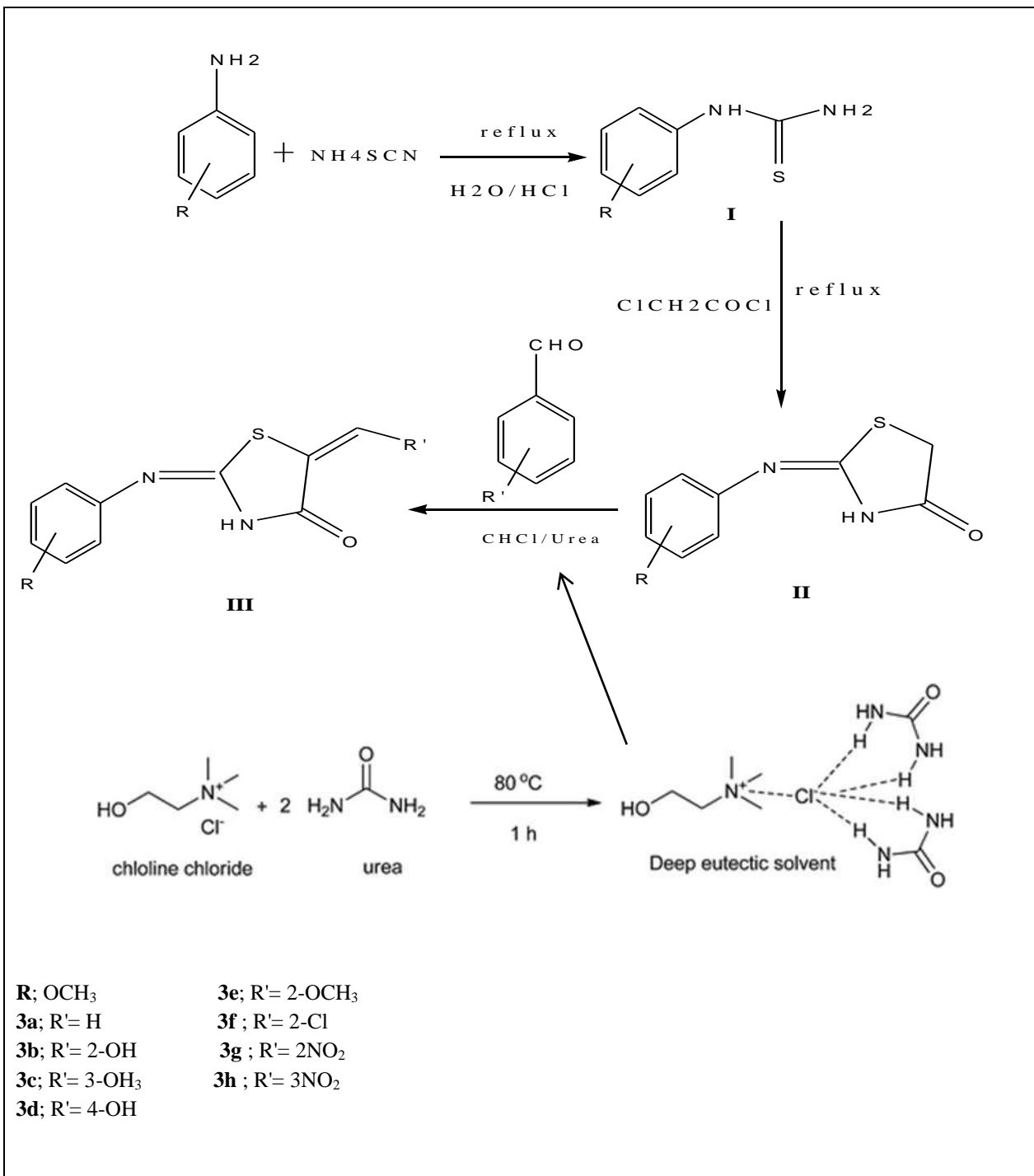
$^{13}\text{CNMR}$ (DMSO, δ ppm): 190.9, 164.0, 150.3, 147.2, 146.8, 130.8, 128.4, 122.7, 122.1, 118.9, 117.9, 115.1, 55.6, 39.4.

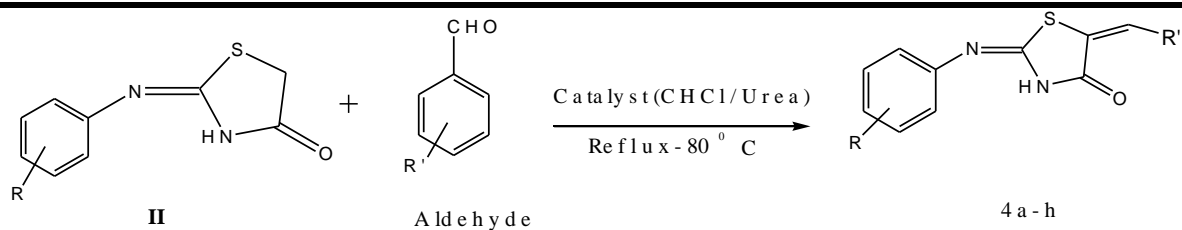
1.5 5-(Meta nitro benzylidene)-2-methoxy phenyl imino thiazolidin-4-one (3h)

1mmol (0.222gr) of 2-methoxy phenyl imino thiazolidin-4-one (II) obtained from the previous step and 1mmol of 3-nitro benzaldehyde was put at refluxing ethanol(10ml) for 6 hours while stirring.then 7 drops of catalysts deep Eutectic was added. The reaction mixture was filtered and then dried. The precipitate re-crystallized from ethanol.

Yield 93%, m.p: 212-215°C; FT-IR (KBr, cm^{-1}): 3287(NH lactam), 3079(CH), 1694(C=O lactam), 1605(C=N), 1527(C=C), 1353(N=O), 1244(C-N). $^1\text{HNMR}$ (DMSO, 300MHz) δ ppm: 12.18 (s, 1H, NH_{BRS}), 6.57-8.31 (m, 9H, H aromatic), 3.70(s, 1H, OCH₃).

III. FIGURES AND TABLES





Entry	Aldehyde	Product	Time (hr)	Yield %	m.p (°C)
1		3a	4	80	185-189
2		3b	6	78	213-216
3		3c	3	78	213-216
4		3d	5	78	213-216
5		3e	4	82	215-218
6		3f	4	88	193-196
7		3g	5	91	212-215
8		3h	6	93	212-215

Antibacterial Activity

All four compounds (3f-h) were screened against two bacteria for their antibacterial activity. Antibacterial activity was carried out against Gram negative bacteria, Escherichia Coli (ATCC, 6538) and Gram positive bacteria, Staphylococcus aureus (ATCC, 25922) by disk diffusion method using Mueller–Hinton Agar against.

The agar diffusion method was used for determination of the inhibition zone. Gentamicin we used as standard drug for antibacterial activities. Their turbidities matched that of a McFarland no. 0.5 turbidity standard. The stock solution of four compounds was prepared in dimethyl sulfoxide (DMSO). A loop of the standardised inoculums of the bacteria was issue over the surface of agar plates by using swabs. All the inoculated plates were incubated at 37 °C and results were evaluated after 24 hr of incubation for bacteria. The concentration of these compound (3f-h) were placed on Muller Hinton agar. Finally, after 24 hr area of growth inhibition were measured. Loops containing 10 µg of 5 DMSO were used as the negative control. The tests are repeated 4 times and the average results are shown in table 2. All of the compounds showed good antibacterial activities (Table 2).

Table.2: Bacteria inhibition zone around disks containing samples.

Compound	S. aureus(mm)	E. Coli(mm)
3a	95	120
3d	45	90
3f	20	110
3g	60	115
3h	52	50
Gentamicine	50	50

IV. CONCLUSION

In this study described the green chemistry and we employed a choline chloride/urea as catalyst to synthesize thiazolidine-4-one derivatives (3a-h) (scheme1). The reaction with deep eutectic solvent as environmentally friendly catalyst. This reaction was more efficient in good yield in short time duration. Finally, after complete the reaction, that's possible to separate the catalyst. The results led to the synthesis of 5 – arylidene– 2- imino thiazolidine-4- ones substances with possibly particular biological and medicinal properties. The structure of synthesis compounds (f-g) were confirmed by FT-IR, ¹H-NMR, ¹³C-NMR spectroscopic methods. All the physical, chemical properties, IR, NMR of the compounds are reported in experimental parts. All the compounds 3a–h display antibacterial effect against Gram positive bacterias, S. aureus, and E. coli Gram negative bacteria. Specifically, the synthesized compounds screened for

their biological study which displayed moderate to good activity.

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Designing of 3D Seismic Survey And Data Processing of Abu Amood Oil Field Southern of Iraq

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Abstract —3D seismic reflection study was applied to Abu Amood oil field which is located to the southern part of Iraq within Dhi Qar province that carried out by oil Exploration Company to an area 1534.88 Km² for studying Nahr Umr Formation. Field tests was the first stage in exploration to determination the best standard to get the better records of signal to noise ratio which is given for instruments to act on it to get better results: In the field of Abu Amood there are three main of field tests (noise test, signal test and geometry distribution pattern of vibrators). According to field tests the seismic selected the standard field to accomplish of the survey program. The pre-planning of the survey, the second step in oil exploration crew used specific design that ensures of execution with high quality of seismic recorded data. The processing of seismic data were carried out using Omega ve 2.7 included processing the following steps:- (Reformatting, Geometry defines, Gain (Spherical Diversions), Static Correction (Elevation Static), AMPSCAL (Noise Suppression by Amplitude Scaling) or (Random Noise Attenuation), TMDDF(Trimmed Mean Dynamic Dip Filter), SCAC (Surface Consistent Amplitude Compensation), Surface-Consistent Deconvolution, CMP Sort, Stack Velocity Analysis (First Pass) , Residual Static Correction Calculation and Application, Normal Move Out Correction / Mute / Stack, Post Stack Time Migration).

Keywords —Field test, standardfield, geometry distribution pattern of Vibrators, Abu Amood oil field.

I. INTRODUCTION

The Rafidain field is located in the province of Dhi Qar, about 16 km north of Qall'at Sukkar area, it is about 26 km north of the Refa'i area. The field is located 17 km southwest of the Dejaila field [1].

According to O.E.C plan in 2012 the second seismic crew has carried out 3D seismic survey of Abu Amood Oil field in 2012/6/26, the survey area was 1534.88 Km²[2].

The current research is about updating and developing of Abu Amood oil field, which deals the interpretation of Abu Amood oil field and analysis the seismic reflection

data in the oil field structurally and stratigraphic [3][4][5]. Before interpretation work, it is necessary to review briefly the field requirements of the 3D at Abu amood survey[4][5], the processing which was carried out in the Oil Exploration Company.

II. METHODOLOGY

- 1- Field tests was carried out to get the best standard and better records of signal which is given for instruments to act on it to get better results.
- 2- Standards field distribution and geometry distribution pattern of vibrators
- 3- Designing the pattern survey.
- 4- Seismic data processing after survey.

III. FIELD TESTS

The field tests has been done for getting the best standard and better records of signal which is given for instruments to act on it to get better results. In the field of Abu Amood there are three main of field test: noise test, signal test and geometry distribution pattern of vibrators [6][7]. Then choosing the best of the receiver line to do the test as shown in figure (1).

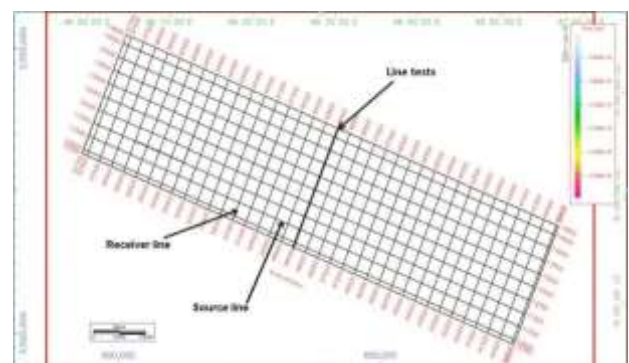


Fig.1: location of the receiver line for test at Abu Amood oil field [8].

- 1- Noise test :- Location were installed for receivers and source as shown figure (2)
 - Deployment of 100 cluster of receivers points .

- Using 4 vibrators as a source of energy as shown figure (3)



Fig.2: Schematic illustration of distribution pattern for noise test[8].

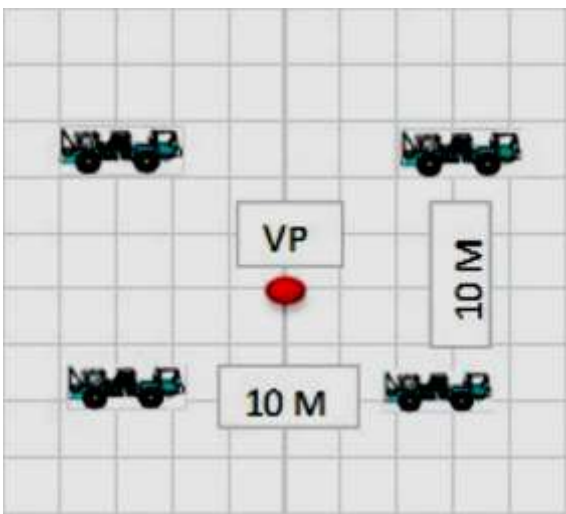


Fig.3: Illustrate the distribution of vibrators pattern around the receiver point [8].

2- Signal test:

Distribution two line of test, the first line was of length 44m and distance between two geophones 4 m as shown in figure (4) and the second line was of length 55 m, and the distance between two geophone 5 m as shown figure (5).

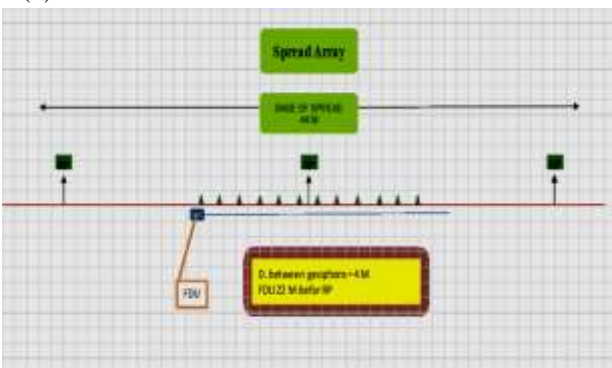


Fig.4: The first line distribution of geophone [8].

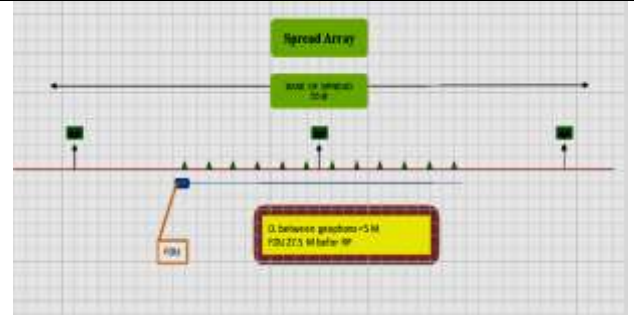


Fig.5: The second line distribution of geophones [8].

3- Geometry distribution pattern of vibrators:

In this test the crew seismic used three distribution pattern of vibrator as shown figures (6)(7)(8).

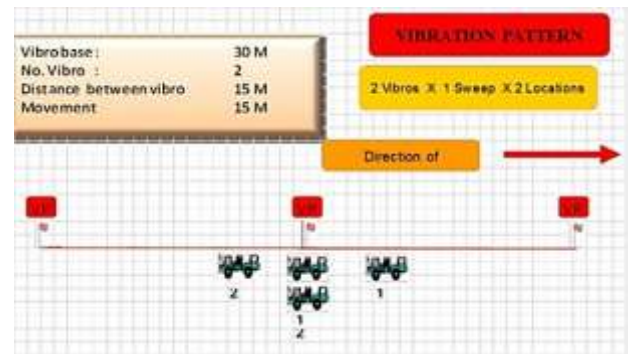


Fig.6: Shows the distribution of vibrators (2*1*2)[8].

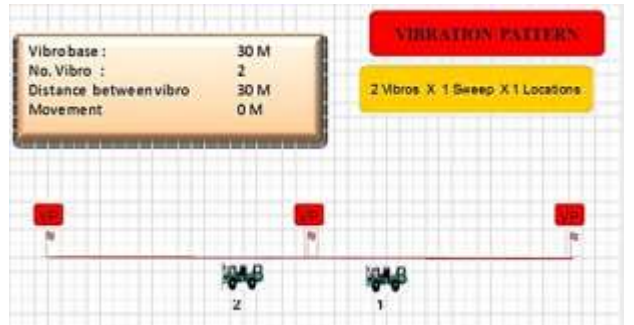


Fig.7: Shows the distribution of vibrators (2*1*1)[8].

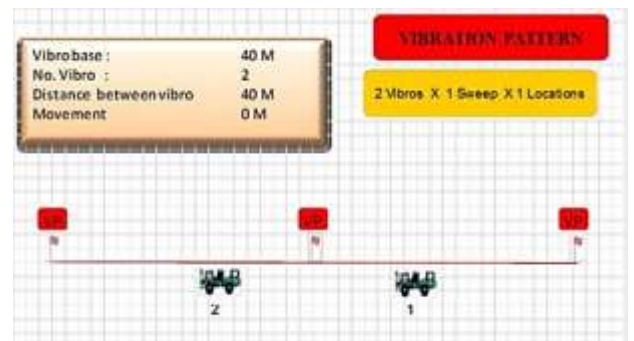


Fig.8: Shows the distribution of vibrators (2*1*1)[8].

4- Standard field
 According to the tests above the crew seismic chose the length of line distribution and geometry distribution pattern of vibrators as shown figures (5)(7). And according to the following standard to accomplish the survey program (table 1,2,3,4) represent standard of field spread, source, receiver and type of recorder consistently that were used in Abu Amood oil Field.

Table.1: Shows the parameters of Spread [8].

Type	3D, symmetrical split spread (84+84)
Number of Receiver Lines	18
Number of active channels per receiver line	168
Receiver stations interval	50 m
Source stations interval	50 m
Source line spacing	300 m
Receiver lines spacing	300 m
Bin size	25X25 m
In-line roll	1 receiver line after 6 VP's per salvo
Nominal CDP fold	126

Table.2: Shows the parameters of source [8].

Type	Vibrators
Model	Nomad 65
Control electronics	Sercel VE432
Number of vibrators in source pattern	2
Geometry of pattern	In-line with source line
Physical pattern length	30 m
Distance between pads	30 m
Sweep type	16 Hz -74Hz linear
Sweep length	12 s
Sweep start and end taper length	300 ms
Number of sweeps per location	1
Drive level for production	70-75 %
Servo mode	Raw
Polarity of Ground Force signal	SEG

Table.3: Shows the parameters of receiver [8].

Type	Sensor SG-10 (12 geophones)
Geophone string	12 sensors (connected

configuration	in series)
Number of strings per pattern	1 string
Geometry of pattern	linear
Pattern dimensions	55 m

Table.4: Shows the parameters of recording instrument [8].

Type	Sercel 428UL
Tape format	SEG-D
Sampling interval	2 ms
Record length, correlated	5 s
Field processing	Correlation after stack
Polarity of seismic data channels	SEG

IV. PROCESSING SEQUENCE OF SEISMIC DATA

The seismic data were processed at the processing center of the oil Exploration Company. The primary objective is to enhance the quality of the recorded data with special regard to the 3D data. Basically, this improvement is essential to facilitate the structural and stratigraphic seismic interpretation. The noise attenuation process leads to improve reflection continuity and enhance the ability to compute seismic attributes. The processing of seismic data was carried out using Omega ve.2.7 [8] Included processing the following steps:-

1- Reformating:-

The seismic data which was supplied in SEG-D format was first, converted internal seismic file format (PARADIGM FORMAT), and then the data was checked using the transcription program print out file, the input and output record number matched with the observer information. The data was extracted with 5000 ms record length and 2ms sampling rate [8].

2- Geometry defines:-

Geometry information was received in the (SPS) file format. A geometry data base was built using this information; many maps were displayed in attribute display utility to Quality Control (QC) the SPS file information as shown in Figure (9).

The geometry data base was updated with filed data information of shots using the geometry update , so old headers were updated, new headers were added, subsurface was built due to surface information [9][10].

3- Gain (Spherical Diversions):-

The geometrical spreading compensation was applied in shot gather to recover decay in amplitude caused by geometric divergence. An RMS constant velocity function

was used to compute V^2T amplitude compensation function [9][10] Figures (10) (11).

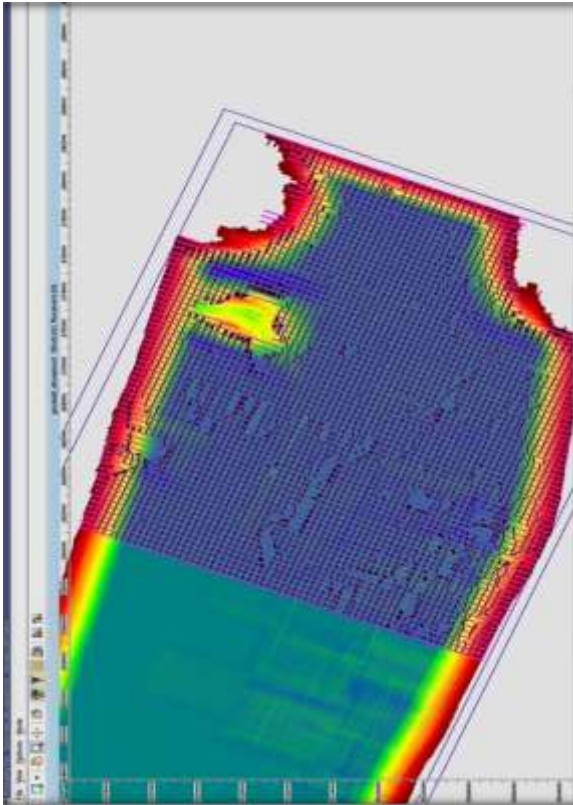


Fig.9: Geometry _QC: processing survey map represent shots and receivers location for the whole survey (as read from SPS file) in Abu Amood oil field [8].

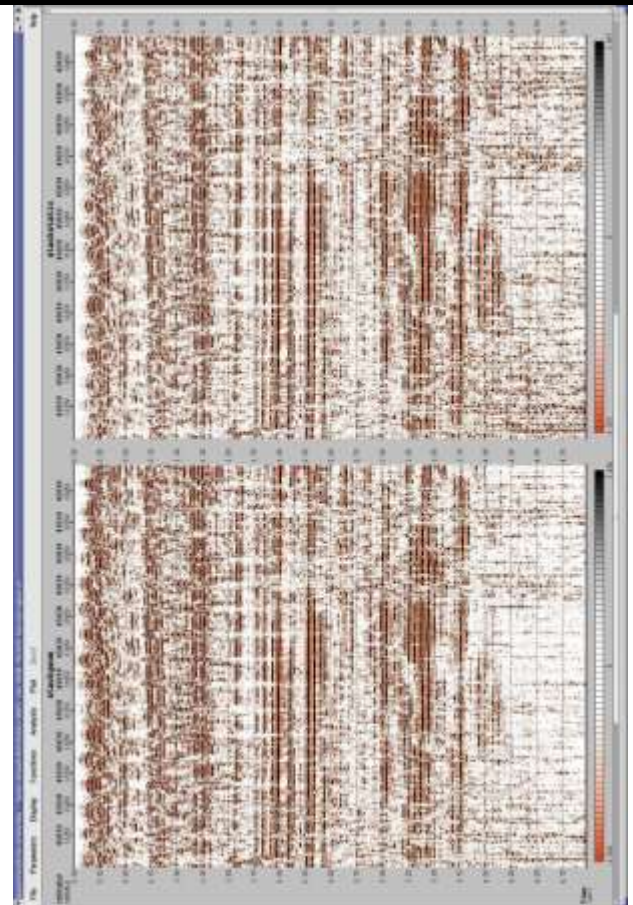


Fig.11: Stack Inline 45030 before and after Gain (Spherical Divergents) in Abu Amood oil field [8].

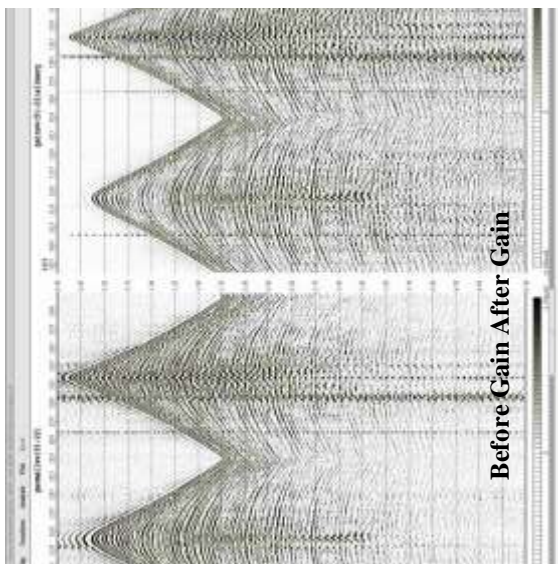


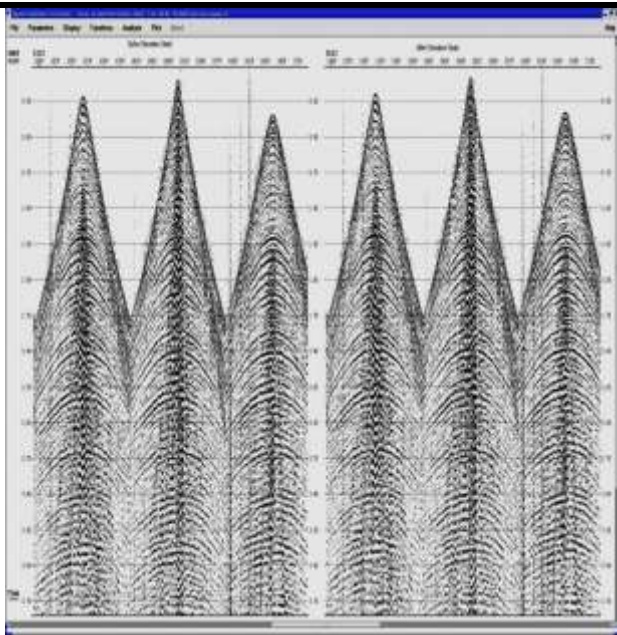
Fig.10: Shot gathers before and after GAIN (Spherical Divergent) in Abu Amood oil field [8].

4 -Static Correction (Elevation Static) :-

Elevation Static was calculated using (weathering velocity, surface elevation, shot elevation and datum elevation) information that were acquired in conjunction with Abu Amood-3D seismic survey [9][10] Figure (12).

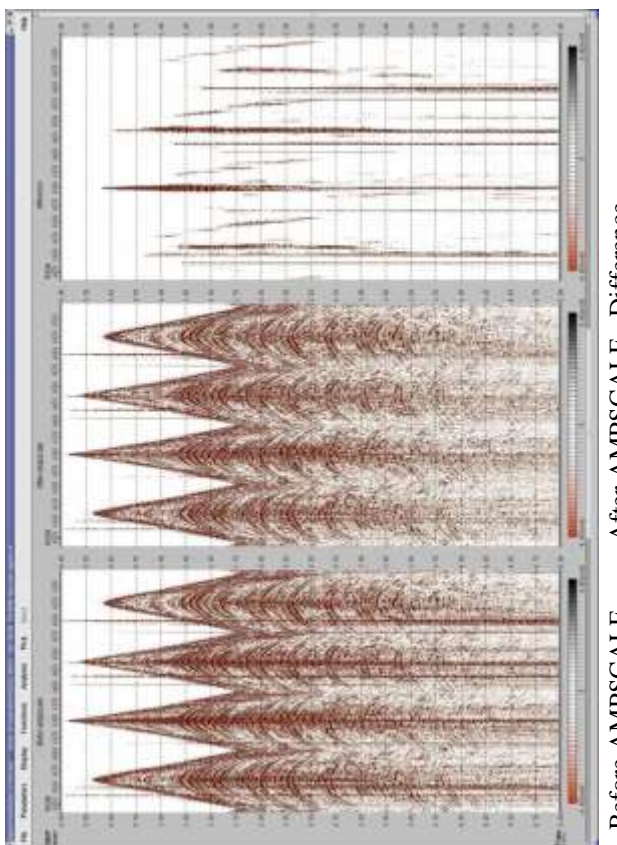
5- AMPSCAL (Noise Suppression by Amplitude scaling) or (Random Noise Attenuation):-

AMPSCAL is designed to attenuate noise bursts, cable slashes, air blasts, and frost breaks. The data are analyzed across small overlapping spatial and temporal windows by comparing the window amplitude with the amplitude of corresponding window on neighboring traces in the dataset. Windows with anomalously high amplitudes are scaled down [9][10]. Figures (13),(14).



Before After

Fig.12: Shot gathers before and after elevation Static Correction in Abu Amood oil field [8].



Before AMPSCALE After AMPSCALE Difference

Fig.13: Shot gather before , after AMPSCALE and the difference in Abu Amood oil field [8].

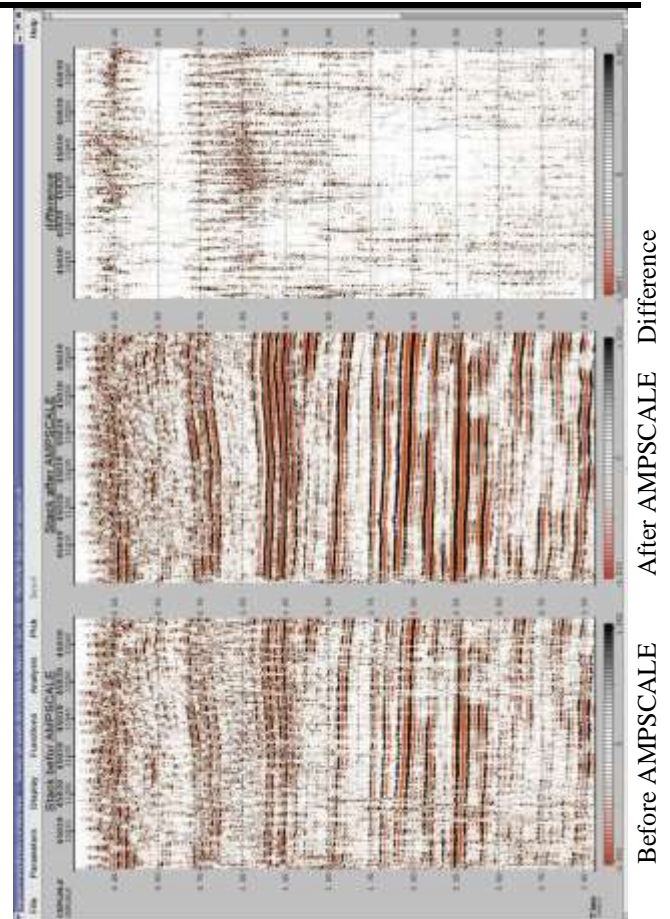


Fig.14: Stack Inline 45030 before and after AMPSCALE in Abu Amood oil field [8].

6-TMDDF(Trimmed Mean Dynamic Dip Filter) :-

TMDDF processes pre-stack data sets to improve the signal-to-random-noise ratio. At each sample of each trace it computes a series of trimmed means along rays (dips), using the sample it self (start and end of dip) traces. The output sample is the trimmed mean that yields the highest amplitude. The object of TMDDF processing is to remove high amplitude noise and locally weak coherent events without eliminating useful trace information [9][10]Figure (15) (16).

7- SCAC (Surface Consistent Amplitude Compensation):-

Amplitude Correction (Acquisition Problem) it was seen that a different portion of the data has amplitude values that are lower than the rest. SCAC is analysis tool to determine a scalar to apply that would bring the low amplitude portion of data to the same RMS amplitude as the rest of the data. It compensates for shot, detector and offset amplitude variation that is caused by acquisition effects and are not a consequence of the subsurface geology [9][10]Figures (17) (18).

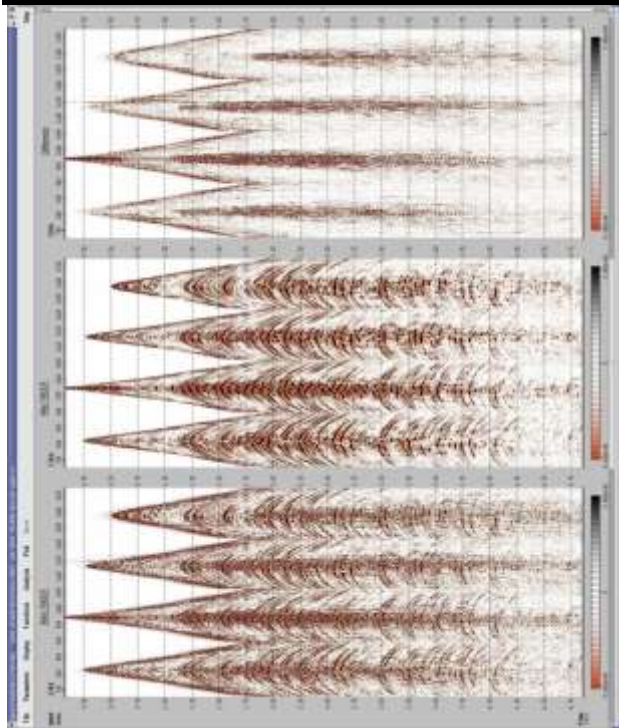


Fig.15: Shots gathers before and after TMDDF as well as the difference in Abu Amood oil field [8].

Before TMDDF After TMDDF difference

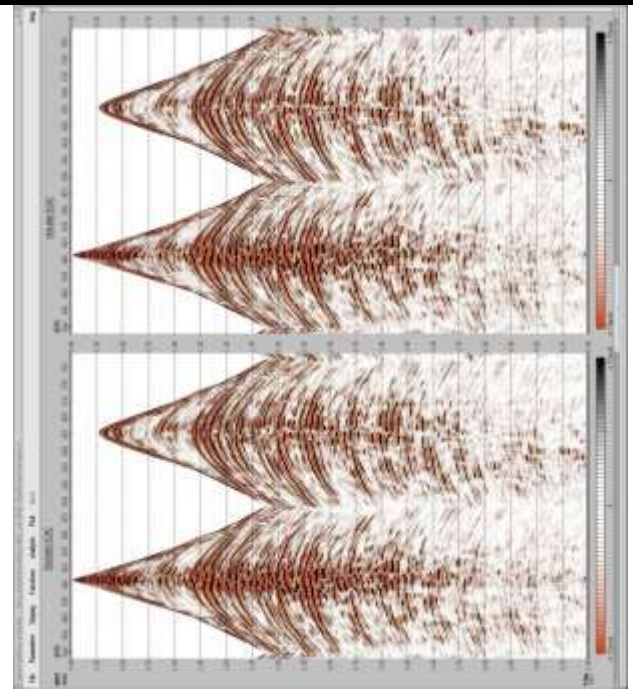


Fig.17: Shots gathers before and after SCAC in Abu Amood oil field [8].

After Before

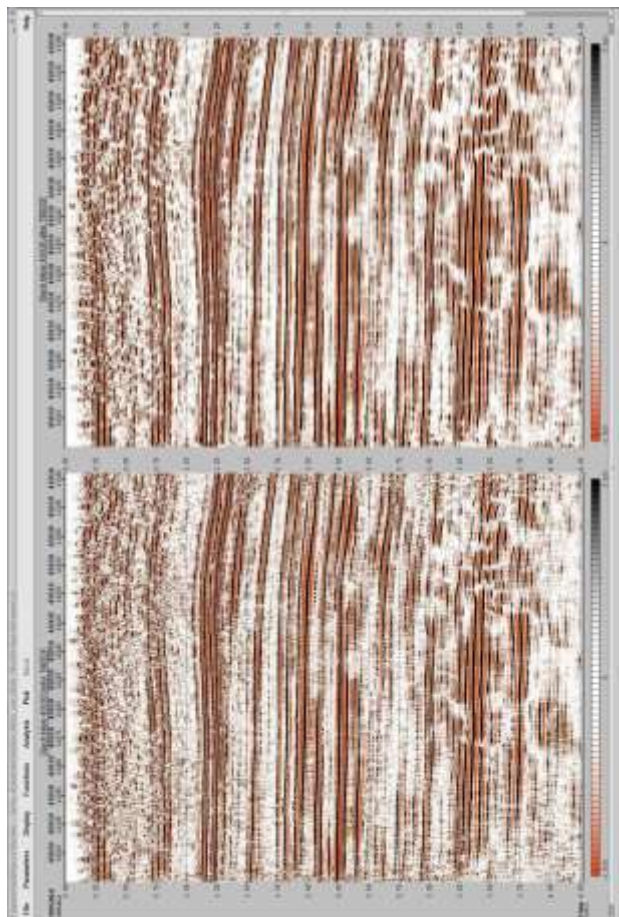


Fig.16: Stack Inline 45030 before and after TMDDF in Abu Amood oil field [8].

Before TMDDF After TMDDF

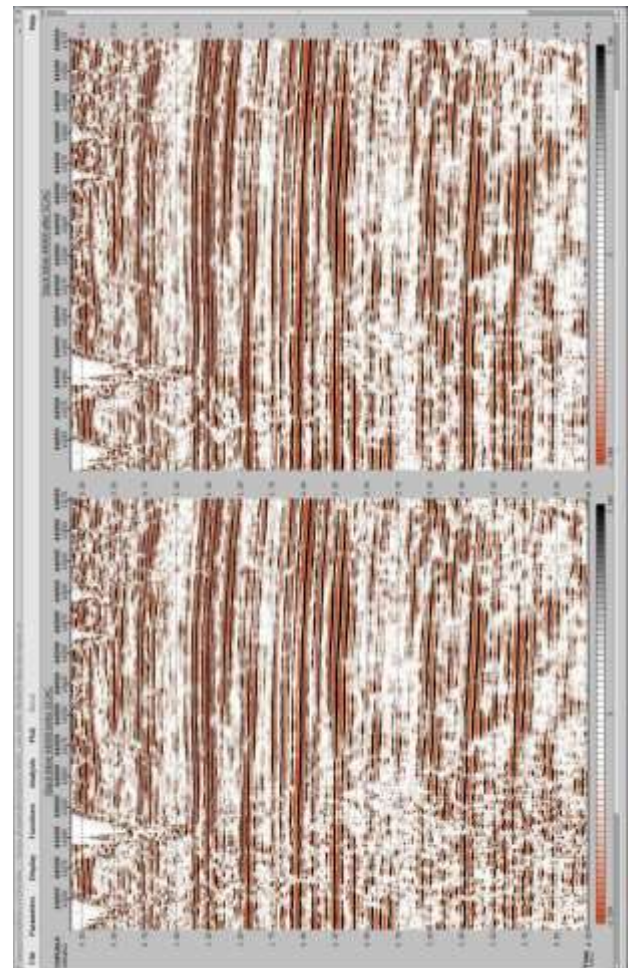


Fig.18: Stack Inline 44000 before and after SCAC in Abu Amood oil field [8].

After Before

8- Surface-Consistent Deconvolution:-

Surface-consistent deconvolution is applied to seismic data to selectively remove the convolutional components contributing to the seismic wavelet. The process is typically more robust than conventional single channel deconvolution, particularly in the presence of noise, since the noise contributes to the operator phase instability and yields residual wavelets that are noise dependent. Surface-consistent deconvolution reduces the operator's sensitivity to noise by averaging the amplitude spectra of the components of the wavelet. Deconvolving the seismic data with surface consistent operators results in residual wavelets that fit the surface-consistent model, consequently, is more suitable for subsequent residual statics computations. The modules (SURFAN, SURFAUT, and SURFDEC) provide a surface-consistent solution that is appropriate for application with both 2D and 3D data sets [9][10] Figures (19, 20, 21).

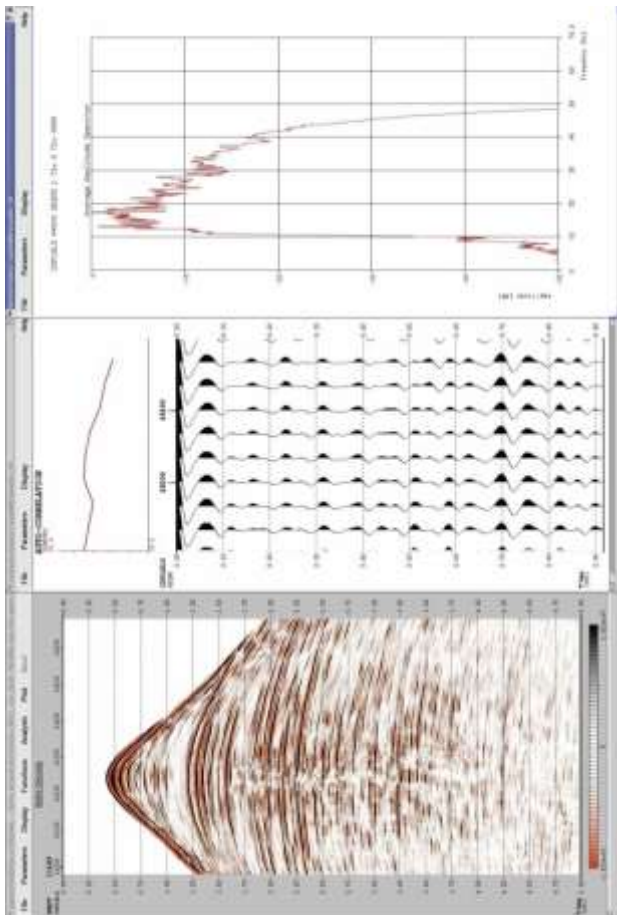


Fig.19: The autocorrelation and the spectral analysis for the shot before apply DECON in Abu Amood oil field [8].

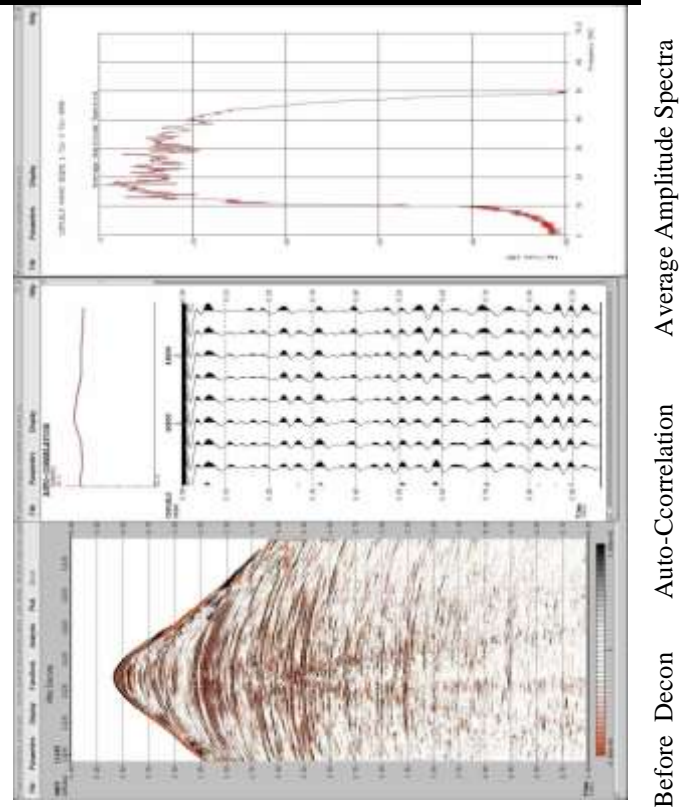


Fig.20: The autocorrelation result and the spectral analysis for the shot after DECON apply .

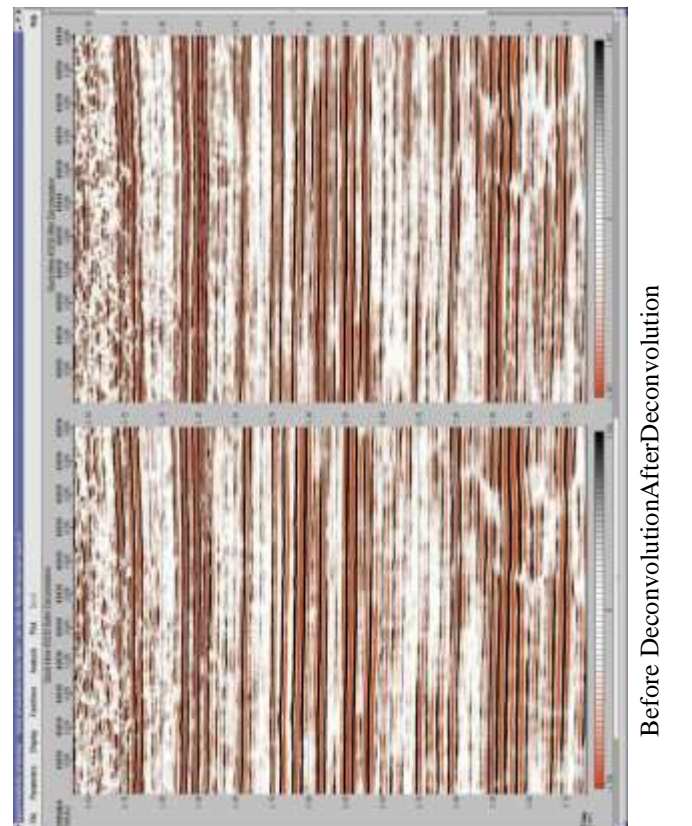


Fig.21: Stack inline 45030 before and after Deconvolution in Abu Amood oil field [8].

9- CMP Sort :-

The shot - ordered data were sorted into CMP gather .The data at this stage was extracted into in-lines groups this will simplify the run and the QCon data [6][7] Figure (22).

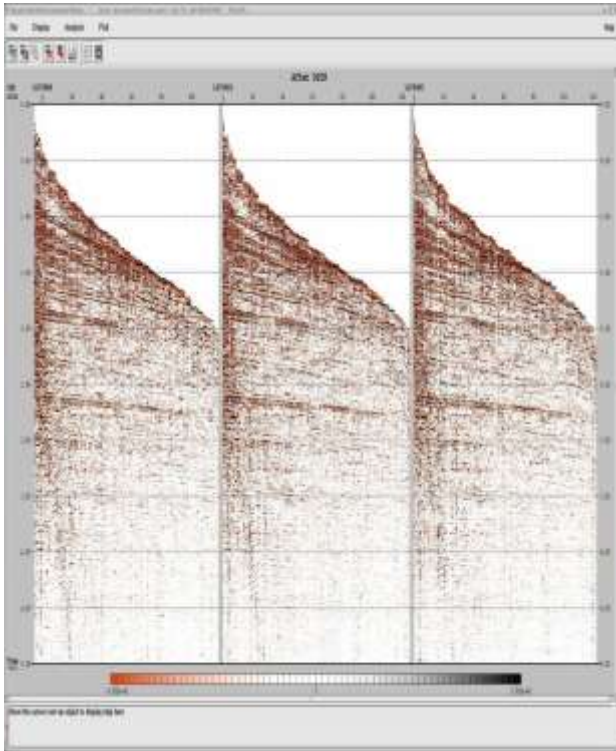


Fig.22: CMP Sort Data for Abu Amood oil field in Abu Amood oil field [8].

10- Stack Velocity Analysis (First Pass) :-

Velocity analysis were performed using programs VELDEF that require velocity , VELDEF doesn't processes seismic data for velocity function that stored by VELDEF which are accessed by other programs that process seismic data to apply Normal Move out Correction.

A regional velocity function taken from 2D line was applied for stacking. Initial velocity were picked every 48 inlines. With an in line spacing of 25 m this corresponds to 1.2 km spacing .The lines were chosen to be near minimum offset(near receiver line), ensuring availability of near traces information and a better handling of the shallow part of the analysis .The location on each line were chosen to be every 48 cross lines, yielding an analysis every 1.2 km. The input data was organized in inlines [9][10]Figure (23).

11-Residual Static Correction Calculation and Application:

Residual static correction removes any remaining short wavelength static shifts using reflection data to 'fine-tune' the initial static [9][10].figure (24)

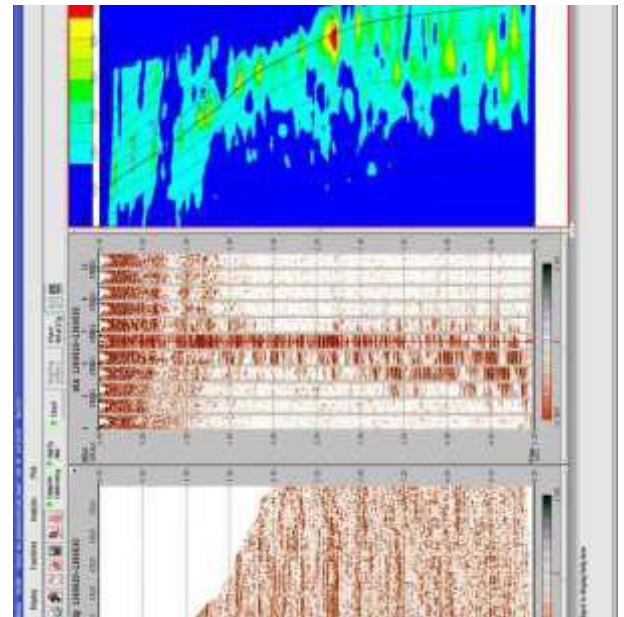


Fig.23: Shows the Velocity Analysis for Abu Amood oil field in Abu Amood oil field [8].

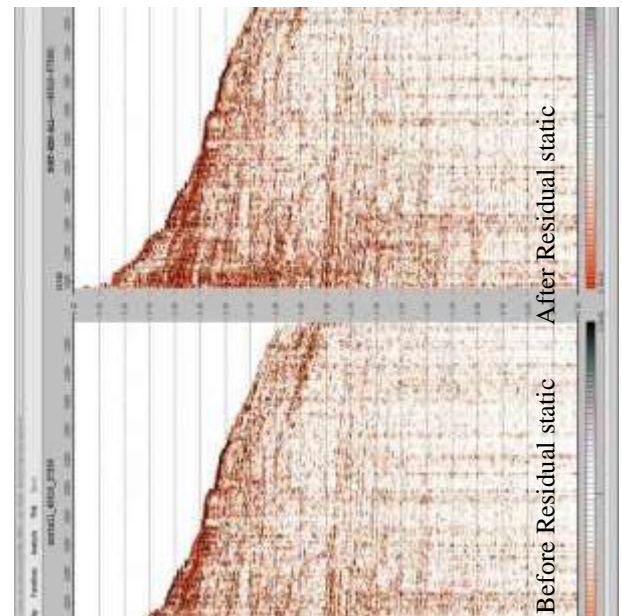


Fig.24: CDP Sort Data before and after Residual static in Abu Amood oil field [8].

12- Normal Move Out Correction / Mute / Stack:-

Normal Move Out (NMO) correction was applied on the CMP gathers , using final set of velocity of the field after residual static .

After (NMO), an outer trace mute was applied to remove first break noise, refraction and wide angle reflection and any stretched beyond acceptable limits. To prevent a rapid amplitude change between the muted and live parts of the trace in mute process, a 20 ms taper was applied from zero to full amplitude. This prevents distortion to the frequency spectrum of the stacked data, which would

otherwise by introduced by an abrupt boundary [9][10] figure (25).

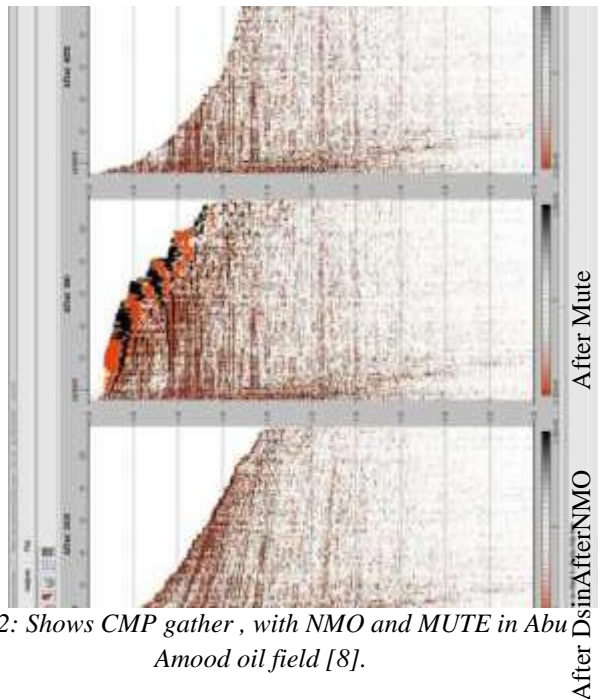


Fig.2: Shows CMP gather , with NMO and MUTE in Abu Amood oil field [8].

13-Post Stack Time Migration

Migration is a process which attempts to correct the distortions of the geological structure inherent in the seismic section. Migration re-distributes energy in the seismic section to better image of the true geological structures, or rearrange seismic data so that reflection events may be displayed at their true position in both space and time.

The post stack time migration in Geodepth collect RMS velocity volume migration in vertical functions window figure (26) and applying it in the main window of post stack time migration [9][10].

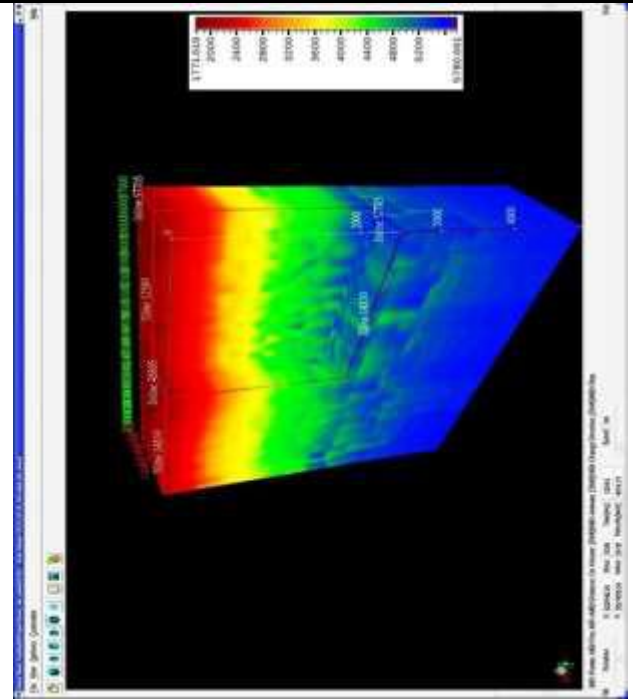


Fig.26: Shows 3D volume for RMS velocity volume to whole survey in Abu Amood oil field [8].

V. CONCLUSION

- 1- The Degrain of pattern survey was very good for this study.
- 2- The quality of seismic data was good quality.
- 3- Selected inline no. (49000) to carry out the test to determination the best standard of (noise test, signal test and geometry distribution pattern of vibrators.)
- 4- Through the implementation of several field tests, a major action plan was adopted as shown in table (1)(2)(3)(4).
- 5- The best signal source represent by four shocks (vibrators) are in work and one vibrators as reserve Type (NOMAD 65) with a maximum capacity (peak force) of (62000 LB) for each shock.

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Simple Processing Sequence to VSP-Seismic data matching in Sindbad oil field, south of Iraq

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Abstract—The purpose of this research is to get the better matching between VSP and seismic data after performing a simple processing sequence on Zero-offset VSP survey. Sindbad oil field is chosen to study goals and it's containing only one well with VSP survey (Snd2) that covering depth from Zubair to Sulaiy Formations and 2D seismic lines of Basrah Survey (2Br & 5Br). In order to get the mentioned information from VSP the main steps of processing sequence (Velocity calculation, Amplitude recovery, wave separation, deconvolution and stacking) has been used to measure (RMS and AVG) velocity and make the corridor stack image of VSP p-waves in Promax landmark software. The principle of VSP and seismic data matching is depended on phase and time shift. The matching filter in Omega software depends on frequency content, phase, locations of the two data and amplitude difference which gives us better correlation for matching. The final test of these filters shows good matching between Snd-2 VSP and 2Br2 Seismic line.

Keywords— Vertical Seismic Profile, Zero-offset VSP survey, Processing of ZVSP, VSP to Seismic matching, Lower Cretaceous age- Sindbad oil field.

I. INTRODUCTION

Seismic surveys can be divided into two main categories that are: surface seismic surveys and borehole seismic surveys [1]. Seismic observations in deep boreholes involve some specific requirements of technical and theoretical types, while in surface observations; the sensitivity is usually restricted by the seismic noise level in the region of the recording point [2]. Acquisition, processing and interpretation of VSP data are essential in hydrocarbon exploration because of the important application of VSP in hydrocarbon exploration which is supporting and clarifying the interpretations of the subsurface geology made from surface-recorded seismic data [3]. The objectives of most VSPs done today, is the refinements which have come with processing of that data. The most important development has been used of velocity filters to separate the upgoing and downgoing waves, thereby allowing studies of their internal relationships and their relationships to data recorded at the surface [4]. The objective of the current paper is to

perform a processing sequence for the better matching of VSP data over 2D seismic line, through utilizing Promax and Omega programs.

II. DATA SOURCE AND LOCATION OF THE AREA

Sindbad oil field is located in Basra city-southeast of Iraq, adjacent to Iraq- Iran border and approximately 16km southwest to center of Basra city as shown in Figure (1). The area has two wells (snd1, snd2). Only (snd2) has VSP data and it will be correlated with log data to seismic line named (2br2). The (snd2) well is drilled to Sulaiy Formation (Lower Cretaceous) and one type of VSP data (Zero-offset) is recorded from 3090m to end depth of the well (4376m).

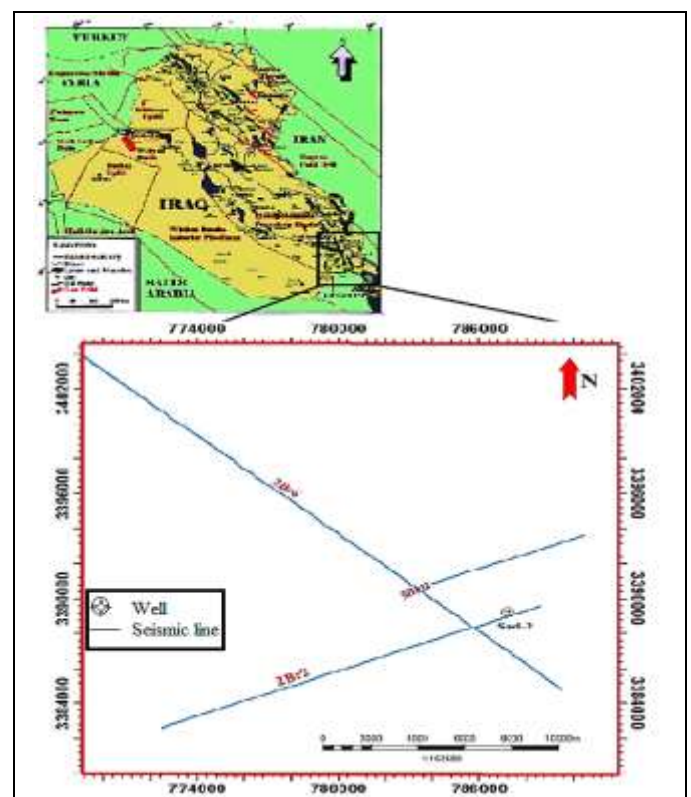


Fig.1: Location map of study area and data of the research.

Sindbad exploration vertical well (2) which drilled by the Iraqi national oil company are reached to a depth 4376m that cover all the thickness of interesting Formation (Yamama) (Lower Cretaceous) in this study. The drilling process is end at September 2013 and gives a remarkable note about oil shows in Zubair and Yamama Formation (Lower Cretaceous).

Vertical seismic profile is executed to get detailed information about the velocity and seismic response in the field. The recording parameter and field tools used in the survey is shown in (Table 1).

Table.1: Shows the field parameter of Sindbad (VSP) survey.

Design, recording and source parameters of VSP Snd2 survey	
Specifications	Parameters
Survey type	Zero offset
No. of Receiver per shot	6
Receiver interval depth	10m
No. of record for each depth	3
Receiver type	3-component hydrophone
Kelly bushing elevation	11.7m
Surface elevation	2.6m
Source type	Vibrator
Offset between well and source	70m
Natural frequency record	6-90 Hz
Sample rate	1msec
Fluid density	1.55
Type of hole	Cased hole
Minimum recorded depth	3085m
Maximum recorded depth	4345m
Sweep length	12sec
Taper length	300-500msec
Total recorded time	5000msec

III. METHODOLOGY

The (VSP) surveys have some special advantages over surface seismic reflection surveys. One key advantage is the ability to separate the downgoing (direct) and upgoing (reflected) wavefields that enable the calculation of the true reflection amplitude or seismic impedance [5].

For the processing, the ProMax (VSP) Data Processing Software which relates to Halliburton Company has been used. The geometry of the survey demands the use of the Zero-Offset (VSP) processing flow of the particular software. The flow diagram in Figure (2) shows analytically the processing steps.

3.1 Data load and Editing

As described in the acquisition section, the receivers in the borehole contain two horizontal components and one vertical component. The two horizontal components are named X and Y while the vertical component is named the Z component [6].

The X and Y components rotate randomly in the borehole since there is no control over their direction. These component trace loaded in the Promax software with Segy format where each level or depth have the X, Y and Z trace combined with one or two auxiliary traces.

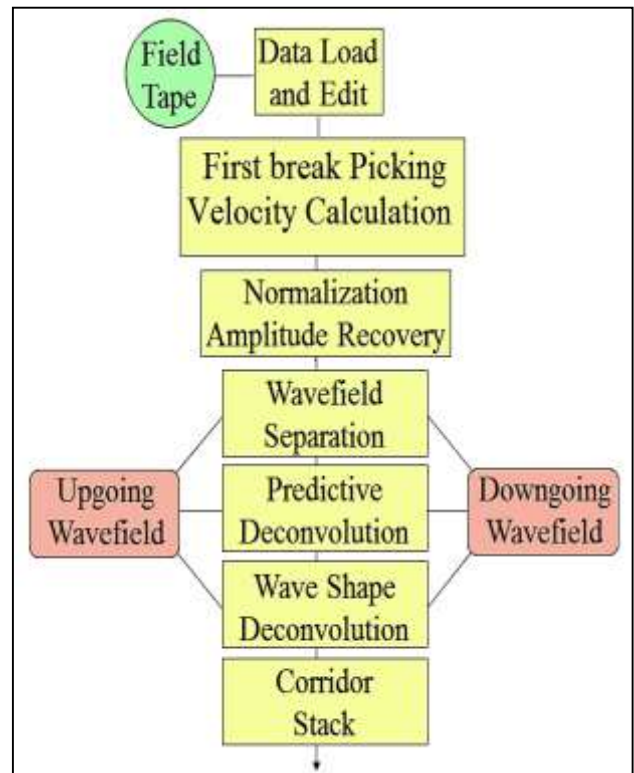


Fig.2: Illustrate the processing sequence of zero-offset (VSP) data Snd-2 well.

Each of the raw data wave-field has a characteristic Trace-ID Code or Trace type in the header of the Segy file. Specifically, the Raw X file has a Trace-ID Code equal to 14, the Raw Y file equal to 13 and the Vertical file equal to 12. This is the way that software can recognize the separation among the three components in the raw data and so the division of the Trace-ID Code is a fundamental aspect as shows in Figure (3). After killing or eliminate the bad trace data will be ready for the separation of its component. The dataset will be sorted on the type number of trace or Field files number with Trace ID for separation the three components Figure (4).

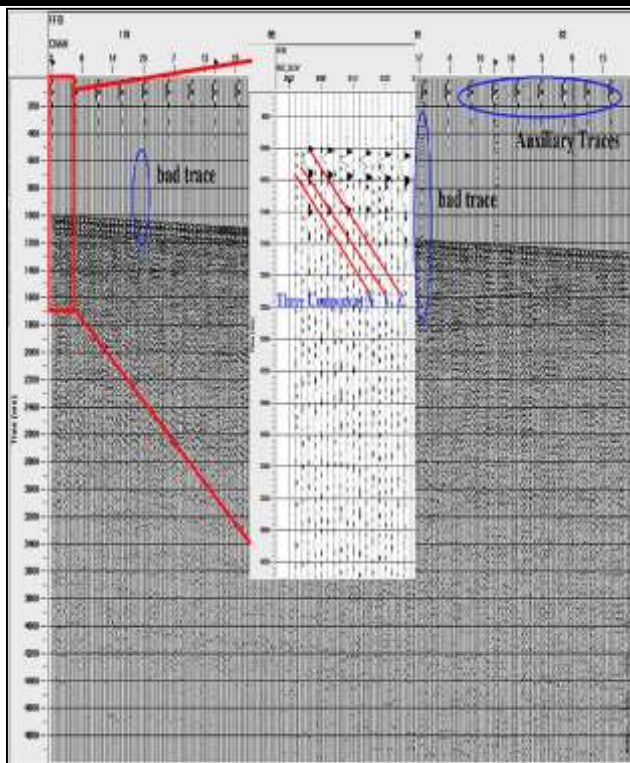


Fig. 3: Illustrate the raw VSP data with three components of Snd-2 well.

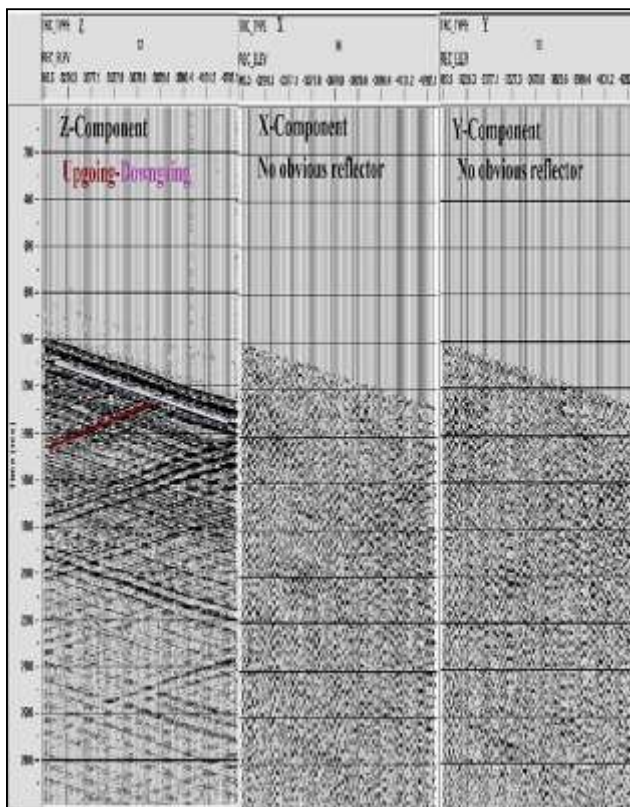


Fig.4: Shows the separated three components Z, X & Y data of Snd-2 well.

The Z component show mainly downgoing P wave and the signature is consistent with no character variation with

increasing depth, except the reflector of depth 3980-4020m which have a distinct amplitude. The X and Y components recorded weaker first P arrivals and the signature has no character variation also the phase of the first P arrivals doesn't show any appearance with continues depth of well. In this Study X and Y component didn't show any signal so that, no process will be operate on them.

3.2 First break pick and Velocity

If a seismic receiver is positioned at the depth of a known geological interface in the well, then the traveltime, from a seismic pulse emitted at surface to that interface of two geologic layers, can be measured directly [1].

Traveltimes are then used to determine velocity, which is calculated using the time difference at which the seismic pulse arrives at the geophones and the distance between receiver points. In the case of dynamite source, this requires picking the time of the first energy arrival at the geophone. For vibrator data, in which the embedded wavelet after cross correlation is assumed to be zero phase, it is necessary to pick the peak of that wavelet as the first arrival as shows in Figure (5).

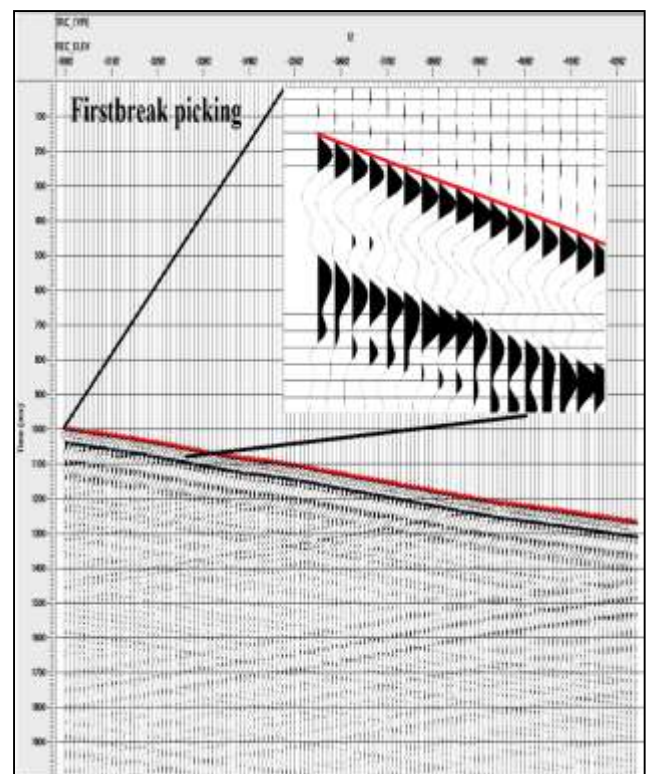


Fig.5: First break picking (red line) on vertical component of VSP data on the first peak amplitude, because of vibrator source.

A fundamental use of VSP surveys is to determine the variation of seismic velocity with the depth [7]. Thus, the interval velocities, the average velocities and the root

mean-square (RMS) velocities for the P waves were calculated. The average velocities, V_{avg} , were calculated directly by dividing the true vertical depths by the picked first-break times at each depth level with consider of 70m offset Figure (6).

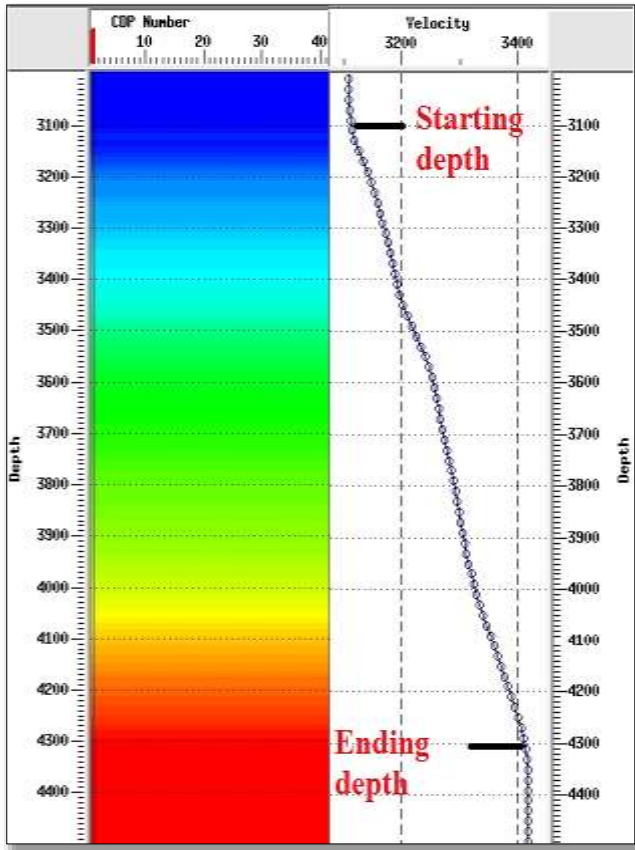


Fig.6: Shows average velocity curve and spectrum for the recorded depth of VSP Snd-2 well.

3.3 True Amplitude Recovery (TAR)

This step is required by signal processing theory for the later steps to work correctly. A point acoustic source generates a spherical expanding wavefront with the energy decaying inversely as the square of the distance travelled.

$$E \propto 1/(d)^2$$

Therefore the signal decays both as a function of recording depth down the borehole and with time along any trace [8], as in the Figure (7). A further complication concerning the signal amplitude is the variability in coupling between tool and formation. In addition to this, the source energy level itself is not necessarily constant.

All of these signal strength factors, if unattended to, would create serious problems in the subsequent processing of the data, especially the velocity filtering. Therefore, it is required that the energy in the direct downgoing waves should be equal at whatever level they

are observed. This is simply done by normalizing each trace with an individual gain.

The test of VSP True Amplitude Recovery processes is an appropriate dB/Sec correction combined with spherical divergence. The spherical divergence correction uses the velocity function that was generated by converting the average velocity function into an RMS function. The produce of a comparison of 10,8,6,4,2 and 0 dB/Sec test value combined with 1/distance spherical divergence correction, gives many result of TAR and the best Correction for Snd-2 well was 4 dB/Sec Figure (8).

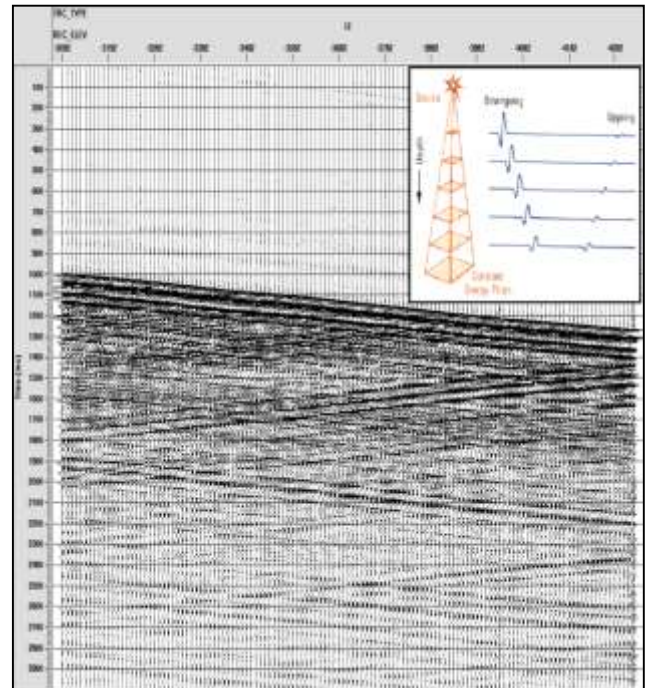


Fig.7: Shows the concept of amplitude decay with time and depth in Snd-2 well vertical traces of VSP data.

3.4 Wavefield Separation

Velocity filter used for Wavefield separation of Sindbad well data to separate upgoing and downgoing waves. The raw Z component is considered the input to the f-k analysis domain. This raw Z component is then flattened to a 100 ms datum by subtracting the first break times from each trace. The flattened raw Z component is shown in Figure (9A).

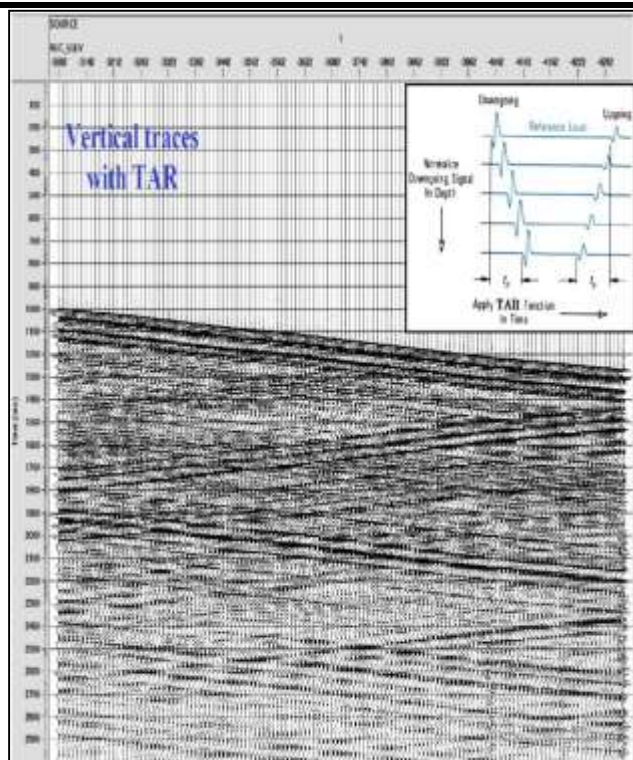


Fig.8: Vertical traces of VSP data Snd-2 after True amplitude recovery process.

The f-k filters are applied to the entire dataset (Z-component data). Separating waves by velocity pass and reject filters is based on the following concept: waves which desired are signal and everything else is noise [9], [10] & [11]. So signal is passed by the time-correcting it for moveout and applying velocity pass filters that are centered about zero moveout.

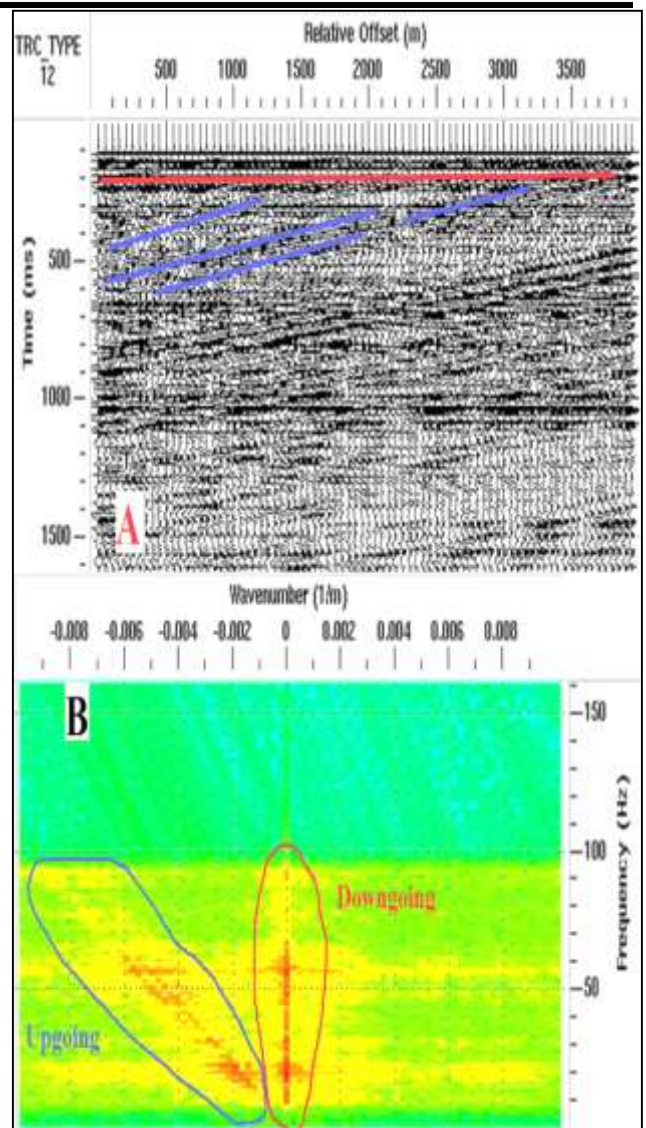


Fig.9: (A) Flattened of Z component VSP data after TAR. (B) f-k domain analysis to select windows for separate up and downgoing waves.

The coherent noise is rejected by time-correcting it for moveout and applying velocity reject filters that are centered about zero moveout. This principle is used to pass signal (upgoing P-waves) and reject noise (downgoing P waves and tube waves) Figure (9B), so the filter will apply two times once for passing the red circle and reject all velocities while the other is passing the blue circle and also rejecting all the surrounding velocities. After several tests of selecting pass and reject window for f-k filter, here in Figure (10) the best separation of VSP data of up and downgoing waves.

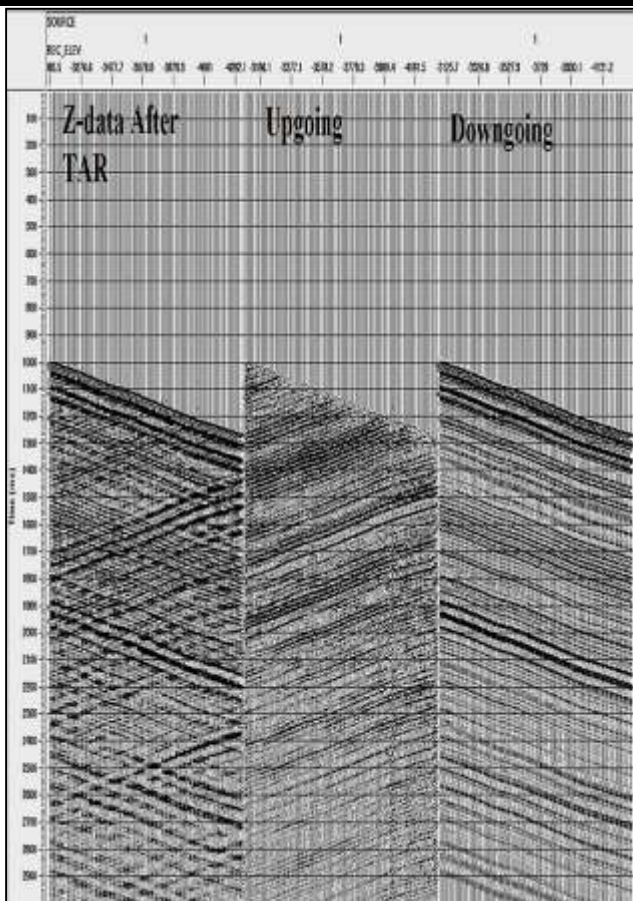


Fig.10: Shows the Input and Output of the Wavefield separation processes.

3.5 VSP Deconvolution

Deconvolution process will be a combination of two types (predictive and Waveshape) by using the inverse filter. The input wavelet is commonly extracted from the separated downgoing wave energy. A filter is designed to compress this energy into a zero-phase wavelet centered on the first arrival time of primary waves [12]. This filter is then applied to the upgoing data to remove the source signature from the reflection energy and output a zero phase wavelet at the actual time of the reflection generation interface also without multiple interfaces.

Some design gate determination is commonly performed to isolate the wavelet from which the inverse filter is designed. This design gate generally starts at zero time, covering the first arrivals and progresses in time for hundred milliseconds. The maximum time gate typically comes immediately after the last consistent reverberation or the main obvious multiple of the first arrival. The best design gate in Snd-2 VSP data on downgoing waves was (100-500ms) after shift the first break by (100ms) so the flatten waves will be full with energy and has no cycle of first break multiple. The zero phase of this wave, on 109ms so that the operator of the inverse filter will be at a time representing zero time on 109msec and the

operator length best tested on data was 1000ms. The applied of deconvolution process on downgoing made it free of multiple reflectors and more resolution as in Figure (11).

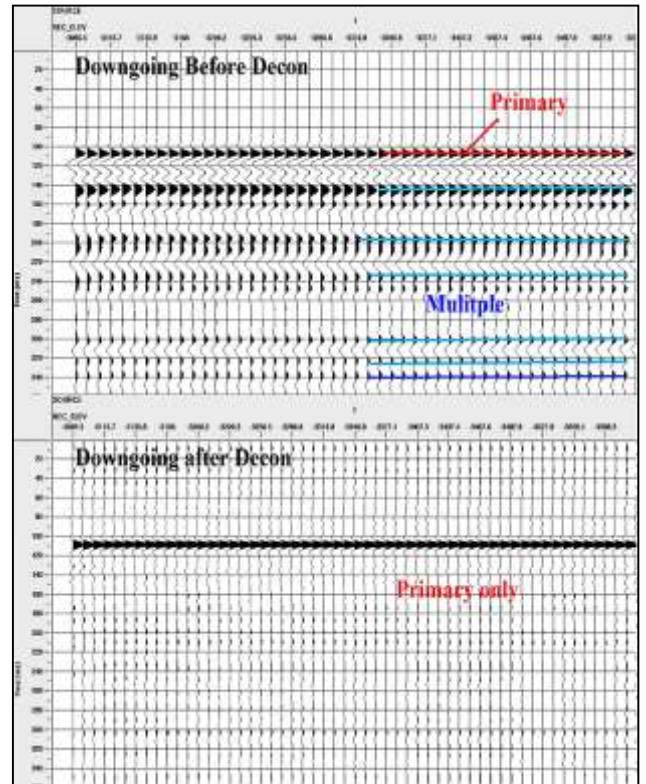


Fig.11: Illustrate the downgoing wave before and after deconvolution process.

After the success of deconvolution process or inverse filter operator on the downgoing waves, same parameter of this filter should apply on upgoing waves, that's what executed on the Sindbad VSP data and shows a good result with amplitude spectrum as in Figure (12) which shows the enhancement of amplitude with high frequency content.

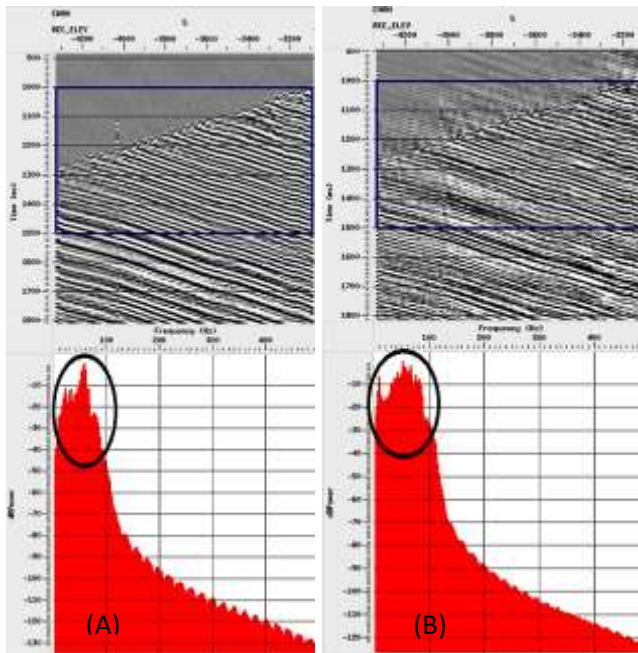


Fig.12: (A) Upgoing waves with amplitude spectrum before deconvolution (B) Same waves after deconvolution.

3.6 Corridor Stack

After deconvolution, the VSP wavefield is multiple free, of a known wavelet shape and contains only reflected energy. It can now be compared with the surface seismic of the same wavelet shape. A more convenient way of doing this is by using a corridor stack [13]. As its name implies, we stack data contained within a specific window of the upcoming VSP wavefield and display the data as a number of vertical traces. This is more convenient to lie alongside the surface seismic data than the wavefield itself.

The data closest to the geophone is of the best quality and the most reliable; because we know the position of the geophone and the location of the well on the surface seismic we can put the corridor stack in the right place; the corridor stack will therefore contain these multiples provided that the window is small enough.

Therefore, by looking at only a window of data, say 100 ms Figure (13A), after the direct arrival, a dataset can be extracted that conforms closely to the assumptions used in the processing.

As noted earlier, upgoing multiples never extend to the direct-arrival curve; therefore, the window automatically excludes any multiples that might have been inadequately collapsed by deconvolution. Typically, this data window is then stacked to form a single trace, which is repeated for clarity the reflectors Figure (13B). This trace, known as a corridor stack, can be thought of as the measured, multiple-free, zero-phase, normal-incidence seismic response at the well. It is the best normal-incidence seismic response that can be obtained at that point.

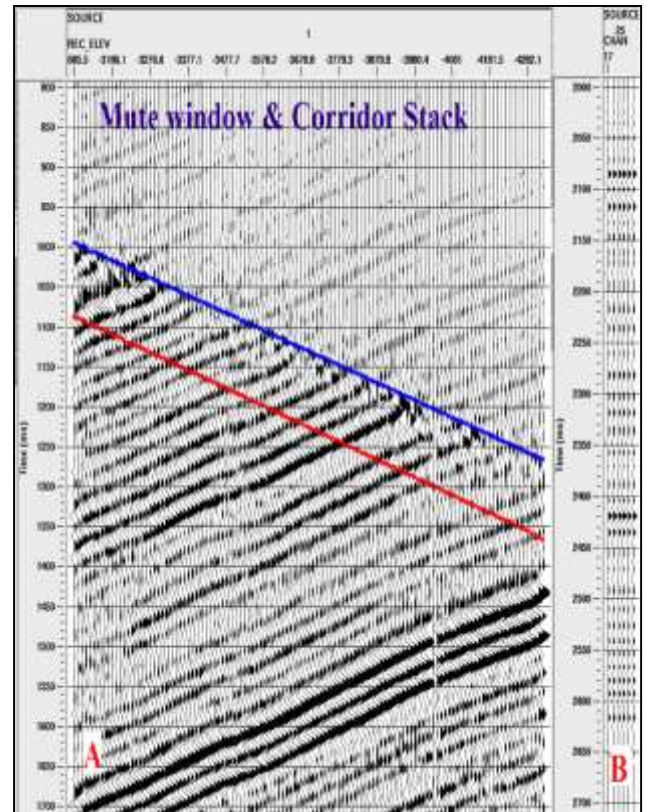


Fig.13: The mute window and corridor stack of VSP data.

IV. CORRIDOR STACK MATCH TO REFLECTION SEISMIC DATA

If the surface seismic wavelet is, indeed, a simple phase rotation away from zero-phase, the cross-correlation function under the optimal phase rotation becomes symmetrically autocorrelated (Pereira and Jones, 2010). Therefore, from a qualitative point of view, the degree of asymmetry in the cross-correlation under the “best” rotation is an indication of the amount of frequency dependence of the wavelet phase.

In Sindbad oil field seismic lines were recorded and processed to a bandwidth of 10-45 Hz while the zero-offset VSP data recorded and final process to keep the best bandwidth of (6-85)Hz, as mentioned before the phase match largely frequency dependent and geologically on distance of correlated data. VSP data was not that far from 2Br2 seismic line (200m) so the phase difference shows (25) degree and the simple bandpass filter to minimize the frequency of VSP to surface seismic gives the good match as shown in Figure (14).

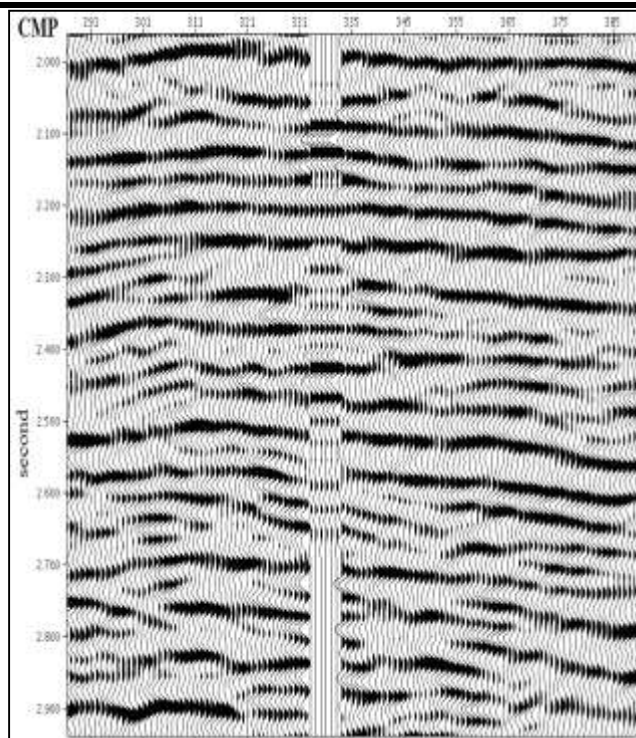


Fig.14: Shows the best match of VSP data with 2Br2 seismic 2D line.

V. CONCLUSION AND RECOMMENDATION

Based on the results of vertical seismic profile survey processing, for (Snd-2 well) and the matching with surface seismic data (2Br), the study comes with the following conclusions:

The processing of VSP surveys are very sensitive to filtering where any filters can remove an important event or reflector. In case of the Zero offset VSP of Snd-2 well, there is very good signal to noise ratio so that a simple processing sequence comes with good result without filtering (only the principle step to get the corridor stack). The multiple reflectors of the area could be remove successfully with deconvolution in VSP survey while in seismic section its hardly attenuate by using a special condition and multi domain transform filters (Hilbert, t-p and f-k), also VSP corridor stack can be used to define the multiple of the field.

According to the study result and for the future work it is recommended to do the following procedures: The field work of VSP surveys should be carefully for S-wave recording in the horizontal component borehole receiver and the S-wave where not recorded because of azimuth of source or the fold of recording levels. The spacing between these receivers in future work less than 6 m will gives better results. It is recommended to record more than one type of VSP (zero-offset) in field which gives more benefit in seismic imaging and solving seismic problems such as subsurface salt dome and highly fracture targets. The recording of VSP must be over

whole depth of well in order to calculate the best attenuation factor (Q) of the area. The recording over all well depth also provide a direct way for delineate the multiple reflectors. The processing of VSP should be before the processing of seismic surveys in order to get the information of velocity profile which in turn simplify the velocity analysis and indicate the reverse zones of velocity.

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Proposed Steps to Projects Development in the Public Sector

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Abstract—Public Policy and projects have been the subject of discussion in public organizations, with the argument that it organizations has resources, but there are no projects to invest. This research aims to suggest a step-by-step proposal to elaborate a project, based on a public policy, in a way that will improve public management, with specific results and contribute to the quality of life of citizens and society. In this research was analyzed the concepts of public management, public policy, programs and projects, which resulted in a logical, interrelated proposal, consisting of steps that comprise a step by step to elaborate project to a public policy. He sought the qualitative aspect and used the bibliographical research as methodology. Structuring the work in chapters organizing in introduction, theoretical survey and its analysis, proposed a step by step to elaborate project and concluded with the final considerations.

Keywords— *project management, public management, public policy.*

I. INTRODUCTION

In the public sector and in the non-governmental organizations it is common the argument that there are resources, but there aren't no good projects to carry out investment. In this way, discussing projects, programs, public management and especially public policy, became a relevant topic.

In view of the above, several factors motivated the elaboration of this work. The first was to know the concepts of public management, public policy, programs and projects, as well as analyze and understand their application to improve productivity of organizations, quality of life of citizens and especially of society. The second was the interdisciplinarity of concepts and their application. The third was to propose a logical sequence constituted in stages that consisted of a step-by-step

sequence composed to elaborate a project and the fourth and last one, its application in the day to day.

In this way, this work aims to present a step-by-step proposal to elaborate a project, based on public policies.

The methodology used was the theoretical-bibliographic research, supported by discussions with professionals in the public sector. After elaboration of the proposal, new discussions were held to pre-validate the method.

This work is structured in 4 chapters. The second presents the theoretical reference and its analysis. The third refers to a step-by-step proposal for drawing up projects from a public policy and the fourth and final chapter deals with the final considerations.

II. LITERATURE REVIEW: PROJECTS FOR PUBLIC POLICIES

This chapter will deal with Public Management, Public Policy, Programs and Projects. It should be noted that the Federal Constitution of the Federative Republic of Brazil of 1988 grants its own tax powers and independence to define and execute its public spending policies and that it remains organized as a federative republic with three levels of Government: a Central represented by the Union, twenty-six Member States and the Federal District, as well as the municipalities.

2.1 PUBLIC MANAGEMENT AND PUBLIC POLICY

Before discussing the public policy issue, it is important to highlight the National Public Management Program, which was established by Decree No. 3778 of February 23, 2005. Its main characteristic is to be essentially public and to be geared towards the provision of results for society and be federative. It is also "contributing to the improvement of the quality of the public services provided to the citizens and to increasing the competitiveness of the country through the continuous

improvement of the management", according to the service letter of the National Public Management Program (2009).

According to the UCP (2004, p. 4), in the field of governmental action, "each level of government has administrative autonomy, both for the organization of public services in general and for its own financial management." The UCP continues: "The financial autonomy of each level of government manifests itself through the formulation of the budget, the power to explore its fields of tax jurisdiction and the ability to make public expenditures."

With the creation of these programs we realize that the focus is on society, so it is independent of the political party that is governing. According to Osório (2005), the Brazilian Public Management "tends to be guided by theoretical parameters of quality, productivity and control of results". It is important to focus on results. The author continues: "This is a reality imposed by international policies and, for this reason, tends to be the official discourse of any government."

This reality focused on results makes the public administration have technical capacity. According to Osório (2005), in order, to be able to "work correctly with the new paradigms of agile, efficient and committed managers with results, we must build, a stable administrative machine, equipped and technically qualified."

It is perceived, therefore, that to implement services of excellence for the citizens, to use project becomes necessary. According to the services charter of the National Public Management Program (2009, p. 16), a public organization "should establish a working team to coordinate the Project". By the services letter, described above, the project is necessary and for this to have a team with knowledge about the processes of attendance of the organization is of fundamental importance.

With this plan, the State, in the current scenario, needs a citizen-oriented organization. According to Queiroz (2011: 32), governance "is its administrative capacity to govern effectively and efficiently, returning to the action of the state services to serve citizens."

We understand that to govern effectively is to govern with monitoring of the results achieved over time through their actions. Actions that result in improvement of the citizens' quality of life. According to Chiavenato (2003, p.40), effectiveness "is to remain sustainable in the environment, present global results over time, coordinate efforts and energies systematically". Efficiency "is to do things the right way, solve problems, take care of the resources applied, fulfill the duty and reduce the costs". Effectiveness "is doing the right things, producing

creative alternatives, maximizing the use of resources and getting results"

It is clear that the State to govern effectively will use public policy to meet the demand of citizens and achieve the necessary results. Queiroz (2011, p. 33), points out that "it is fundamental to value regional and local social demands through greater attention of the State to these interests".

Understanding that public policies are the means available to the public administration for the defense and realization of the rights of freedom, defining and formulating laws that meet this demand is necessary. Queiroz (2011, p. 99) points out that: "the sector in which the definition and formulation of laws and public policies is defined comprises, in the Federal Executive Branch, the direct administration organs that integrate the structure of the Presidency of the Republic and the ministries and, in the State or Municipal Executive Branch, the organs of direct administration that integrate the structure of the government / cabinet and the structure of the secretariats". It is clear that the Executive Power is important in this process and knowing the Master Plan of a government is necessary.

Thus, evaluating the results of the actions established by the public policies and the responsibility of the rulers becomes necessary. Queiroz (2011, p.104) cites the need for social control of public policies as: "evaluation of results and accountability of government officials for their actions". To have public policy and to control its results and responsibilities we understand as actions of fundamental importance in the current social context.

Possessing programs and / or projects that allow the realization of public policy, whether Federal, State or Municipal, presents itself as an initiative that facilitates the accomplishment of actions, results monitoring and identification of those responsible. When analyzing the concepts, it is also possible to understand that the actions of the public policies favor in some way the local and / or regional development.

Given the importance of public management and public policy, knowing projects, their concepts and procedures, we understand that it will facilitate identifying a specific action to be taken that results in an improvement in the quality of life of the citizen and society.

2.2 PROGRAMS AND PROJECTS

To propose a step-by-step to design project, from a public policy, we initially need to understand what is program for design purposes.

According to Keeling (2002, p. 7), programs "are presented in the form of a series of projects", so according to the author, projects "may be autonomous modular".

Then, it can be understood that the programs welcome the projects with specified objectives and expected results.

According to the same author, in continuation: "the projects are destined to obtain an independent but complementary result, that is frequently integrated to the work of other agencies with interests in the same area of operations or field of activity". According to Keeling (2002, p. 4), the project presents common characteristics, "are independent enterprises, have distinct purposes and objectives, and are of limited duration". The author continues to cite that the projects have: "determined dates for beginning and ending, own resources and administration and own administrative structure."

According to Oliveira (2005, p. XIV), "project is a unique and temporary event". Thus, design is unique and has clearly defined beginning and end. Being unique, to elaborate it or to plan it, it is necessary. The author continues: "project needs specific planning to achieve its objectives".

In this way, a project is a specific action that disengages from a routine activity, but can contribute to its efficiency. According to Keeling (2002, p.4), a project "... is planned, financed and administered as a distinct activity". The author continues: "The project perspective is rigidly defined, limited by time and resources, and the objectives are more specific."

Since a project is a specific and unique action, a project is defined as a defined challenge. According to Chiavenato (2003: 361) "a project is a defined challenge to create a single product or service". The author continues: "Project is temporary because it has a definite beginning and a definite end".

The PMBOK Guide (2004, p.5) cites a project as "a temporary effort undertaken to create a unique product, service, or result."

When analyzing these project citations, it is clear that the project has specific characteristics and benefits that KEELING (2002, p.5) highlights: "simplicity of purpose, clarity of purpose and scope, independent control, ease of measurement, flexibility of employment, leads to motivation and team morale, sensitivity to management style and leadership, useful for individual development, conducive to discretion and safety, mobility and ease of distribution".

According to the PMBOK Guide (2004, p.7), "projects are used as a means to achieve the strategic plan of an organization". When understanding that a project meets a strategic plan, knowing the strategy of an organization is necessary to achieve results, thus identifying the improvement programs is an action of fundamental importance, in order, to elaborate the projects that will serve those programs. Improvements.

In addition, to strategic considerations, project can also meet specific objectives. Oliveira (2005, p. XIV) exemplifies projects such as "creating a product for classes A and B". The specificity of the objective is clear. The author continues: "build a residential building".

In this paper, the authors describe the ISO standard 10006 (1997), which defines a project as "a unique process, consisting of a group of coordinated and controlled activities with dates for beginning and ending, undertaken to reach a goal according to requirements, including time, cost and resource constraints. "

According to Tuman (1983) apud Rabechini, Carvalho and Laurindo (2002), a project is an organization of dedicated people aiming at achieving a specific purpose and objective.

According to Oliveira (2005, p. 15), "to start a project is to recognize the need to formalize its beginning". Presenting a proposal is of fundamental importance. According to Oliveira (2005, p. XV), "executive proposal is a document that summarizes analytical data on the technical, operational and financial viability of a project". Through the executive proposal of the project that will seek its approval. According to Oliveira (2005, p. XV), "objectives, premises, constraints and financial returns presented in the Executive Proposal need approval, so that the project advances to the planning process."

2.2.1 PROJECTS MANAGEMENT

According to the PMBOK Guide (2004, p.8), "project management is the application of knowledge, skills, tools and techniques to project activities to meet their requirements."

According to Keeling (2002, p.9), project management "is the center around which all activity, the link between internal and external stakeholders and organizations, regulates progress, speed, quality and costs, leader and motivator of staff, communicator and negotiator on all things related to the project, and controller of finance and other resources. "

When it comes to project management, defining the profile of a manager is of fundamental importance. According to Keeling (2002, p.10), the characteristics considered important for a manager's profile are: "strong, energetic but tolerant personality, diplomacy and advocacy."

To defend the project, its independence and ability are of fundamental importance. On this independence the author continues: management must possess "Intelligence with an independent spirit". About Ability the author continues: that "it must be proven in the branch of the project and to see things as a whole". Therefore, according to the author who continues "the management of own interest and concern to see the project completed.

Ability to direct and delegate technical work. Commercial, financial procedures, contractual, legal, entrepreneurial dynamism, and energy and persistence. " Once the manager's profile has been identified, the project life cycle must be identified through the phases of a project. Keeling (2002, p. 13), cites four phases of a project life cycle: "conceptualization, planning, implementation (execution), and completion." To reinforce the importance of identifying the project life cycle, the PMBOK Guide (2004, p.5) cites the following management processes: "initiation, planning, execution, monitoring and control, and closure".

In order, to elaborate the project, the conceptualization phase is fundamental. It is the moment that presents the idea or vision of improvement for one direction. According to Keeling (2002, p.17), "it is the project proposal, defining justification, proposed methods, estimated costs and benefits and other details."

If the proposal is approved by the management, a detailed study is necessary. Keeling (2002, p.17), recommends "a structured feasibility study that offers recommendations as to whether the project should continue." It is important to emphasize that in this conceptual phase of the project the purpose is clarified. Keeling (2002, p.25), cites as the moment when: "its exact purpose, that is, to stipulate objectives, scope, outcome and cost, and to identify stakeholders is clarified."

As Keeling (2002: 26) writes, it is important to consider the following questions: "What exactly should be achieved? What results are important (needs), which are desirable, but not so important (desires)? What should not be included? How could the "goal" of the project be better achieved? How long will it take to achieve the results? When would it be wise to start the project? How much will it cost and where will the resources come from? What opposition could be found, by whom?"

Scratched and defined the concept and the proposal, studying the viability of the project becomes necessary. Keeling (2002: 45) points out that an initial proposal should have four purposes: "introducing the concept, testing the reactions of potential stakeholders, obtaining support, and establishing a basis for assessing viability." It is clear the importance of the feasibility study that naturally considers the project risks.

Managing the risks of the project is of relevant importance. A threat can lead to abandonment of the project. According to Keeling (2002: 53), "risk management is an ongoing process throughout the life of all projects, starting with the viability stage, when foreseeable risks are identified, graded and evaluated." Neglecting this practice can create serious difficulties in the execution of the project. According to Keeling (2002: 54), which considers risk management occurs in four

phases that are: "identification, evaluation, analysis and elimination".

These four phases depend on the elaboration of a table that shows the activities, their dependencies, time of accomplishment, cost, probability of the risk occurring and its impact. Managing projects effectively is key. Finally, as Chiavenato (2003, p. 361) proposes, "to manage projects effectively is to define, rationalize and optimize all forms of work that are essential for good corporate results."

2.2.2 PROJECTS: PLANNING, IMPLEMENTATION AND CLOSURE

Once the conceptual phase has been completed, the project is designed for the analysis, study and approval of stakeholders and especially public policy.

It can be understood that it begins the planning phase when the decision to carry out the project was made. According to Keeling (2002, p.17), planning "begins when the decision to proceed" was made. This moment requires a more analytical study of the proposal and the selection of management. Keeling (2002, p.17), defines the moment in which "selects the management, realizes the plan of activity, finances, human resources, communication, norms of quality, security and administration." The planning carried out must be validated by project supporters.

After the planning phase, the implementation phase begins, which for Keeling (2002, p.17), "is a period of concentrated activity when the plans are put into operation". Controlling each activity in relation to the planned one is necessary, and Keeling (2002, p.17) states that "each activity is monitored, controlled and coordinated to achieve the project objectives." According to Keeling (2002, p.17), "the efficiency of work will be directly linked to the quality of the plans already formulated, to the effectiveness of the administration".

Implemented the plan established in the planning begins the completion phase. Keeling (2002, p.18) points out: "it is the delivery, attribution of duties and responsibilities of follow-up, such as disposal of machinery and equipment, closure of bank accounts, evaluation, transfer of personnel and closure report".

III. A STEP BY STEP PROPOSAL TO DEVELOP PROJECT

Figure 1 presents eleven steps proposed to elaborate a public policy project. These steps are interrelated and ordered.

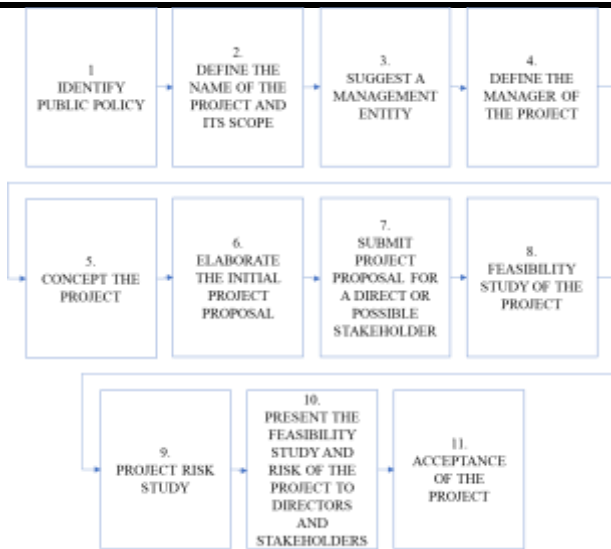


Fig.1: Public Policy Project step by step

Below are described each one of the proposed steps:

- **STEP 1 - IDENTIFY PUBLIC POLICY:** Identify in public policy their objectives, requirements, deadlines, costs and results that they intend to achieve, in order, to offer improvement to society.
- **STEP 2 - DEFINE THE SCOPE OF THE PROJECT:** Give a name to the project, even if it is provisional. And, define the scope and the time that the temporary efforts that will be undertaken to create a unique product, service or result. This is the moment to identify the project stakeholders.
- **STEP 3 - SUGGEST A MANAGEMENT ENTITY:** Once the exclusive product or service is defined, it is necessary to define the managing entity for this project.
- **STEP 4 - DEFINE THE MANAGER OF THE PROJECT:** Once the management entity is defined, it will be necessary to identify the project manager.
- **STEP 5 - CONCEPT THE PROJECT:** defined the project manager, it is recommended to conceptualize the project. Moment in which the exact purpose is clarified. It outlined the objectives, scope, outcome, and cost.
- **STEP 6 - ELABORATE THE INITIAL PROJECT PROPOSAL:** Defined the concept, it is suggested to present the justification of the project. Time to report the methods, costs, time, risks, materials that will be used, the people needed, the form of communication and especially the scope of the project.
- **STEP 7 - SUBMIT PROJECT PROPOSAL FOR A DIRECT OR POSSIBLE STAKEHOLDER:** Having a clear and objective proposal, meet with a direction or group of potential stakeholders and discuss the concept of the project to get support and,

also, seek new stakeholders by the project. Tests the reactions of those interested. Moment to validate the concept of the project.

- **STEP 8 - FEASIBILITY STUDY OF THE PROJECT:** Study the viability of the project. Moment to consolidate the concept, seek data that aggregate the project and further clarify the project. It is suggested to develop a framework that clearly presents information on how the project should achieve its results.
- **STEP 9 - PROJECT RISK STUDY:** Analyze the risks of the project and present ways to mitigate and solve possible predictable problems, that may interfere with the project. It is recommended to develop a process that identifies, evaluates, analyzes and presents a way to eliminate possible and predictable risks.
- **STEP 10 - PRESENT THE FEASIBILITY STUDY AND RISK OF THE PROJECT TO DIRECTORS AND STAKEHOLDERS:** Present the project, which has been studied, analyzed and argued. Moment still conducive to contributions, changes and suggestions for improvements. Discussed the project, obtain final project approval and authorization for continuity.
- **STEP 11 - ACCEPTANCE OF THE PROJECT:** Proceed with the documentation and preparation and signing of the contracts. The planning, implementation, (execution and control) and project closure phases begin (themes that are out of focus for this work).

IV. CONCLUSION

This work presented the concepts of public management, public policy and projects in a way that allowed to present a logical and interrelated sequence composed by a step-by-step to elaborate project, from a public policy. From this it was possible to suggest eleven steps to elaborate a project.

With the definition of the eleven steps, it is concluded that the research reached its objective, thus contributing to a certain interested party, who wishes to elaborate a project, based on the objectives and results expected by a public policy.

It is suggested for future work the detailing of each one of the proposed steps, as well as its insertion of already consolidated project management tools.

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Proposal for a technology vigilance system for a Technology License Office

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Abstract—To search for new technologies and to map new scientific and technological developments capable of significantly influencing a scientific and technological institution, is the main role of technological prospecting. Technological prospecting can be a useful tool for the provision of subsidies to finance R&D activities. In this context, using technological prospecting techniques in a Technology License Office is relevant to leverage R&D&I activities in an institution. Thus, the purpose of this task is to present a proposal for the application of technological prospecting tools to a Technology License Office, to support R&D&I activities. This task was conducted through bibliographic research and observation of activities. After the studies, it was verified that for technological prospecting, different methods should be used, since prospecting technology requires systemic vision, through monitoring, forecasting and future vision, guiding the decision making relevant to the positioning of R&D teams in conducting their research.

Keywords—*technological innovation, technology license office, technological prospecting, technological vigilance.*

I. INTRODUCTION

Science and Technology are essential tools in the great pursuit of the development and progress of a Country. For Martens and Monteiro (2016), Pope, Annandale and Morrison-Sauders (2004) and Wilkins (2003), current social, economic and environmental scenarios have forced organizations to innovate, manage change, and generate new activities and new products. Thus, according to Ikenami, Garnica and Ringer (2016), an organization's capacity for innovation is not only a differential, but an essential factor for its survival. Thus, for Bruno-Faria and Fonseca (2014), innovation has become a goal for different types of organization, that is, in each reality, aspects must be observed to the purpose of fostering it or to eliminate the barriers that may hinder -over there. This

context, according to Pope, Annandale and Morrison-Sauders (2004) and Wilkins (2003), presents new challenges for organizations, which present themselves in a more complex way and require greater speed for their treatment and management.

Brasil (2005) defines that technological innovation is the conception of a new product or process of manufacture, as well as the aggregation of new functionalities or characteristics to the product or process, which implies in incremental improvements and in the effective gain of quality or productivity, resulting in greater competitiveness in the market. For the OCDE (2003), technological innovation activities are the set of scientific, technological, organizational, financial and commercial steps, including investments in new knowledge, which lead to or try to lead to the implementation of new or improved products and processes.

For Andrade, Soto Urbina and Torkomian (2016), Kon (2016), Marzall, Santos and Godoy (2016), Pacheco and Gomes (2016), Festa (2015), Macedo, Miguel and Casarotto Filho (2015), Reichert, Camboim and Zawislak (2015), Sousa et al. (2015), Tres e Ferreti (2015), Dias e Cabral (2014), Gomes et al. (2014), Martins et al. (2014), Pereira et al. (2014) and Chimendes (2011), innovation is essential for improving the performance of an organization, and concerns the outcome of an organization's ability to articulate its specific sets of resources, competencies, and the interactions and relationships among the various actors impact of the organization's activities, in order to constitute a strategic mechanism, with the objective of achieving superior performance, creating a sustainable competitive advantage, and thus, generating added value and growth of the organization, besides remaining competitive in the market, which is constantly changing, and, ultimately, to promote economic development.

In other words, according to Andrade (2016), Marzall, Santos and Godoy (2016), Minguela-Rata et al. (2014),

Persico; Manca and Pozzi (2014), Bruce and Birchall (2011), Nieto and Santamaria (2010), Coral, Ogliari and Abreu (2009), it is possible to understand that innovation is the commercial exploitation of an invention, that is, of turning an invention into results. One can still think of product innovation or process innovation.

Andrade (2016), Frezatti et al. (2005), Froehlich and Bitencourt (2015), Selan (2009), Coral, Ogliari and Abreu (2008) and Al-Ali (2003) argue that there is an important relationship between strategy and innovation, and the effective innovation involves changes in the strategies, tactics and operational actions of the organization, that is, the alignment of innovation practices with organizational strategies. If the organization does not view innovation as a preponderant factor and does not have a well-defined strategy, it will not be able to efficiently and effectively manage all the factors involved in promoting innovation.

In a dynamic environment and surrounded by complex systems, such as the environment of action of the Scientific and Technological Institutions (ICT), a tool that can help in the direction of Research and Development (R & D) strategies is Technological Prospecting.

Technological prospecting can be defined as a systematic means of mapping scientific and technological developments that can significantly influence an organization, an industry, a specific product or process, or the economy or society as a whole.

Thus, the purpose of this task is to present a proposal for the application of technological prospecting tools for application in a Technology License Office (TLO), to support the R & D teams of an ICT.

Considering that this work was conducted through bibliographic research, patent research, observation of activities and possible comparisons between best practices, this research could be classified as a qualitative, explanatory, deductive and original research. For Godoy (1995), qualitative research is applied when researchers have broad interests that are defined as the research is developed. In this type of approach, the researcher has a particularly important role because he has direct contact with the problem studied and it is through the researcher that the problems are understood and the focus of the research can be altered or adjusted. According to Gil (1991; 2008), a research can be classified as explanatory when it aims to deepen the knowledge about a certain reality. According to Gil (1991, 2008), the deductive research comprises the analysis that starts from the general and then descends to the particular, that is, deductive reasoning starts from principles considered as true and indisputable to reach conclusions in a purely formal, that is, by virtue of its logic alone. An original scientific research is, according to Cervo et al (2007) and

Andrade (2009), of that research that contributes with new conquests for the evolution of knowledge.

Also, there was direct and continuous interaction with the TLO members of the ICT studied, as well as with their researchers. In this way, this research can also be considered as applied research, since it allowed to apply knowledge in a practical way. According to Kauark, Manhães and Medeiros (2010), applied research aims to generate knowledge for practical application, directed to the solution of specific problems. And yet, it can be considered as an action research. According to Thiollent (2009), Severino (2008), Tripp (2005), Coughlan and Coughlan (2002) and Kincheloe (1997), action research allows the researcher to understand a problem and intervene in real time, it is a methodology in which the target process of the research is improved through the practice, generating learning and knowledge about the process and the research during the resolution of the problem. For Tripp (2005), action research is applied through a 4-step cycle: planning an improvement, acting to implement planned improvement, monitoring and describing the effects of the improvement implemented, and evaluating action outcomes, feedback cycle.

This work is divided into 4 parts. The second concerns a review of the literature on technological prospecting, the third presents a proposal for applying the tool in a TLO, and finally the fourth part indicates the final considerations of this research.

II. LITERATURE REVIEW:

TECHNOLOGICAL PROSPECTING

Corroborating the definition of technological prospecting presented in the introduction of this task, Almeida and Moraes (2014), Robinson et al. (2013), Georghiou et al. (2008), Coelho et al. (2003) and Cuhls and Grupp (2003; 2001), Slaughter (2001), describe that prospecting is a process that examines the long-term future of science (2005), UNIDVO (2005a; 2005b), Porter, technology, economics and society in order to interpret data, trends and signs of change and future events, with the objective of identifying areas of strategic research and emerging generic technologies that are likely to generate greater economic and social benefits. social policies.

In other words, for Horst et. al (2011), the technological prospecting is the survey of a relation of technologies and supporting activities for its development in order to meet the expectations and demands of a certain group.

For CTPETRO (2003), technological prospecting consists of: It is a process, not just a set of techniques; It focuses on creating and improving understanding of possible future developments and the forces that seem to shape them; It assumes that the future cannot be scientifically demonstrated from certain premises. The central point is

to discuss the chances of development and the options for action in the present; Passive behavior is not expected in the future, but an active positioning. The future will be created by the choices that are made today.

Coelho (2003) complements that technological prospecting is not the same thing as prognosis or foresight, since it implies an active participation in shaping the future. De Castro, Lima and Freitas Filho (1999) indicate that traditional forecasting builds the future in the image of the past, while technological prospecting focuses on futures with alternative possibilities of being different from the past. It is important to highlight that technological prospecting is aimed at guiding present decision making, based on the existence of turbulence that causes changes in the behavior of variables - critical factors - considered relevant.

For Jannuzzi et. Al (2004), technological prospecting is an instrument to know the possibilities and opportunities of investments in R & D, in areas that may be important for the economic and social development of the country. Technological prospecting has as one of its main objectives, the offer of subsidies for the financing of R & D activities, relating sets of technologies that will be important, according to society's expectations. The results of the technological prospect thus allow the indication of a list of topics (a R & D agenda) ordered by priorities, according to a panel of experts. In addition, the very process of consulting specialists, collecting information, processing and organizing these data provide support for those decision makers, and are also part of a prospective study.

Kupfer and Tigre (2004) describe that the technological prospecting is carried out with the following objective:

- Monitoring (monitoring the evolution of facts and signals and factors that bear change and future);
- Forecasting (making projections based on historical statistical series); and,
- Vision (anticipate future possibilities based on interaction with experts).

In order to apply technological prospecting, according to Almeida and Moraes (2014), Millet (2006), Camarinha-Matos and Afsarmanesh (2004), Phaal et al. (2001; 2004), one of the most applied methods is the construction of technological and strategic roadmaps, considering the mapping and mobilization of specialists around the R & D topics in the area in focus, the definitions of objectives and the scope of the prospecting and the the most appropriate methods and prospecting tools.

Mayerhoff (2008) describes a four-phase model for the technological prospecting, being:

- Preparatory phase (definition of objectives, scope, approach and methodology);
- Pre-prospective phase (details of methodology and data collection);
- Prospective phase (collection, treatment and analysis of data); and
- Post-prospective phase (communication of results, implementation of actions and monitoring).

Regarding the prospective phase, Kupfer and Tigre (2004) and Caruso and Tigre (2004) indicate some techniques for collecting information: conducting experiments or tests; query database records (authors and titles); consultation of publications (papers and patents); conducting visits; conducting interviews; application of questionnaires; observation techniques.

According to Mayerhoff (2008), the historical information used in prospecting methods should be obtained through continuous and reliable series. The Technological Prospecting studies that need this information find in the Intellectual Property system, specifically in the Patents system, a valuable resource, since this system feeds a database that has been growing significantly in the last decades, due to the growing importance patents in the economy.

For Tomiaka, Lourenço and Facó (2010), Barroso, Quoniam and Pacheco (2009), De Castro, Lima and Freitas Filho (1999), Contant and Bottomley (1988), a patent is a document that contains numerous internationally standardized information. Therefore, it is a document of easy identification, such as: patent title, name of the depositor, inventors, prosecutors, date of filing, date of grant of the patent, classification of the patent according to the application, summary, complete descriptions, claims, quotes referenced, among other information. The information available in a patent is relevant and it is necessary to carry out collections and analyze large quantities of patents, through tools such as Data Mining, for decision making.

Also, for Tomiaka, Lourenço and Facó (2010), Barroso, Quoniam and Pacheco (2009), De Castro, Lima and Freitas Filho (1999), Contant and Bottomley (1988), based on patents, consequently a variety of information. Access to patent databases is relatively simple and can provide access to two types of databases: the free ones maintained by the offices of each country and the commercial ones maintained by companies that organize on a single server the vast majority of the world's databases. Here are some of the free bases: World Intellectual Property Office (WIPO); United States Patent and Trademark Office (USPTO); European Patent Office (EPO); National Center for Industrial Property Information and Training (NCIPIT).

Still in the prospective phase, after collecting information, these should be analyzed. Kupfer and Tigre (2004) and Caruso and Tigre (2004) present some methods for the analysis of the information, through the technological prospection: technological mapping; science and technology analysis; scenario analysis; Industry analysis; Patent analysis; delphi.

According to Kupfer and Tigre (2004) and Caruso and Tigre (2004), unlike classic prediction activities, which are dedicated to anticipating a supposed future as unique, prospecting exercises are constructed from the premise that there are several possible futures. These are typically the cases in which the present actions change the future, as with technological innovation. Future technological advances depend on the complex and unpredictable mode of allocative decisions taken in the present by a relatively large set of non-conclusive agents. Prospecting exercises serve as a means to achieve two objectives: The first is to prepare the actors in organizations to seize or face future opportunities or threats. The second goal is to trigger a process of building a desirable future.

In this sense, Tomioka, Lourenço and Facó (2010) describe that technological prospecting is of fundamental importance for the development of research, both in business and academic. Technological prospecting can be used to: anticipate technological changes; understand the course of change; support the decision-making process in research and development; support the technology protection process; support the technology commercialization process.

Also, according to Tomioka, Lourenço and Facó (2010), the information from the technological prospection are useful to: determine the state of the art or state of the art; identify alternative technologies; locate technological and commercial information that involves specific companies, owners, depositors or inventors; improvement of the quality of patents to be deposited, if this is the focus; identify alternative holders or exchange of technologies; research advancement in the inventive novelty of an invention; identify a member of a patent family; seek the country in which a patent has been deposited; locate the document that is written in a desired language; obtain a list of priority documents or references cited; to estimate the importance of the invention by the number of patents deposited; obtain information on the validity of a patent deposited or granted; patent infringement of third parties. According to Quintella et. al (2011a; 2011b; 2011c; 2011d), in order to carry out the technological prospection, tools and skills are usually not well detailed and not incorporated into vocational training. However, for De Castro, Lima and Freitas Filho (1999), the knowledge and tools for technological prospection are still limited, although there is great interest in expanding

them. Such a quote, made 18 years ago, is still a reality today.

In this same sense, for Tomioka, Lourenço and Facó (2010), Barroso, Quoniam and Pacheco (2009), De Castro, Lima and Freitas Filho (1999), Contant and Bottomley (1988), in general, the use of technological prospecting is rare, to subsidize research projects, whether in academia or industry. However, the use of this type of tool is important, because in the industrial or technological field, about 70% of the information is described in patent databases and the rest, 30%, is in scientific publications or other forms of dissemination.

De Castro, Lima and Freitas Filho (1999) and Contant & Bottomley (1988) indicate that a number of reasons have hindered the practical implementation of more formal models of technological prospecting: a) The tradition within the scientific community to leave exclusively to the researcher the responsibility of choosing what to research; b) The fragmentation of the research structure between public and private sectors makes it difficult to construct a single set of priorities; c) Market forces, determining the lines of R & D to be followed by the private sector, impose biases on the priorities for those more profitable activities; d) The belief that the public sector should be responsible for the generation of basic science and the private sector for R & D contributes to the bias in establishing demands and priorities, since it is difficult to predict the impact to be generated by basic knowledge.

For Quintela et al. (2011), Technological Prospecting should be demystified, becoming a routine tool, influencing the decision-making processes, which may facilitate the appropriation of the technologies through Intellectual Property, and improve the management of innovation, while increasing the critical sense and to broaden the vision of technological bottlenecks and opportunities associated with them.

III. PROPOSAL FOR A TECHNOLOGY VIGILANCE SYSTEM, BASED ON TECHNOLOGICAL PROSPECTING, FOR A TLO

For Kupfer and Tigre (2004), prospecting exercises work as a means to achieve two main objectives: 1) prepare the actors in the industry to seize or face future opportunities or threats; and, 2) unleash a process of building a desirable future. Therefore, according to Jannuzzi et. al (2004), this exercise aims to indicate an agenda and prioritize R & D activities for a given time horizon.

For Freire, Guimarães and Jesus (2011), success in the competitive strategy of a given industry also depends on the prospection and monitoring of information about a particular process or technology. Through this prospecting study it is possible to establish a differential

in competitiveness, based on the mapping of fundamental information and knowledge sources.

In this way, one of the possible applications for technological prospecting is linked to the possibility of anticipating the technologies that can be applied and / or contributing to the R & D projects of an ICT. Therefore, it is necessary to establish a directive for the application of technological prospecting tools.

Reinforcing the above, Freire, Guimarães and Jesus (2011) describe that the marketing and technological monitoring needs to be carefully structured so that it can serve as an identification of new opportunities and signs of change in a given market.

Thus, in order to initiate technological prospecting, the technologies to be prospected should be prioritized, giving priority to those with the greatest impact and relevance on ongoing R & D projects, including, but not limited to, problems not yet solved by R & D areas. This prioritization should be done in conjunction with the researchers in the area in question.

After the prioritization of technologies, the search process begins, to identify technologies developed and protected through intellectual property. As previously described, prospecting may be carried out by searching national and international patent databases (example: INPI, USPTO, Sp@cenet, WIPO, among others). This search should be carried out by combining two distinct criteria: keywords and fields of the international patent classification. Keywords describe the technology of interest and the fields of international patent classification indicate the allocation of such technologies. In order, to perform this search, it will be necessary, firstly, to elaborate the search strategies, which begin with the determination of the databases to be used, then, together with other members of the research group, the identification of the keywords, both in Portuguese, and in English for use during searches.

Once the searches have been completed, data processing should be carried out to group similar technologies to analyze each technology individually, pointing out its strengths and weaknesses and its stage of development.

In addition to database searches, it will also be necessary, and of great importance, to promote a literature review on the technologies prioritized for prospecting. This review of the literature should point to the state of the art about the technologies used to solve the question or research problem that one wants to reach.

After the collection and treatment of the prospecting data, complemented with a review of the literature, it will be possible to evaluate how the prospected technologies can collaborate with the R & D projects, now in progress, that is, it will be possible to identify if there are technologies that can be used or applied to solve problems not yet

solved by the research team. Also, it will be possible to indicate the possible improvements to be made in the developed processes or the possible needs of the development of new technologies, or the improvement of the already developed, to incorporate the processes.

However, before applying or using the prospected technologies, it is important to assess your maturity level so as not to use technologies that are still mature enough to actually solve the problem. Considering Silva Neto (2015), Jochem, Geers and Heinze (2011) and Fraser, Moultrie and Gregory (2002), technological maturity can be observed as a competency model that points to different degrees of maturity, from an initial stage to an advanced stage, going through several intermediate stages, being necessary to fulfill specific criteria for each stage.

In this way, it was created by NASA in the 1970s, according to Jesus and Chagas Júnior (2017) and Lemos and Chagas Júnior (2016), a tool called Technology Readiness Level (TRL), whose objective is to measure or estimate the level of maturity of a particular technology. The application of TRL is standardized through ISO-16290: 2013 (Space systems - Definition of the Technology Readiness Levels (TRLs) and their criteria of assessment).

According to Jesus and Chagas Júnior (2017) and Lemos and Chagas Júnior (2016), each technology is evaluated according to the parameters for each technology level, and then the TRL of the critical elements of the technology can be estimated.

Thus, TRL can be applied to assess the level of maturity of the technologies being prospected, that is, to identify the technological risk of each technology, prior to its application in R & D projects, as already described. According to Mankins (2009) and Almeida (2008), the application of TRL can contribute to reduce the risk in the development of new technologies, since it represents an important tool or metric that evaluates the anticipated uncertainty in research and development activities.

The application can be performed using TRL Calculator, which consists of a tool developed using MS-Excel worksheets, which allows the selection of several descriptive items related to the various levels of TRL, related to the current stage of the analyzed technology. This tool was developed, according to Almeida (2008), by the Air Force Research Laboratory of the United States of America. It should be emphasized that the data and information necessary for the application of this evaluation should be collected and discussed through the interaction with the other researchers that compose the research team.

The evaluation of technological maturity, through TRL, is important to indicate the necessary effort to be undertaken

in the research and development of each technology, under study, giving subsidy to the researchers to conduct their projects, as well as opening new fronts of studies and research.

Based on the above information collected and addressed, an information framework for technologies should be created, describing each technology, pointing out its strengths and weaknesses and its level of technological maturity. Based on this framework, the research team can carry out a comparison between technologies.

With the comparison made, an important point is to know effectively the technologies that are compared, through contact with the ICT or team that created the technology. Also, in this contact, you can be asked to demonstrate the use of the technology and, especially, to carry out tests, during a certain period.

Based on the tests, the technology to be incorporated into the technology that is in development may be chosen. For those technologies with a similar profile, priority should be given to those with the highest level of maturity, since the chances of failure are lower.

Having made the choice, a relevant issue is the negotiation of technology transfer and intellectual property rights.

Concluding this item, different technological prospecting methods should be used simultaneously, because none of them, in isolation, meet the needs of the research team, that is, the application of technological prospecting with a systemic view. And, according to Castro, Lima and Cristo (2002), without a good mapping of the important forces and events that have determined the past and shape the present, it is impossible to draw good visions of plausible futures, with enough robustness to guide the formulation of strategies. Vision of future without knowledge of the occurrences and past and present occurrences is exercise of divination and fiction, it is magical knowledge. It may even be confirmed, but the way to reach this vision can hardly be incorporated into scientific and managerial methodology.

IV. CONCLUSION

As stated by Chimendes (2011), the leverage of economic and social growth is linked to the role of knowledge and technology in the performance of production, distribution, economy and social performance. Therefore, scientific research, technological development plays a key role in this scenario.

Moreover, the importance of technological innovation in economic development was widely studied by Schumpeter (1982) in the first half of the century. Knowing the impact of scientific and technological research and its applications and discussing the results are fundamental to the development of a nation.

In this way, technological prospecting contributes directly to the strengthening of the R & D & I activities of a science and technology institution, and its techniques applied from a TLO, has a significant result in the promotion of research.

Aiming to present a study for the application of technological prospecting tools to a TLO innovation, considering that this work was conducted through bibliographical research, observation of activities and possible comparisons, it is understood, finally, that the objective was made effective.

It is concluded that "if" the organization does not commit itself to stimulating innovation, it will be in the near future, doomed to failure, since science and technology are really eminent elements for economic and social advancement.

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Nominal Construction and Maintenance of Highway Roads by using FBF (Fly Ash-bc Soil-Foam) Method

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Abstract— Roads play a significant part in the development of nation. They are life saver giving a smooth stream of man and materials. With the expanding of populace and the lessening of accessible land, road developments and other structural building structures must be done on weak or delicate soil. Inferable from such soil of weak shear quality and high swelling and shrinkage, an extraordinary decent variety of ground change methods, for example, soil adjustment and reinforcement are utilized to enhance mechanical conduct of soil, in this way improving the dependability of development. This article covers roadway development in Black cotton soils (BC soils) and furthermore depicts a case history of interstate development in thruway development in Black cotton soils. The reason for this investigation is to decide the ideal dosage of the stabilizer, which enhances the quality which is appropriate for pavement structure. The outcome demonstrates that the utilization of sand in mix builds the California Bearing Ratio values(CBR).

Keywords— Black cotton soil, Fly ash, lime concrete, coarse aggregate, sand, CBR, density and stabilization.

I. INTRODUCTION

Urbanization and modern advancement in India needs to focus on development procedures of highways, railways, air terminals and private structures. For these developments should require great soil conditions for establishment sand dikes. The sweeping soils are hazardous soil for development and most generally accessible in significant places in India. Particularly far reaching soils are primarily under goes swelling and shrinkage issues when dampness content changes in that soil. Because of high swelling and shrinkage issues posture huge issues to the structures. Adjustment on sweeping soil utilizing admixtures is a decent answer for

the swelling and shrinkage issues. Adjustment controls the impacts on establishment and structures. Research centerwork conveyed by adding admixture to the sweeping soil at various extents for this test ponder. The shear quality of the soil has both inside grinding and union. Compaction offers quality to the soil expanding the heap bearing limit and soil ends up noticeably steady. Artificially adjusted the soil by including lime, cement, flyash and lime mixes were utilized adequately. Research center test was directed for street development with previously mentioned concrete mixes properties. The point of this paper, depends on our Indian economy and budgetary status we have to give the development strategy too.

Road construction method through geo-technology schedule with precautions:

1. Road construction/maintenance with the analysis of soil type and causes of the damage using with BC soil, fly ash and Lime concrete.
2. To increase the life time and strengthening of the road construction based on different BC soil land.
3. BC soil based concrete mix for support BC soil land and other soil lands.

II. DESIGN PROBLEMS IN BLACK COTTON SOILS

In India, CBR strategy created and commonly utilized for the outline of outside layer thickness. This strategy stipulates that while deciding the CBR values in the research facility and in the field, an additional charge weight of 15 kg and 5 kg for each 62 mm and 25 mm thickness separately ought to be utilized to neutralize the swelling weight of Black cotton soils (BC soils). BC soils deliver swelling weight in the scope of 20-80 tons/m² and swelling in the scope of 10-20%.Therefore, CBR values

acquired are not objective and logical adjustment is required for deciding CBR values of broad soil. Having substantial obligation movement of 4500 business vehicles for each day and 150 as by and large found on our National Highways and taking CBR values of 2%, add up to hull thickness of adaptable asphalt works out to 830 mm which is for all intents and purposes an incomprehensible relational word. It is felt that CBR values bends require adjustment for far reaching soils. Expecting overwhelming movement force of 4500 business vehicles for each day and msa 150, covering thickness of inflexible asphalt works out roughly 300-320 mm, which is around 33% of thickness required for adaptable asphalt. In this way, it sounds sensible to embrace cement concrete asphalt in Black cotton soil zones. This kind of asphalt may spare the architects from everyday upkeep issues moreover.

Characteristics of Black Cotton Soil

- Black cotton soil (BC soil) is a highly clayey soil.
- It is so hard that the clods cannot be easily pulverized for treatment for its use in road construction.
- The black colour in Black cotton soil (BC soil) is due to the presence of titanium oxide in small concentration.
- The physical properties of Black cotton soil (BC soil) vary from place to place.

III. REVIEW OF LITRATURE

Cokcaet et al. (2000) Utilized from high-calcium and low-calcium class C fly ashes for adjustment of a far reaching soil and assessment of the far reaching soil-lime, sweeping soil-cement and far reaching soil-fly powder frameworks. Lime, cement and fly ashes remains were added to the far reaching soil at various rates. The examples were subjected to substance creation, grain measure dissemination, consistency breaking points, and free swell tests. Additionally, the Specimens with fly ashes were cured and after that they were subjected to oedometer free swell tests. It can be reasoned that the expansive soil can be effectively settled by fly ashes. Moreover, plasticity index, action and swelling capability of the samples diminished with expanding level of stabilizer and curing time.

Bose et al. (2012) Utilized fly ash to balance out a very plastic earth. The geo-designing properties, for example, Waterberg limits, grain estimate appropriation, straight shrinkage, free swell list, welling pressure, compaction attributes, unconfined compressive quality and CBR value of virgin clay and balance out with fly ash were assessed. In this way expansion of fly ash remains expands its workability by colloidal response and changing its grain

measure. The free swell index value and swelling pressure of extensive mud blended with fly slag diminished with increment in fly ash content. Fly powder decreased the ideal dampness content however the dry thickness expanded and unconfined compressive quality of mud fly cinder blends is observed to be greatest. This finished up the fly ash has a decent potential for enhancing the designing properties of expansive soil.

Buhler and Cerato et al. (2013) Utilized lime and Class C fly ash debris to lessen the versatility of profoundly far reaching dirt. Soil tests with comparative arrangement were utilized to indicate shrinkage fluctuation with the expansion of lime and Class C fly fiery ash. The pliancy lessening was resolved with direct shrinkage test. The outcomes demonstrated that both lime and fly fiery remains lessened the direct shrinkage however the expansion of lime created additional reduction in straight shrinkage.

Prasad and Sharma et al. (2014) Assessed the effectiveness of clay soil mixed with sand and fly ash for soil adjustment by concentrate the subgrade qualities. The motivation behind this work is to discover an answer for legitimate transfer of fly ash and furthermore gives great subgrade material to pavement construction. The outcomes demonstrated that considerable change in compaction and California bearing proportion of composite containing clay, sand and fly fiery debris. The swelling of the mud likewise diminished after adjustment. The greatest dry thickness of dirt sand-fly fiery debris blend diminished with the expansion of fly cinder and ideal dampness content expanded. In this way the settled soil can be utilized for construction of adaptable pavements in low activity regions.

IV. ANALYSIS OF RESEARCH MATERIALS

Black cotton soils are inorganic clay of medium to high compressibility and frame a major soil portion in India. They are likewise clarified by high shrinkage in swelling property. This black cotton soils happen for the most part in the focal and western parts and cover roughly 20% of the aggregate zone of India. In light of its high swelling and shrinkage described, the black cotton soil has been a challenge to the highway engineers.

The proportions of **Fly Ash** used along with the soil in the study are 4%, 6%, 8%, 10% and 12%. The following tests were conducted on the soil samples mixed at different proportions of WPSA the liquid limit and plastic limit tests were conducted as per IS: 2720 (Part 5)- 1985. Heavy compaction test was carried out according to IS: 2720 (Part 8)-1983. Unconfined compressive strength tests were conducted at OMC and MDD as per IS: 2720 (Part 10)- 1991. The California Bearing Ratio tests were conducted as per IS: 2720 (Part 16)- 1987.

Soil stabilization with lime can be done by mixing dosage of unsoaked lime into damp soil creates both immediate and medium term effects. The supportive power of sub grade generally depends three properties of soil that are Shear strength, Bearing power and Penetration resistance of soil. Here we have selected BC soil land for research and with BC soil for admix. Some of immediate effects are discussed below:

Drying: On mixing, there is immediate exothermic hydration reaction. It reduces water content with further reduced by aeration of soil. Water – fall percentage varies by 2 to 3 % of added lime.

Flocculation: Mixing affects the ultrasonic field between clay particles which changes to granular structure.

Reduction in Plasticity Index (PI): It switches from being plastic to stiff and grainy.

Improvement in bearing capacity: After two hours of mixing, CBR of a treated soil is between 4 and 10 times higher than that of an untreated soil. The reaction greatly relieves on site transportation difficulties.

Table.1: Chemical composition of Indian Fly ash

Constituent	Percentage Range (%)
Silica (SiO ₂)	49-67
Alumina (Al ₂ O ₃)	16-29
Iron Oxide (Fe ₂ O ₃)	4-10
Calcium Oxide (CaO)	1-4
Magnesium Oxide (MgO)	0.2-2
Sulphur (SO ₃)	0.1-2
Loss on ignition	0.5-3

Table.2: Properties of BC Soil and Fly ash

Soil Type	Liquid Limit (Awl) %	Plastic Limit (Wp)	Plasticity Index Ip	Flow Index	Toughness IT	Liquidity Index IL	Consistency Index IC	Specific Gravity GS	Classification
Fly ash	NP	NP	NP	-		-		1.72	ML
BC Soil	43.5	25.0	18.5	4.75	3.8	-1.08	2.08	2.54	MH

Lime concrete: Lime concrete used to enhance certain properties of a characteristic soil to influence it to fill enough a planned designing need. The primary advantages of utilizing lime to balance out muds/BC Soil are enhanced workability, expanded quality and Hedge solidness. Workability is enhanced on the grounds that flocculation makes the mud more friable; this helps blend for successful blending and compaction. Lime expands the ideal water content for compaction, which is favourable position when managing wet soil. The compaction bend for lime-treated dirt is by and large compliment, which influences dampness to control less basic and decreases the inconstancy of the thickness created. In initial couple of hours in the wake of blending,

lime added substances cause a consistent increment in quality, yet at a slower rate than cement. Lime stabilization of earth soils is accomplished in the field by shallow/surface adjustment or profound adjustment techniques. Shallow adjustment utilizing lime is accomplished by mechanical blending of lime and black cotton soil, spreading the blend and after that compacting it. Profound adjustment includes the utilization of lime segments, lime heaps or lime infusion techniques. Blending spreading-compacting has the favorable position over the lime heap system that it guarantees proficient contact amongst lime and clay mineral particles of the soil.

Table.3: Improvement in BC soil characteristics with Lime

Property	Observed values of BC Soil	
	Without Lime Treatment	With Lime Treatment
Plasticity Index	45	15
Water absorption at OMC and MDD	29	5
Uncontained compressor strength(kg/cm)	1.3	3.0
CBR value at OMC&MDD	3	20

Table.4: Variation of Index Properties of Black Cotton Soil with Fly Ash Percentage

S. No.	Fly ash content (%)	Liquid Limit (WL)	Plastic Limit (WP)	Plasticity Index (IP)	Liquidity Index (IL)	Consistency Index (IC)	Specific Gravity (GS)
1.	0	43.5%	25.0%	18.5%	-1.081	2.081	2.540
2	10	36.0%	13.0%	23.0%	-0.356	1.356	2.465
3	20	34.25%	14.8%	19.45%	-0.534	1.534	2.403
4	30	33.8%	15.7%	18.1%	-0.618	1.618	2.350
5	40	34.25%	16.1%	18.15%	-0.644	1.644	2.305
6	50	33.0%	16.4%	16.6%	-0.735	1.735	2.266

V. MATERIALS FOR SOIL/ROAD STABILIZATION

The materials for Black cotton soil (BC soil) stabilization shall comprise lime or Ordinary Portland Cement (OPC) 43 grade, moorum of approved quality, sand and Cohesive Non swelling Soil(CNS) having following properties,

- OPC 43 grade as per IS: 8112- 1989.
- Well graded granular moorum having minimum 4 day soaked CBR of 10% and maximum laboratory dry unit weight when tested as per IS:2720 (Part-8) shall not be less than 17.50 kN/m3.
- The sand shall be as per IS: 383-1970.
- The material for CNS soil should be good quality soil having laboratory dry unit weight when tested as per IS: 2720 (Part-8) not less than 16kN/m3.

Laboratory tests on soils, fly ash, foam and lime mixtures

In Experimental investigation the soil-Fly ash, form concrete and lime mixtures were prepared by mixing BC

Soil (10,20,30,40), fly ash (4%, 6%, 8%, 10% and 12%...), foam (10%,15%, 20%, 25%) and lime.All these mixtures were tested in the laboratory for their index properties, compaction characteristics. The test were carried out to determine the maximum dry density (MDD) and optimum moisture content (OMC) of soil mixtures using Heavy compaction (Modified Proctor Test) asper IS 2720-PartVII-1974. The mould used was 100 mm in diameter and 127.3 mm high. The samples were compacted in 5 layers by applying 25 blows to each layer with a free fall of 450 mm of 4.89 Kg weight.

CBR: The samples were prepared at OMC and compacted using Dynamic Compaction (Modified Proctor Test) as per IS: 2720-Part VII-1974. The mould used was 150 mm in diameter and 127.3 mm high. The samples were compacted in 5 layers by applying 56 blows to each layer with a free fall of 450 mm of 4.89 Kg weight. The penetration tests were carried out for samples soaked for 96 hours. The rate of penetration of the plunger was kept at 1.25 mm per minute.

Table.5: The most common desirable properties of soil/BC Soil as road material are listed below

Property	Sub base	Base course	Surface course
Liquid limit	20% Max.	25% Max.	35% Max
Plasticity Index	6% Max.	6% Max.	5 to 10% Max.

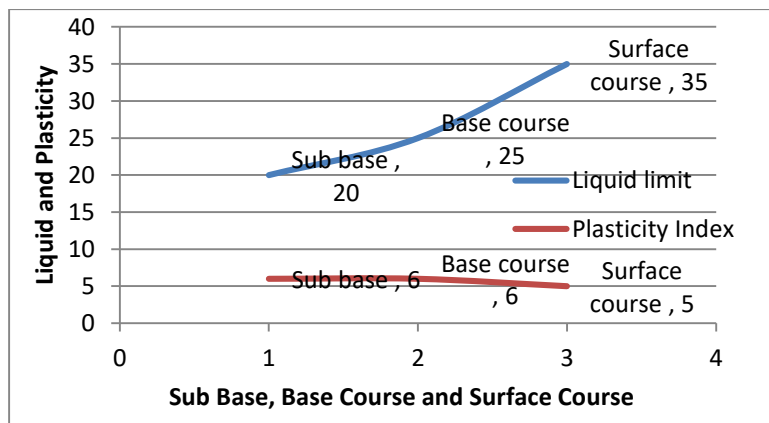


Fig.1: Desirable properties of soil/BC Soil

Consolidation of pavement takes much time, due to poor drainage capacity of soil. Shear strength of soil decreases with increase in moisture. Bearing capacity of soil is very low, resulting in extra thickness of pavement.

VI. RESULT DISCUSSION

The mix with perfect degree of (BC Soil + lime + fly ash stays) to soil and besides extent by weight of lime to fly powder should first be picked in the lab by experimentation. The same should be grasped in the field. The degrees of lime; fly blazing flotsam and jetsam and soil in the total mix conveyed in parts by dry weight.

Foamed concrete composition changes with the density that is request. For the most part, the foamed concrete that has densities lesser than 600kg/m³ will have cement, foam, water additionally some option of fly ash or lime stone tidy. To accomplish higher densities for frothed concrete, sand can be utilized. The base blend is 1:1 to 1:3 for heavier frothed concrete, which is filler to portland cement proportion. For more densities, say more greater than 1500kg/m³ more filler and medium sand is utilized. To diminish the thickness, the filler sum ought to be lessened. It is prescribed to dispose of the foam concrete with thickness lesser than 600kg/m³. Light weight filling material for street construction - Foam Technology: Foam concrete is a concrete blend that requires more prominent quality check to ensure the aggregate movement of its massiveness. The void rounding application has ended up being more obvious because of its related course of action of central focuses like warm security, its rigid nature, and controlled water ingestion properties. Ground feebleness issue is an problem generally went up against by old mines and sections. They have now used frothed concrete to fill the voids as a response for recoup quality in sewers, advantage trenches and various road structures like in cable cars and courses. Consequently the extent: L: FA is 1: 4: the task by parts may be,

Lime	3 parts
Fly Ash	12 parts
Soil	75 Parts
Foam Concrete	10 Parts
Total (Dry and Weight)	100

Experience recommends that lime-fly red hot flotsam and jetsam extents of 1:3 to 1:4 give perfect quality for various soil sorts sensible for lime-fly powder soil adjustment. Moreover increase in lime content does not demonstrate a proportionate augmentation in quality. Lime notwithstanding fly red hot flotsam and jetsam content going in the region of 10 and 30 for each penny by weight of the total dry mix has been seen to be sensible. Lime fly powder requirements, frankly, depend on the level of fines in the total mix. Fine solid residue requires a more elevated amount of (lime-f fly ash) appeared differently in relation to particularly explored soils. Quality advancement calls for sufficient system material (fines) to fill the voids in coarse materials.

The correct extents of the ingredients viz. lime fly fiery debris and soil, to be received at a specific area ought to be founded on the research facility blend configuration relying on the quality necessity. The base unconfined compressive quality and CBR values following 28 days curing and 4 days dousing ought to be 7.5 kg/cm² and 25 for each penny separately. As far as seven days curing and four days splashing, the base unconfined compressive quality and CBR esteems ought to be 3 kg/cm² and 10 for every penny individually. The curing might be done at a temperature extending from 30°C to 38°C. 5. Trial blends utilizing (lime-fly cinder) proportions of 1:2, 1:3, 1:4, are at first arranged. The accompanying general extents may as needs be utilized for setting up the mix for research facility tests:

Table.6: Lab Test Result

BC Soil + %5 Lime + 10% Fly Ash		BC Soil + %5 Lime + 20% Fly Ash		CBR -BC Soil + %5 Lime + 10% Fly Ash			CBR- BC Soil + %5 Lime + 20% Fly Ash		
Water Content	Dry Density	Water Content	Dry Density	Penetration	Load (Unsoaked)	Load (Soaked)	Penetration	Load (Unsoaked)	Load (Soaked)
19	1.625	18.34	1.63	0.5	20	12	0.5	24	15
23.61	1.657	21.25	1.685	5.0	116	84	5.0	132	96
28.57	1.69	25	1.75	10.0	132	96	10.0	152	115
33.33	1.63	29.165	1.68	15.0	140	102	15.0	158	120

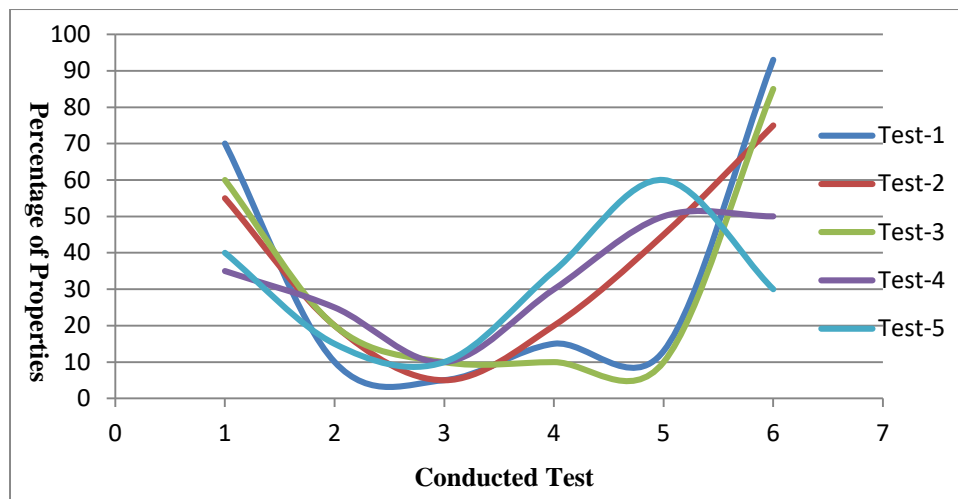


Fig.2: Lab test result of concrete

Index properties of soil have an essential part in choice of soil as a road construction material. Soils that experience huge volume changes with change in water substance might be troublesome if utilized for highway bases. The volume change can bring about knocks in road and break the structures, since the volume changes after some time may not and generally will not be equivalent. As far as possible, plastic breaking point might be utilized to foresee potential inconvenience in soil because of volume changes.

VII. CONCLUSION

The expansion in CBR (California Bearing Ratio) and dry density is most extreme for 20% fly ash mixture with black cotton soil, lime concrete, coarse, aggregates and sand. Black cotton soil of low or medium plasticity can be utilized for base courses by balancing out with fly ash, lime concrete, coarse, aggregates and sand because of change in its versatility attributes. So as level of Fly Ash is expanded the fluid furthest reaches of black cotton soil diminishes, bringing about lessened swelling of soil. There is a requirement for giving the designing attributes of B.C. soil for road construction. Flexible pavement design technique including utilization of CBR strategy needs change because of high swelling attributes of Black cotton soil (BC soil). Rigid pavement construction can be utilized to bring out general economy in Black cotton soil (BC soil) territories. Utilization of lime-soil adjustment innovation has an awesome potential in Black cotton soil (BC soil) zones. Some mechanical properties of clayey sands were explored and the conduct of these materials was communicated in a simple mathematical equations in view of test comes about on soil tests gave from the Peelamedu, Coimbatore, Tamilnadu, India. These capacities are pertinent for materials that have the same or close degrees to those, which were utilized as a part of

this investigation. As indicated by the results, it is noticeable that concrete mix was can use in wetland of BC soil land and for maintenance of road constructions.

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Controller Design of Automatic Guided Vehicle for Path-Following Using Input-Output Feedback Linearization Method

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Abstract— In this paper, the controller design for path-following using input-output feedback linearization method for the automatic guided vehicle with uncertainties and external disturbances is proposed. The dynamic model of the system with uncertainties and external disturbances is presented. An auxiliary control input vector is designed using input-output linearization technique. The auxiliary control input vector transforms the overall system into two linearized subsystems of the position control subsystem and velocity control subsystem. Based on the two linearized subsystems, a new control law vector for path-following is designed. The new control input vector for path-following guarantees that the tracking errors vector converges exponentially to zero. In addition, a scheme of measuring the errors for experiment by a USB camera is also described. The simulation and experimental results are presented to illustrate effectiveness of the proposed controller.

Keywords—Automatic Guided Vehicle (AGV), Input-Output Feedback Linearization (IOFL), Path-Following Controller (PFC).

I. INTRODUCTION

Generally, AGV have been used extensively in several industrial and service fields such as transportation, military, security, space, household, office automation and scientific laboratory systems.

Recently, many research results of AGV have been implemented via feedback linearization. In most researches, AGV was considered as a mobile robot. The control problems of a mobile robot include trajectory tracking, to control the robot to follow a desired trajectory starting from a given initial configuration, and point stabilization, to drive a robot from a given initial point to target point. Point stabilization of mobile robot via state-space exact feedback linearization based on dynamic extension approach was proposed in [1]. The objective of this controller is to stabilize a mobile robot at a given target point in the polar coordinate. In [2, 3], feedback linearization technique was also used for trajectory tracking and point stabilization of mobile robot systems.

All the above controllers show that they have a good performances and the tracking errors to go to zero in both case but consider only the kinematic model.

Many control schemes have been proposed to deal with the mobile robot control problem including the mechanical system dynamic. In [4], Kalman-based active observer controller (AOB) was applied to the path following. It guarantees the overall system's stability even in the presence of uncertainties. The performance of the proposed control algorithm is verified via simulation results but consider only in discrete model. Jeon et al. [5] also proposed the feedback linearization controller based on dynamic model for lattice type welding with seam tracking sensor that shows a good results in simulation but did not consider uncertainties and external disturbances. Control of welding mobile robot or mobile robot for tracking trajectory considering uncertainties and external disturbances using sliding mode control with good tracking performance are presented in [6]-[9].

This paper proposed the path-following controller design method using input-output feedback linearization technique for the automatic guided vehicle with uncertainties and external disturbances. The dynamic model of the system with uncertainties and external disturbances is presented. An auxiliary control input vector is designed using input-output linearization technique. The auxiliary control input vector transforms the overall system into two linearized subsystems of the position control subsystem and velocity control subsystem. Based on the two linearized subsystems, a new control input vector for path-following is designed. The new control input vector for path-following guarantees that the tracking errors vector converges exponentially to zero. In addition, a scheme of measuring the errors for experiment by a USB camera is also described. The simulation and experimental results are presented to illustrate effectiveness of the proposed controller.

II. SYSTEM DESCRIPTION AND MODELING OF AGV

1. System description

Fig. 1 shows configuration of the AGV. It consists of frame, two driving wheels, two passive casters, one rotation wheel, control system and USB camera etc. Fig. 2 shows the configuration for geometric model of the AGV. The two driving wheels are independently driven by two dc motors to achieve a desired motion and orientation. The two driving wheels have the same radius denoted by r and are separated by $2b$. The center of mass of the AGV is located at C ; point P is the intersection of a straight line passing through the middle of the vehicle and an axis of the two driving wheels and is rotation center of AGV. The distance between the two points is denoted by d . The body length of the AGV is l . P_a is a tracking point attached to the platform with coordinates (x_a, y_a) and is placed in the X_0 axis at a distance L_a (look-ahead distance) of P . A USB camera is located at the tracking point P_a . The posture of the AGV in the global coordinate frame OXY is specified by the vector $\mathbf{q} = [x_p, y_p, \phi]^T$ where x_p and y_p are the coordinate of point P in the global coordinate frame and ϕ is the orientation of the local frame PX_0Y_0 attached on the AGV platform. The AGV is modeled under the assumptions in [5, 6].

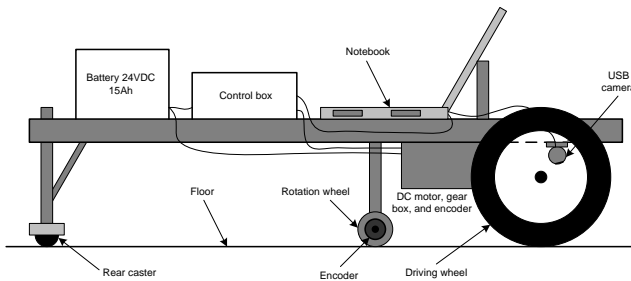


Fig. 1: Configuration of the AGV

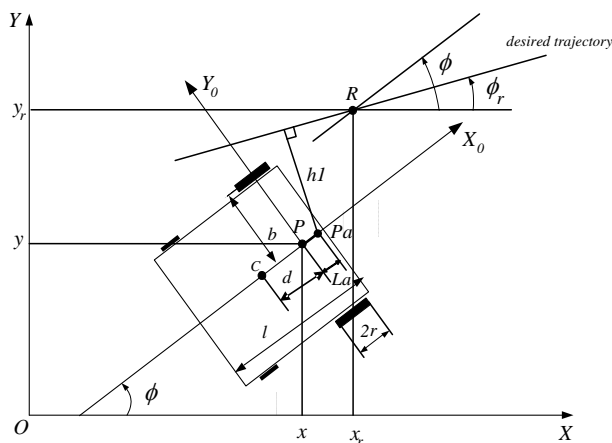


Fig. 2: Configuration for geometric model of the AGV

2. Kinematic Modeling

Consider a robot mobile system having an n -dimensional configuration space with a generalized coordinate vector $\mathbf{q} \in \mathcal{R}^{n \times 1}$ and the robot is subjected to m independent constraints of the following form [4]-[6]:

$$\mathbf{A}(\mathbf{q})\dot{\mathbf{q}} = \mathbf{0} \quad (1)$$

where $\mathbf{A}(\mathbf{q}) \in \mathcal{R}^{m \times n}$ is a full rank matrix associated with the nonholonomic constraints.

$\mathbf{S}(\mathbf{q}) \in \mathcal{R}^{n \times (n-m)}$ is defined to be a full rank matrix formed by a set of smooth and linearly independent vector fields, spanning the null space of $\mathbf{A}(\mathbf{q})$. Thus, the result of multiplication of these matrices can be written as follows:

$$\mathbf{A}(\mathbf{q})\mathbf{S}(\mathbf{q}) = \mathbf{0} \quad (2)$$

Supposing pure rolling conditions with no slip of the wheels, the following kinematics constraints ($m = 3$) can be written:

$$\dot{x}_p \sin \phi - \dot{y}_p \cos \phi = 0 \quad (3)$$

$$\dot{x}_p \cos \phi + \dot{y}_p \sin \phi + b\dot{\phi} = r\dot{\theta}_{rw} \quad (4)$$

$$\dot{x}_p \cos \phi + \dot{y}_p \sin \phi - b\dot{\phi} = r\dot{\theta}_{lw} \quad (5)$$

From Eqs. (3)-(5), the constraint matrix in Eq. (1) can be obtained as

$$\mathbf{A}(\mathbf{q}) = \begin{bmatrix} \sin \phi & -\cos \phi & 0 & 0 & 0 \\ \cos \phi & \sin \phi & b & -r & 0 \\ \cos \phi & \sin \phi & -b & 0 & -r \end{bmatrix} \quad (6)$$

and $\mathbf{q} = [x_p, y_p, \phi, \theta_{rw}, \theta_{lw}]^T$ denote configuration of the system ($n = 5$).

The null space matrix $\mathbf{S}(\mathbf{q})$ of $\mathbf{A}(\mathbf{q})$ that satisfies Eq. (2) is

$$\mathbf{S}(\mathbf{q}) = \begin{bmatrix} cb \cos \phi & cb \cos \phi \\ cb \sin \phi & cb \sin \phi \\ c & -c \\ 1 & 0 \\ 0 & 1 \end{bmatrix} \quad (7)$$

where the constant $c = (r / 2b)$.

From the constraint Eq. (1), $\dot{\mathbf{q}}$ must be in the null space of $\mathbf{A}(\mathbf{q})$. It follows that $\dot{\mathbf{q}} \in \text{span} \{ \mathbf{s}_1(\mathbf{q}), \mathbf{s}_2(\mathbf{q}) \}$, and that there exists a smooth angular velocity vector $\mathbf{z} = [\omega_{rw}, \omega_{lw}]^T = [\dot{\theta}_{rw}, \dot{\theta}_{lw}]^T \in \mathcal{R}^{(n-m) \times 1}$ such that

$$\dot{\mathbf{q}} = \mathbf{S}(\mathbf{q})\mathbf{z}(t) \quad (8)$$

where ω_{rw}, ω_{lw} are angular velocities of the right and the left wheels, respectively.

3. Dynamic Modeling

Lagrange equations of motion for the nonholonomic mobile robot system are given by

$$\frac{d}{dt} \left(\frac{\partial L}{\partial \dot{q}_k} \right) - \frac{\partial L}{\partial q_k} = f_k - \sum_{j=1}^m \lambda_j a_{jk} \quad (9)$$

where λ_j are Lagrange multipliers associated with j^{th} ($j=1, \dots, 3$) constraint equation, a_{jk} is k^{th} ($k=1, \dots, 5$) coefficient of k^{th} constraint equation, q_k is generalized coordinate, f_k is generalized force, and L is a Lagrangian. Lagrangian is defined as:

$$L = \frac{m_c}{2} (\dot{x}_p^2 + \dot{y}_p^2) + \frac{m_w}{2} (\dot{x}_{rw}^2 + \dot{y}_{rw}^2) + \frac{m_w}{2} (\dot{x}_{lw}^2 + \dot{y}_{lw}^2) + \frac{(I_c + m_c d^2)}{2} \dot{\phi}^2 + 2 \frac{I_m}{2} \dot{\phi}^2 + \frac{I_w}{2} \dot{\theta}_{rw}^2 + \frac{I_w}{2} \dot{\theta}_{lw}^2 \quad (10)$$

where m_c is the mass of the robot platform and m_w is the mass of each driving wheel plus the rotor of its motor; I_c is the inertia of the robot platform about a vertical axis through the center of mass C ; I_w is the inertia of each wheel with the motor's rotor about the wheel axis; and I_m is the inertia about a defined axis in the plan of the wheel (perpendicular to the wheel axis); $(\dot{x}_{rw}, \dot{y}_{rw})$ and $(\dot{x}_{lw}, \dot{y}_{lw})$ are linear velocities of right wheel and left wheel in x and y axes, respectively.

Defining $I = I_c + 2I_m + 2m_w b^2 + m_c d^2$ and $m = m_c + 2m_w$, Eq. (10) can be rewritten as:

$$L = \frac{m}{2} (\dot{x}_p^2 + \dot{y}_p^2) + \frac{I}{2} \dot{\phi}^2 + \frac{I_w}{2} (\dot{\theta}_{rw}^2 + \dot{\theta}_{lw}^2) \quad (11)$$

According to Eqs. (6), (9) and (11), the dynamic model is written as:

$$\begin{aligned} m\ddot{x}_p &= -\lambda_1 \sin \phi - (\lambda_2 + \lambda_3) \cos \phi \\ m\ddot{y}_p &= \lambda_1 \cos \phi - (\lambda_2 + \lambda_3) \sin \phi \\ I\ddot{\phi} &= -(\lambda_2 - \lambda_3)b \\ I_w \ddot{\theta}_{rw} &= \tau_{rw} + \lambda_2 r \\ I_w \ddot{\theta}_{lw} &= \tau_{lw} + \lambda_3 r \end{aligned} \quad (12)$$

where $\lambda_1, \lambda_2, \lambda_3$ are Lagrange multipliers which can effectively be eliminated by the below procedure. τ_{rw} and τ_{lw} are the torques of the right and left wheels, respectively.

The equations in Eq. (12) can be expressed in matrix form, such as:

$$\mathbf{M}(\mathbf{q})\ddot{\mathbf{q}} + \mathbf{C}(\mathbf{q}, \dot{\mathbf{q}})\dot{\mathbf{q}} = \mathbf{D}(\mathbf{q})\boldsymbol{\tau} - \mathbf{A}^T(\mathbf{q})\boldsymbol{\lambda} \quad (13)$$

$$\text{where } \mathbf{M}(\mathbf{q}) = \begin{bmatrix} m & 0 & 0 & 0 & 0 \\ 0 & m & 0 & 0 & 0 \\ 0 & 0 & I & 0 & 0 \\ 0 & 0 & 0 & I_w & 0 \\ 0 & 0 & 0 & 0 & I_w \end{bmatrix},$$

$$\mathbf{C}(\mathbf{q}, \dot{\mathbf{q}}) = \mathbf{O}_{5 \times 5}, \quad \mathbf{D}(\mathbf{q}) = \begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ 1 & 0 \\ 0 & 1 \end{bmatrix}, \quad \boldsymbol{\tau} = \begin{bmatrix} \tau_{rw} \\ \tau_{lw} \end{bmatrix}.$$

$\mathbf{M}(\mathbf{q}) \in \mathfrak{R}^{n \times n}$ is the inertia matrix; $\mathbf{C}(\mathbf{q}, \dot{\mathbf{q}}) \in \mathfrak{R}^{n \times n}$ is the centripetal and Coriolis forces matrix; $\mathbf{D}(\mathbf{q}) \in \mathfrak{R}^{n \times (n-m)}$ is the input transformation matrix; $\mathbf{A}^T(\mathbf{q}) \in \mathfrak{R}^{n \times m}$ is a matrix of nonholonomic constraints; $\boldsymbol{\tau} \in \mathfrak{R}^{(n-m) \times 1}$ is the control input vector; $\boldsymbol{\lambda} \in \mathfrak{R}^{m \times 1}$ is the vector of constraint forces.

4. State Space Realization

Differentiating Eq. (8) with respect to t , substituting in Eq. (13), multiplying the both sides of the equation by \mathbf{S}^T and noticing that $(\mathbf{S}^T \mathbf{A}^T)\boldsymbol{\lambda} = 0$ from Eq. (2) and $\mathbf{S}^T \mathbf{D} = \mathbf{I}_{(n-m) \times (n-m)}$, the following form can be obtained:

$$\mathbf{S}^T \mathbf{M} \mathbf{S} \dot{\mathbf{z}} + \mathbf{S}^T (\mathbf{M} \dot{\mathbf{S}} + \mathbf{C} \mathbf{S}) \mathbf{z} = \boldsymbol{\tau} \quad (14)$$

The real dynamic equation of AGV with the external disturbance can be derived from Eq. (14)

$$\begin{aligned} \mathbf{S}^T \mathbf{M} \mathbf{S} \dot{\mathbf{z}} + \mathbf{S}^T (\mathbf{M} \dot{\mathbf{S}} + \mathbf{C} \mathbf{S}) \mathbf{z} + \boldsymbol{\tau}_d &= \boldsymbol{\tau} \\ \Leftrightarrow \bar{\mathbf{M}} \dot{\mathbf{z}} + \bar{\mathbf{C}} \mathbf{z} + \boldsymbol{\tau}_d &= \boldsymbol{\tau} \end{aligned} \quad (15)$$

where $\bar{\mathbf{M}} = \mathbf{S}^T \mathbf{M} \mathbf{S} \in \mathfrak{R}^{(n-m) \times (n-m)}$,

$$\bar{\mathbf{C}} = \mathbf{S}^T (\mathbf{M} \dot{\mathbf{S}} + \mathbf{C} \mathbf{S}) \in \mathfrak{R}^{(n-m) \times (n-m)}.$$

It is assumed that the disturbance vector can be expressed as a multiplier of matrix $\bar{\mathbf{M}}$ as follows [6]:

$$\boldsymbol{\tau}_d = \bar{\mathbf{M}} \mathbf{f}_d \in \mathfrak{R}^{(n-m) \times 1}, \quad \mathbf{f}_d \in \mathfrak{R}^{(n-m) \times 1}. \quad (16)$$

$$\mathbf{f}_d = [f_{1d} \ f_{2d}]^T, \quad |f_{1d}| \leq f_{1d}^m, \quad |f_{2d}| \leq f_{2d}^m. \quad (17)$$

where f_{1d}^m and f_{2d}^m are upper bounds of disturbances.

The state variable vector is defined as

$$\begin{aligned} \mathbf{x} = [\mathbf{q} \quad \mathbf{z}]^T &\in \mathfrak{R}^{(2n-m) \times 1} \\ &= [x_p \ y_p \ \phi \ \theta_{rw} \ \theta_{lw} \ \omega_{rw} \ \omega_{lw}]^T \end{aligned} \quad (18)$$

Based on Eqs. (8), (15), (16) and (18), the dynamic system of AGV can be expressed in the following state-space form:

$$\dot{\mathbf{x}} = \begin{bmatrix} \dot{\mathbf{q}} \\ \dot{\mathbf{z}} \end{bmatrix} = \begin{bmatrix} \mathbf{S} \mathbf{z} \\ \mathbf{f}_2 \end{bmatrix} + \begin{bmatrix} \mathbf{0}_{n \times (n-m)} \\ \bar{\mathbf{M}}^{-1} \end{bmatrix} \boldsymbol{\tau} + \begin{bmatrix} \mathbf{0}_{n \times 1} \\ -\mathbf{f}_d \end{bmatrix} \quad (19)$$

where $\mathbf{f}_2 = -\bar{\mathbf{M}} \bar{\mathbf{C}} \mathbf{z} \in \mathfrak{R}^{(n-m) \times 1}$.

Assuming that the number of system inputs $r \geq (n-m)$, and that $\bar{\mathbf{M}}^{-1}$ has rank $(n-m)$, the following control input vector can be obtained.

$$\boldsymbol{\tau} = \bar{\mathbf{M}}[\mathbf{u} - \mathbf{f}_2 + \mathbf{f}_d] \quad (20)$$

where $\mathbf{u} \equiv \dot{\mathbf{z}} \in \mathfrak{R}^{(n-m) \times 1}$ is an auxiliary control input vector.

From Eq. (20), Eq. (19) can be rewritten to the form

$$\dot{\mathbf{x}} = \begin{bmatrix} \mathbf{S}(\mathbf{q})\mathbf{z} \\ \mathbf{0}_{(n-m) \times 1} \end{bmatrix} + \begin{bmatrix} \mathbf{0}_{n \times (n-m)} \\ \mathbf{I}_{(n-m) \times (n-m)} \end{bmatrix} \mathbf{u} = \mathbf{f}(\mathbf{x}) + \mathbf{g}(\mathbf{x})\mathbf{u} \quad (21)$$

where $\mathbf{f}(\mathbf{x}) = \begin{bmatrix} \mathbf{S}(\mathbf{q})\mathbf{z} \\ \mathbf{0}_{(n-m) \times 1} \end{bmatrix} \in \mathfrak{R}^{(2n-m) \times 1}$,

$$\mathbf{g}(\mathbf{x}) = \begin{bmatrix} \mathbf{0}_{n \times (n-m)} \\ \mathbf{I}_{(n-m) \times (n-m)} \end{bmatrix} \in \mathfrak{R}^{(2n-m) \times (n-m)}.$$

III. CONTROLLER DESIGN FOR PATH-FOLLOWING USING INPUT-OUTPUT FEEDBACK LINEARIZATION METHOD

Consider the following MIMO (multi-input/multi-output) nonlinear system.

$$\dot{\mathbf{x}} = \mathbf{f}(\mathbf{x}) + \mathbf{g}(\mathbf{x})\mathbf{u} \quad (22)$$

$$\mathbf{y} = \mathbf{h}(\mathbf{x}) \quad (23)$$

where $\mathbf{x} \in \mathfrak{R}^{(2n-m) \times 1}$ is the state vector, $\mathbf{u} \in \mathfrak{R}^{(n-m) \times 1}$ is auxiliary control input vector, $\mathbf{y} \in \mathfrak{R}^{(n-m) \times 1}$ is the output vector. $\mathbf{f}(\mathbf{x}) \in \mathfrak{R}^{(2n-m) \times 1}$ and $\mathbf{g}(\mathbf{x}) \in \mathfrak{R}^{(2n-m) \times (n-m)}$ are smooth vector fields, and $\mathbf{h}(\mathbf{x}) \in \mathfrak{R}^{(n-m) \times 1}$ are smooth functions on the state space.

The objective of this part is to design a path-following controller that allows the AGV to follow a desired path in the Cartesian space starting from a given initial configuration with a desired linear velocity.

Let the output equation be represented by a vector \mathbf{y} as follows:

$$\mathbf{y} = [y_1 \quad y_2]^T = [h_1(\mathbf{q}) \quad h_2(\mathbf{z})]^T \quad (24)$$

where $h_1(\mathbf{q})$ is the shortest distance from the tracking point P_a on the AGV platform to the desired path, $h_2(\mathbf{z})$ is linear velocity v_p of point P of AGV along the X_0 axis.

In case of a straight line described by $Ax + By + C = 0$, the output equations are given as follows:

$$y_1(\mathbf{q}) = h_1(x_a, y_a, \phi) = \left| \frac{Ax_a + By_a + C}{\sqrt{A^2 + B^2}} \right| \quad (25)$$

and $y_2 = h_2(\mathbf{z}) = \dot{x}_p \cos \phi + \dot{y}_p \sin \phi$

$$= \frac{r}{2}(\omega_{rw} + \omega_{lw}) = v_p \quad (26)$$

where (x_a, y_a) is the coordinates of the point P_a ; (x_p, y_p, ϕ) is related to the state variables by the following equations.

$$x_a = x_p + L_a \cos \phi \quad (27)$$

$$y_a = y_p + L_a \sin \phi$$

Now, a path-following controller can be designed based on the feedback linearization technique. To get the decoupling matrix for feedback linearization of the above output equations, the output equations are differentiated until the input terms appear in the differentiated output equations as follows:

$$\dot{y}_1 = \frac{\partial h_1}{\partial \mathbf{q}} \dot{\mathbf{q}} = \mathbf{J}_{h1}(\mathbf{q})\mathbf{S}(\mathbf{q})\mathbf{z} \quad (28)$$

$$\ddot{y}_1 = \frac{\partial(\mathbf{J}_{h1}\mathbf{S})}{\partial \mathbf{q}} \dot{\mathbf{q}}\mathbf{z} + \mathbf{J}_{h1}(\mathbf{q})\mathbf{S}(\mathbf{q})\dot{\mathbf{z}}$$

$$\Leftrightarrow \ddot{y}_1 = \frac{\partial(\mathbf{J}_{h1}\mathbf{S})}{\partial \mathbf{q}} \dot{\mathbf{q}}\mathbf{z} + \mathbf{J}_{h1}(\mathbf{q})\mathbf{S}(\mathbf{q})\mathbf{u} \quad (29)$$

$$\dot{y}_2 = \mathbf{J}_{h2}(\mathbf{z})\dot{\mathbf{z}} = \mathbf{J}_{h2}(\mathbf{z})\mathbf{u} \quad (30)$$

where $\mathbf{J}_{h1}(\mathbf{q}) = \frac{\partial h_1}{\partial \mathbf{q}} \in \mathfrak{R}^{1 \times n}$ and $\mathbf{J}_{h2}(\mathbf{z}) = \frac{\partial h_2}{\partial \mathbf{z}} \in \mathfrak{R}^{1 \times (n-m)}$ are

Jacobian matrices.

So the decoupling matrix Φ_d for the above equations is given as follows:

$$\Phi_d \equiv \begin{bmatrix} \Phi_{d1}(\mathbf{q}) \\ \Phi_{d2}(\mathbf{z}) \end{bmatrix} \equiv \begin{bmatrix} \mathbf{J}_{h1}(\mathbf{q})\mathbf{S}(\mathbf{q}) \\ \mathbf{J}_{h2}(\mathbf{z}) \end{bmatrix} \in \mathfrak{R}^{2 \times (n-m)} \quad (31)$$

where the Jacobian matrices in Eq. (31) for the straight line are calculated from Eqs. (25) and (26) as follows:

$$\mathbf{J}_{h1}(\mathbf{q}) = \frac{\partial h_1}{\partial \mathbf{q}} = \frac{1}{\sqrt{A^2 + B^2}} \begin{bmatrix} A \\ B \\ BL_a \cos \phi - AL_a \sin \phi \\ 0 \\ 0 \end{bmatrix}^T \quad (32)$$

$$\text{and } \mathbf{J}_{h2}(\mathbf{z}) = \frac{\partial h_2}{\partial \mathbf{z}} = \begin{bmatrix} r & r \\ 2 & 2 \end{bmatrix} \quad (33)$$

The necessary and sufficient condition for the system Eq. (22) to be input-output linearized form and to be controllable is that the determinant of the following decoupling matrix Eq. (31) is not zero, $\det(\Phi_d) \neq 0$ [8].

$$\det(\Phi_d) = \frac{r^2 L_a}{2b} \times \frac{(B \cos \phi - A \sin \phi)}{\sqrt{A^2 + B^2}} \quad (34)$$

where Φ_d is singular if the X_0 axis is perpendicular to the straight line.

From Eqs. (29)-(31), the decoupling matrix is used to establish the input-output feedback linearization as shown below,

$$\ddot{\mathbf{y}} = \begin{bmatrix} \ddot{y}_1 \\ \ddot{y}_2 \end{bmatrix} = \dot{\Phi}_d \mathbf{z} + \Phi_d \mathbf{u} \quad (35)$$

where $\dot{\Phi}_d = \begin{bmatrix} \frac{\partial(\mathbf{J}_{h1}\mathbf{S})}{\partial \mathbf{q}} \dot{\mathbf{q}} \\ \frac{\partial(\mathbf{J}_{h2})}{\partial \mathbf{z}} \dot{\mathbf{z}} \end{bmatrix} = \begin{bmatrix} \frac{\partial(\mathbf{J}_{h1}\mathbf{S})}{\partial \mathbf{q}} \dot{\mathbf{q}} \\ \mathbf{0} \end{bmatrix} \in \mathbb{R}^{2 \times (n-m)}$

Assuming that the condition $\det(\Phi_d) \neq 0$ is satisfied and the transformation of state variables is a diffeomorphism, the auxiliary control input vector for achieving input-output linearization is given by

$$\mathbf{u} = \Phi_d^{-1} [\boldsymbol{\eta} - \dot{\Phi}_d \mathbf{z}] \quad (36)$$

where \mathbf{z} is the vector of wheels velocities; $\boldsymbol{\eta} \in \mathbb{R}^{2 \times 1}$ is defined as a new control input vector in the following form.

$$\boldsymbol{\eta} = \begin{bmatrix} \eta_1 \\ \eta_2 \end{bmatrix} = \begin{bmatrix} k_p e_p + k_D \dot{e}_p + \dot{r}_d^1 \\ k_v e_v + \dot{r}_d^2 \end{bmatrix} \quad (37)$$

where a tracking error vector with the position and linear velocity errors is defined as follows:

$$\mathbf{e} = \begin{bmatrix} e_p \\ e_v \end{bmatrix} = \begin{bmatrix} r_d^1 - y_1 \\ r_d^2 - y_2 \end{bmatrix} \quad (38)$$

and k_p, k_D, k_v are gains chosen to ensure the exponential convergence of the control errors to zero; r_d^1, r_d^2 are reference shortest distance and reference linear velocity, respectively.

The new control input vector $\boldsymbol{\eta}$ with $k_p, k_D, k_v > 0$ makes the tracking error vector go to zero.

Substituting the auxiliary control input vector Eq. (36) into Eq. (35), a closed loop system can be obtained in the following two decoupled linearized form:

$$\begin{cases} \ddot{y}_1 = \eta_1 \\ \dot{y}_2 = \eta_2 \end{cases} \text{ or } \ddot{\mathbf{y}} = \boldsymbol{\eta} \quad (39)$$

Eq. (39) are single input-single output systems with second-order of position control model and first-order of velocity control model.

From Eqs. (37)-(39), the tracking error dynamics of the closed loop systems are given by

$$\ddot{e}_p + k_D \dot{e}_p + k_p e_p = 0 \quad (40)$$

$$\dot{e}_v + k_v e_v = 0 \quad (41)$$

which are exponentially stable [9].

The path-following control scheme is presented in Fig. 3. In Fig. 3, \mathbf{r}_d represents the desired values for the outputs,

h_1 and h_2 . \mathbf{e} is the error vector between the actual and the desired values. The control input vector Eq. (20) is applied so that the AGV dynamics state equation (19) is simplified into the form Eq. (21). This process is represented by the dotted block in Fig. 3. An auxiliary control input vector Eq. (36) designed with input-output linearization technique linearizes and decouples the overall system into two decoupled linearized subsystems, the position control subsystem and the velocity control subsystem as shown Eq. (39). The thick dashed block in Fig. 3 represents the global system plant with input-output linearization. The new control input vector Eq. (37) makes the tracking error vector go to zero.

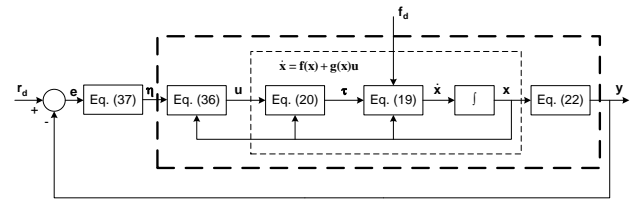


Fig. 3: Scheme of the control algorithm

IV. ERROR MEASUREMENT AND HARDWARE

1. Measurement of tracking error using camera

To achieve the controller, the errors have to be detected. The reference path is a straight line as a desired trajectory marked on a floor. A camera is mounted in front of the AGV to capture directly an image of the tracking line. The errors detecting scheme is shown in Fig. 4.

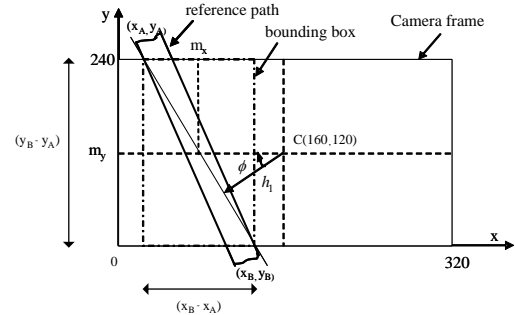


Fig. 4: Errors detecting scheme

The errors can be expressed by

$$\begin{cases} \phi = \arctan[(x_A - x_B) / (y_A - y_B)] \\ h_1 = (160 - m_x) \cos \phi \end{cases} \quad (42)$$

2. Hardware and Control System

The configuration diagram of the total control system is shown in Fig. 5. The control system is based on the integration of notebook and PIC-based controller. The hardware of the system is composed of two-level control: the image processing control as high level computer control and the device control as low level microcontroller control. High-level image processing control algorithms are written in VC++ and run with a sampling time of 15 ms on the notebook (a Pentium IV-

2GHz processor). The notebook communicates with the PIC-based controller on the AGV through a COM port. For the operation, QuickCam SDK is used to capture the image stream into memory in bitmap format with size 320pixel×240pixel via a USB camera at speed of 30 frames per seconds. The image is processed by VC++ program to extract the parameters of bounding box, center and direction of line. These parameters are used to determine orientation angle and shortest distance as errors detecting scheme in Fig. 4. The input-output feedback linearization controller is designed to calculate the demand velocity of wheels. These demand torques are sent to the PIC-based controller to control the AGV motion. The tracked desired trajectory is shown on the computer interface of image processing in Visual C++ as shown in Fig. 6.

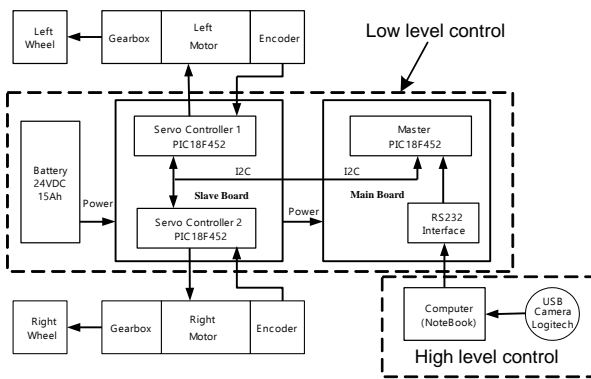


Fig. 5: The configuration of control system

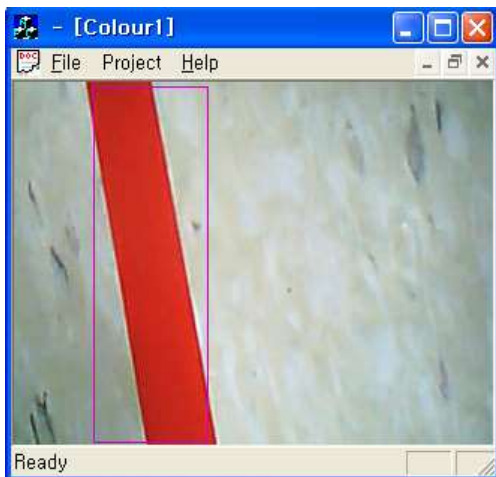


Fig. 6: The tracked desired trajectory

The configuration of the PIC-based controllers for the low level control is shown in Fig. 7. It consists of microcontrollers PIC18F452's which are operated with the clock frequency 40MHz. The microcontroller performs three basis tasks: 1) communicating with the higher-level controller through RS232; 2) reading number of pulses from encoders; and 3) generating PWM duty

cycle. The low level controller is composed of two parts: master controller and slave controller. The master controller functions as the low level control, that is, to receive demand velocities from the computer via RS232 and, in turn, to send the commands to the two slave controllers via I2C communication, respectively. The slave controller integrates two PIC18F452's with two motor drivers LMD18200 for the DC motor control. The sampling time of low level control system is about 10ms. The experimental AGV developed for this paper is shown in Fig. 8.

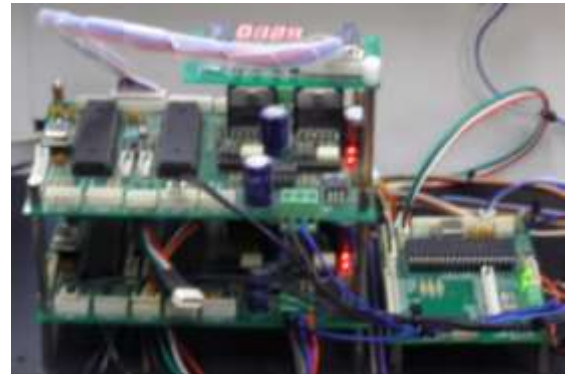


Fig. 7: The configuration of the PIC-based controllers



Fig. 8: The experimental AGV

V. SIMULATION AND EXPERIMENTAL RESULTS

To verify the effectiveness of the proposed controller, simulations have been done for a AGV following a straight line. Fig. 9 shows that the desired trajectory is the straight line of 2.82 [m]. The straight line has the form of $y=x$. So the factors are $A=1, B=-1, C=0$. The desired linear velocity of AGV is $v_d^2 = 0.05 [m/s]$. The gains for the new control input vector are $k_p = 3.6 [s^{-2}]$, $k_D = 1.4 [s^{-1}]$, $k_v = 4.2 [s^{-1}]$. The input external disturbances are chosen to be random noises of mean 0 with variance 0.7, and the upper bounds of disturbances are assumed as $f_{1d}^m = 1 [rad/s^2]$ and $f_{2d}^m = 1 [rad/s^2]$. The numerical parameter values and the innital values for

simulation and experiment are given in Table 1 and Table 2.

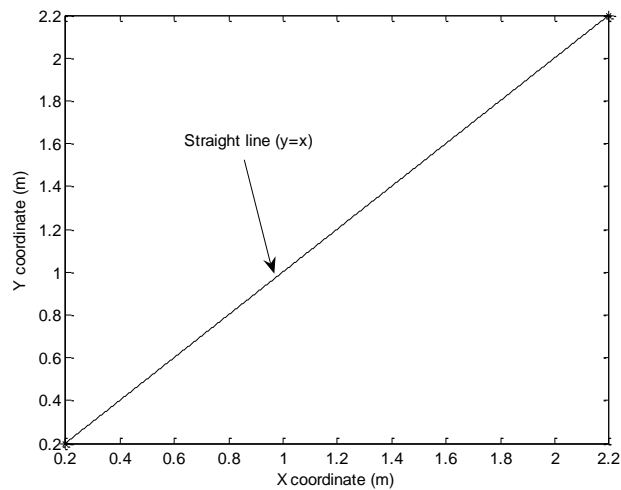


Fig. 9: The desired trajectory

Table. 1: The numerical parameters values for simulation and experiment

Parameters	Values	Units
b	0.39	[m]
r	0.16	[m]
d	0.45	[m]
l	1.2	[m]
m_c	32.67	[kg]
m_w	2.75	[kg]
I_c	17.85	[kgm ²]
I_w	0.0135	[kgm ²]
I_m	0.0068	[kgm ²]

Table. 2: The initial values for simulation and experiment

x_r	0.2 [m]	x_p	0.32 [m]
y_r	0.2 [m]	y_p	0.24 [m]
ϕ_r	45 [deg]	ϕ	30 [deg]
v_p	0 [m/s]	Reference inputs	$r_d^1 = 0$ [m], $r_d^2 = 0.05$ [m/s]
L_a	0.06 [m]	Sampling time	$\Delta T = 0.01$ [s]

The simulation and experimental results for path-following are shown in Figs. 10 to 17. Figs. 10 and 11 show the movement of the AGV along the desired trajectory for full time 40 seconds and the beginning time. As shown in Fig. 12, the tracking point P_a of the AGV is able to reach the straight line path and stay on the path for full time. Fig. 13 shows that the linear velocity of the AGV is at the vicinity of 0.05 [m/s] as desired. The

experimental position error e_p and the experimental linear velocity error e_v converge to zero and are bounded along the simulation result as shown in Figs. 14 and 15. The angular velocities of left and right wheel are shown in Fig. 16. It shows that the angular velocities of left and right wheels change quickly at the beginning time and have same value about 0.32 [rad/s] for following the straight line from about 7 seconds. Fig. 17 shows the control input vector τ . They change greatly at the beginning time. However, they are bounded within the bounds of ± 7.6 [N.m] and their average value converges to zero when AGV moves along the desired trajectory after 4 seconds. The above simulation and experimental results are presented to illustrate the effectiveness of the proposed control algorithm.

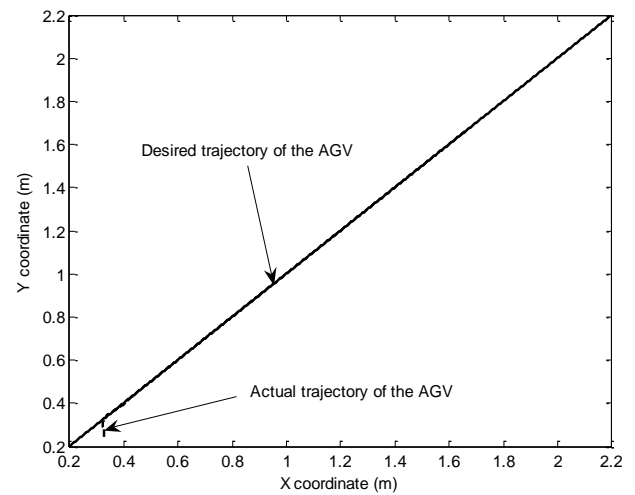


Fig. 10: Movement of AGV for full time

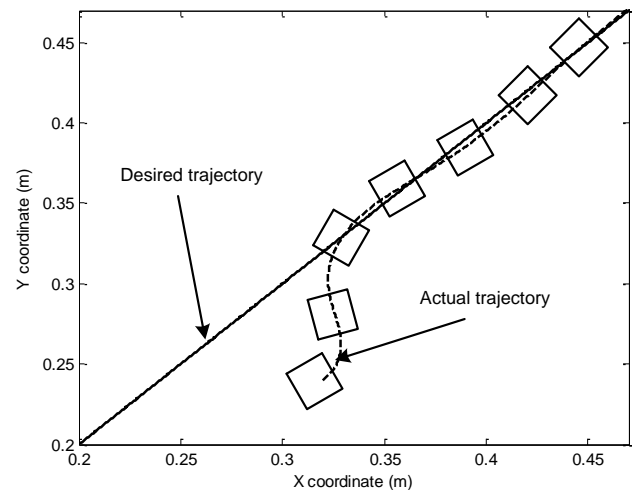


Fig. 11: Movement of AGV at the beginning time

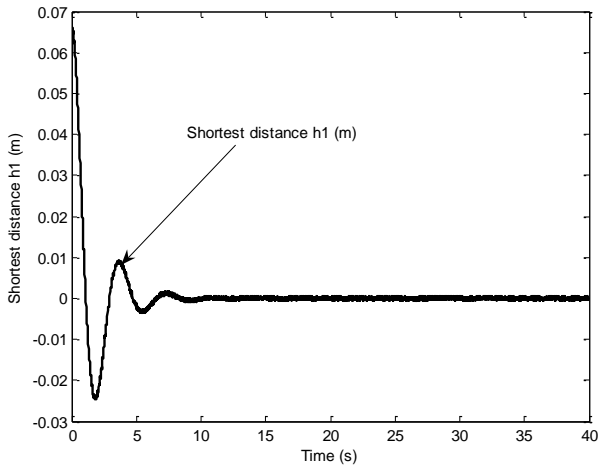


Fig. 12: Shortest distance h_1

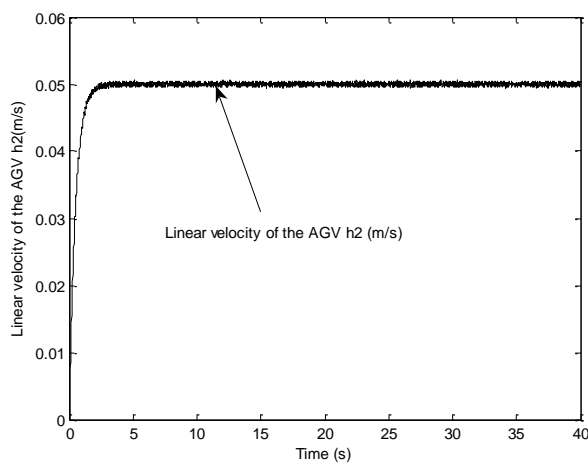


Fig. 13: Linear velocity of the AGV for full time

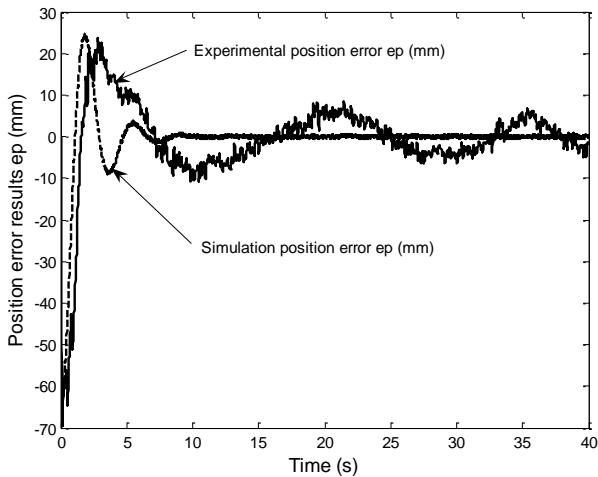


Fig. 14: Simulation and experimental position error results e_p

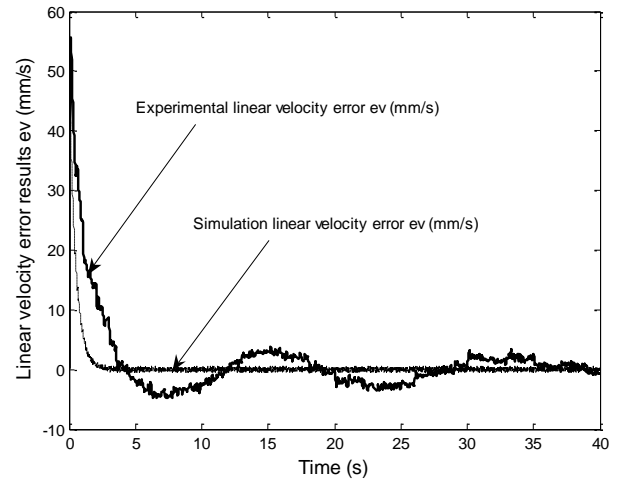


Fig. 15: Simulation and experimental linear velocity error results e_v

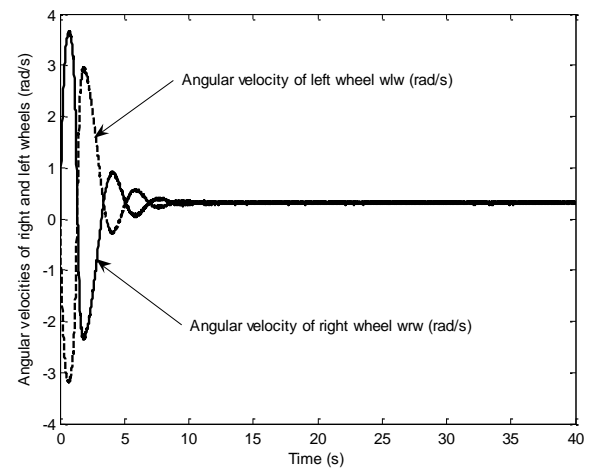


Fig. 16: Angular velocities of the right and left wheels

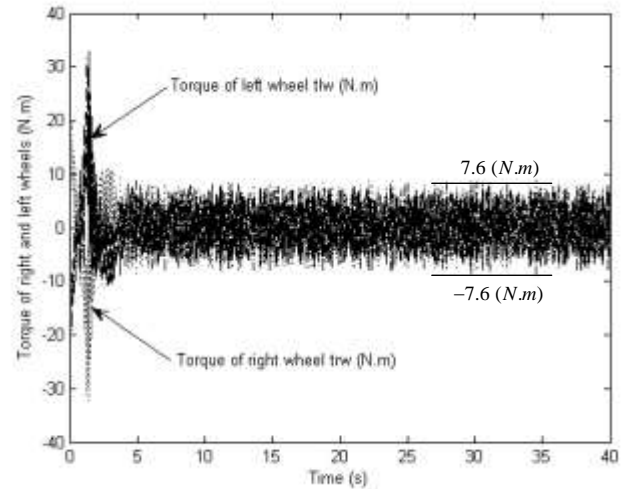


Fig. 17: Control input vector τ

VI. CONCLUSION

In this paper, a path-following controller is proposed based on the dynamic model of AGV under uncertainties and external disturbances using input-output feedback linearization method. Using the input-output feedback

linearization technique, two decoupled linearized SISO system are obtained: a second-order position model, and a first-order velocity model. A new control input vector is chosen to make the tracking error vector go exponentially to zero. To implement the proposed controller, a control system is developed based on PIC microcontroller and USB camera. The simulation and experimental results are presented to illustrate the good applicability to AGV of the proposed control algorithm.

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An algorithm for three-dimensional indoor positioning based on Bayesian inference, Fingerprinting method and Wi-Fi technology

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Abstract—Wireless indoor positioning systems have been shown to be very useful in many applications and have been the subject of a considerable amount of research, mainly concerning the two-dimensional (2D) case. However, in many practical situations it is necessary to determine the three-dimensional (3D) coordinates of an object or user. In this paper, a hybrid algorithm for implementation in a 3D indoor positioning system is proposed. This algorithm is implemented by using a fingerprinting technique based on both the k-means and naive Bayes methods, and uses the received signal strength (RSS) as an input parameter. In addition, a comparison of the main algorithms discussed in previous research papers and the proposed algorithm is presented. Indoor positioning experiments were conducted in a typical building with two floors (180m²) and four access points (APs).

The proposed algorithm exhibited a better performance than that of other algorithms, with a mean error around 1.80m.

Keywords—3D Indoor positioning, Fingerprint, Naive Bayes, k-means, Cost 231 multi-wal.

I. INTRODUCTION

Technological development has made the location of both people and objects in outdoor environments possible by means of tools such as the Global Positioning System (GPS). However, these tools are not efficient for handling indoor locations because the variability of these environments is high as compared that of outdoor environments. This is because the variability depends not only on the antenna's characteristics, but also on the type of construction and internal structures, such as the walls, floors, and partitions walls.

Because of the numerous applications of indoor positioning systems (IPS), including utilization in emergency systems, localization of mobile robots, and navigation assistance in malls, schools, university campuses, airports, and hospitals, several studies have

been conducted on location estimation in this type of environment.

A survey of the main implementation techniques shows that they can be classified into three typical location estimation schemes: triangulation, scene analysis (fingerprinting technique), and proximity. These schemes are discussed in [1] and [2], whereas in [3] and [4] the application of artificial neural networks (ANNs) to the problem was proposed. The k-nearest neighbours (k-NN) algorithm and the Bayes method were addressed in [5], [6], [7], [8] and [9].

In this paper, we propose a three-dimensional (3D) solution to this problem through a hybrid algorithm. This algorithm is implemented by using a fingerprint technique based on both the k-means and naive Bayes methods, and uses the received signal strength (RSS) as an input parameter. Furthermore, we compare the proposed method with the ANN multilayer perceptron (MLP) and radial basis function (RBF) algorithms, as well as with the k-NN and Bayes (histogram and kernel) methods and the method of triangulation (lateration), which is one of the most commonly used methods in the context of outdoor locations.

The experiments were conducted in two distinct scenarios, both in a typical build with a total area of 180m² (first floor 131m² and second floor 49m²) and four APs. In the first scenario, actual measurements were performed and the RSS values obtained in pre-defined regions. In the second scenario, the signal behavior was simulated from the Cost 231 multi-wall (MWM) model. The rest of this paper is structured as follows: Section II presents an overview of the main techniques and technologies related to indoor positioning, proposed algorithms are discussed in section III, section IV presents the main discussions and computational results and finally, section V summarizes the results and presents suggestions for future work.

II. INDOOR POSITIONING SYSTEMS

2.1 METHODS FOR INDOOR POSITIONING SYSTEM

In literature, the indoor positioning system can be classified into three main categories: triangulation (method based on geometric properties), fingerprint (signal data collection or pattern recognition technique) and proximity. A comparison of these methods is presented in [1].

2.1.1 TRIANGULATION

The Triangulation method uses geometric properties of triangles to estimate the target location [1] and [2]. This method is classified into two categories:

- **Lateralation:** estimates user location by calculating the distance between the mobile unit and a set of APs with known coordinates. For a 3D positioning, it is necessary at least four APs. Centered on each of the APs, a sphere with radius r , being the location of the user defined by the intersection of such spheres. Figure 1 shows this concept.

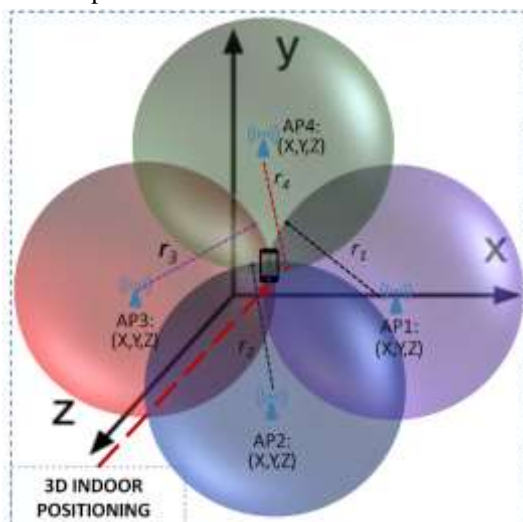


Fig. 1: Indoor Positioning System Based on Lateralation

- **Angulation:** The location of the target can be estimated by the intersection of several pairs of lines with respect to the direction of the angles, each formed by the circular radius from a set of APs. Figure 2 shows this concept.

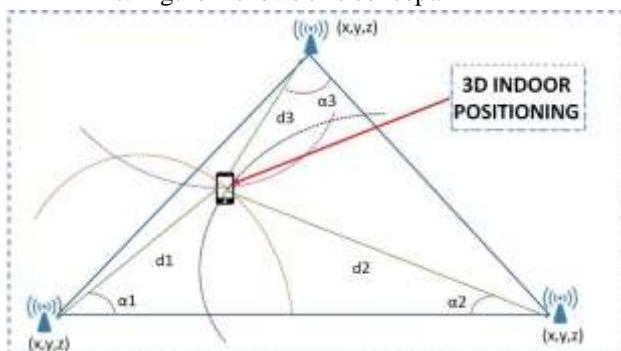


Fig. 2: Indoor Positioning System Based on Angulation

The most common methods used to estimate distance in the triangulation method are [1]:

- **Time of Arrival (TOA):** The distance between the mobile unit and the unit of measurement is directly proportional to the propagation time. For 3D positioning, TOA measurements must be performed in relation to the signals of at least four APs.
- **Time Difference of Arrival (TDOA):** It consists of a variation of the TOA, however, the estimation of the mobile unit is obtained from multiple measurements in order to obtain the difference between the arrival times of the signal to the receiver.
- **Received Signal Strength (RSS):** This technique is based on attenuation of the signal between multiple transmitters and the receiver. The estimation of the difference between transmitted and received RSS is determined through empirical and theoretical propagation models. Some of these models are discussed in [10].

A comparison of the methods in question, including parameters such as cost and accuracy, is presented in [11].

2.1.2 FINGERPRINT

Fingerprint is a technique based on pattern recognition and involves the division of the location system into two phases, offline and online phases. In the offline phase, the vectors of received signal strength are collected the of all the detected Wi-Fi signals from different access points at many known locations (reference points) [8]. The online phase consists of reading an RSS value, and by using a classification algorithm, this RSS value is compared with the values stored in the database during the offline phase, thus obtaining the location. The Figure 3 summarizes this procedure.

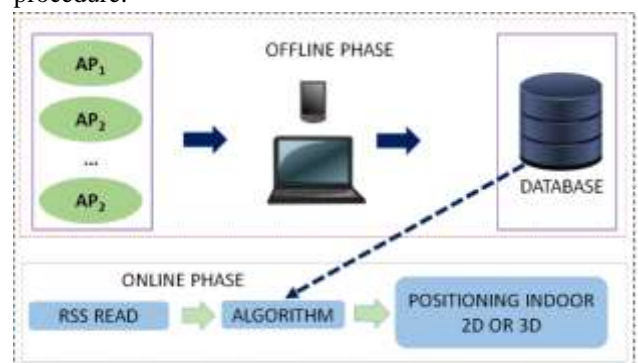


Fig. 3: Indoor Positioning System Based on Fingerprint

2.1.3 PROXIMITY

Among the three methods for indoor location, the proximity method is considered the simplest. Location systems based on this method do not provide a coordinate as a user location estimate. In this case, the indoor

position is given sectorally, that is, the system returns the room in which the user can be at a given time. Technologies used by this method include radio frequency identification and Bluetooth [1].

2.2 TECHNOLOGIES FOR INDOOR POSITIONING

2.2.1 Radio Frequency Identification - RFID

It consists of a technology that uses radio waves to identify people or objects. Identification can be obtained by reading information stored in a tag attached to an object. Some works that use this technology include [13], [14] and [15].

2.2.2 Wi-Fi

It is a technology that uses radiofrequency to transmit data from devices based on one of the 802.11 standards developed by the IEEE. These devices include for example: Notebooks, cell phones, cameras and TV's, which makes this technology more suitable for implementing an IPS [16].

2.2.3 Bluetooth

It is often classified as a wireless personal area networks (PANs) technology, with transmission power and range much smaller than a Wi-Fi network, occupying a limited space around the user (usually 10 meters). It is used to connect wireless devices within a short distance, such as: Cellular phones, TV's, notebooks and stereos. For more detailed discussions on the application of this technology to the problem in question, see [17], [18], [19], [20] and [21].

III. PROPOSED SOLUTION AND GENERAL DESCRIPTION OF THE SYSTEM

3.1 METHODS FOR INDOOR POSITIONING SYSTEM

The proposed algorithm is based on Bayesian inference and use the fingerprint technique as the basic structure for estimating the location. The algorithm consists of a combination of the k-means and the naive Bayes, a simplified version of the Bayes theorem discussed in the subsection 3.3. The Bayes theorem is given by [22]:

$$P(x_i|y) = \frac{P(y|x_i)P(x_i)}{\sum_{k=1}^N P(y|x_k)P(x_k)} \quad (1)$$

The central idea of the proposed method is to determine the most probable position of the target based on the RSS vector measured in relation to all n APs. This procedure is performed through the following rule:

Let $\mathcal{S}_1, \mathcal{S}_2, \dots, \mathcal{S}_N$ be a collection of subsets, called sectors or rooms, where each is a candidate for target location and consists of n RP's where $\bigcap_{i=1}^N \mathcal{S}_i = \emptyset$ and $\bigcup_{i=1}^N \mathcal{S}_i = \mathcal{A}$, represents the indoor space for the set of sectors and $\mathbf{s} = \{RSS_1, RSS_2, \dots, RSS_N\}$ the RSS vector observed during the online phase. Select \mathcal{S}_i , if

$P(\mathcal{S}_i|\mathbf{s}) > P(\mathcal{S}_j|\mathbf{s})$, for $i, j = 1, 2, \dots, N$ and $i \neq j$. This results in the following model:

$$P(\mathcal{S}_i|\mathbf{s}) = \frac{P(\mathbf{s}|\mathcal{S}_i)P(\mathcal{S}_i)}{\sum_{t=1}^N P(\mathbf{s}|\mathcal{S}_t)P(\mathcal{S}_t)} \quad (2)$$

When the sector that represents maximum probability is selected, the 3D location of the target is defined from the centroid of the RP's belonging to the sector in question.

3.2 ESTIMATION OF THE LIKELIHOOD FUNCTION

Let $\mathbf{x} = \{x_1, x_2, \dots, x_N\}$ an RSS sample obtained from an unknown probability distribution with density $f_X(x)$, in the off-line phase of the location system, our objective is to estimate the density in question. There are several methods for this estimate. The most common are presented below:

- Histogram: this method subdivides the space of $f_X(x)$ with support $[0,1]$ in n bins of (Sectors of \mathcal{A}) equal sizes, given by:

$$B_1 = [0, \frac{1}{n}], B_2 = [\frac{1}{n}, \frac{2}{n}], \dots, B_N = [\frac{n-1}{n}, 1] \quad (3)$$

To estimate $P(\mathbf{s}|\mathcal{S}_i)$, we obtain the frequency distribution of the signals in the environment. The goal is to check the frequency of each RSS interval for all locations.

- Density estimation Kernel (EDK): In probability and statistics, EDK, is a non-parametric method for estimating a probability density function $f_X(x)$ given by: [9].

$$f_X(x) = \frac{1}{nh} \sum_{i=1}^N K\left(\frac{x - X_i}{h}\right) \quad (4)$$

Where η is the sample size. h is a non-negative data smoothing parameter called bandwidth. Similar to the histogram method, the kernel estimation establishes a function for representing the probability distribution, with the difference that the data is not to be allocated in discrete regions (bins), instead a continuous function is defined. $K(\bullet)$ is the kernel function in which:

$$\int_{\mathbb{R}} K_X(x) dx = 1 \quad (5)$$

A widely used function in this case is the Gaussian kernel [9]. Thus, the estimate for the term $P(\mathbf{s}|\mathcal{S}_i)$, can be modeled through a normal distribution is given by:

$$f_X(x) = \frac{1}{N} \sum_{i=1}^N \frac{1}{h\sqrt{2\pi}} \exp\left[-\frac{1}{2}\left(\frac{RSS - RSS_i}{h}\right)^2\right] \quad (6)$$

3.3 PROPOSED SOLUTION (KMEANS-BAYES)

The implementation of an IPS through this algorithm divides the off-line phase into two steps. The first step starts with reading the RSS vectors in n RP's with predetermined 3D positions that make up the vector r . For each RP, measurements are taken for all APs. In addition, these measurements are performed at different heights and with the mobile device directed to the north, south, east and west. This results in the following matrix:

$$A = \begin{pmatrix} RP_1(z_1) & RP_2(z_1) & \dots & RP_N(z_1) \\ RP_1(z_2) & RP_2(z_2) & \dots & RP_N(z_2) \\ \vdots & \vdots & \dots & \vdots \\ RP_1(z_N) & RP_2(z_N) & \dots & RP_N(z_N) \end{pmatrix} \quad (7)$$

This procedure aims to make the database robust, thus maximizing the accuracy of the algorithm. When all measurements are completed, in the second step, the k -means algorithm partitions the indoor space into P clusters that represent the sectors in which the RP's will be allocated. For each of the clusters a set of centroids with Cartesian coordinates randomly chosen in the first iteration is defined. From the second iteration, the centroids are obtained based on the mean coordinate of the RP's. In addition, a value for P is defined. Then, the distance between each RP and the centroids is calculated by assigning each RP to the cluster that has the nearest centroid. This procedure is repeated until there is no RP change between the clusters.

This procedure is performed by minimizing an objective function, called the squared error function, which is defined as

$$J = \sum_{j=1}^{\mathfrak{P}} \sum_{i=1}^N \|r_i - c_j\|^2 \quad (8)$$

Where $\|r_i - c_j\|$ is a 3D measure of the distance between each reference points and the centroid. In general, Euclidean distance is applied in (8). This, together with other measures of similarity, including Mahalanobis, Minkowski, and cosine distances, are discussed in [23].

When the clustering process is completed, there have the following configuration:

- Each RP has a definite 3D coordinate $P = (x,y,z)$ and an RSS vector related to this coordinate.
- are assigned probabilities for each of the clusters, according to the knowledge of the frequency of users in each of these clusters or evenly, that is, considering that $P(\mathfrak{P}_i), i = 1, \dots, N$ are equiprobable. After this procedure, the offline phase is complete.

In the online phase the vector $s = \{RSS_1, RSS_2, \dots, RSS_N\}$ is read and the target position is estimated based on equation (2), resulting in:

$$P(\mathfrak{P}_i|s) = \frac{P(s|\mathfrak{P}_i)P(\mathfrak{P}_i)}{P(s)} = \frac{P(RSS_1, RSS_2, \dots, RSS_N|\mathfrak{P}_i)P(\mathfrak{P}_i)}{P(s)} \quad (9)$$

Using the general multiplication rule [24] in (9), results in:

$$P(RSS_1, RSS_2, \dots, RSS_N|\mathfrak{P}_i) = P(RSS_1|RSS_2, \dots, RSS_N, \mathfrak{P}_i) \times P(RSS_2|RSS_3, \dots, RSS_N, \mathfrak{P}_i), \dots, \times P(RSS_{N-1}|RSS_N, L_i).P(RSS_N|\mathfrak{P}_i) \quad (10)$$

In order to reduce the computational cost of system incurred by equation (9) when it is necessary to acquire a large volume of data, we will consider that that the probability of each attribute of vector s are independent of each other given the locations. This means that $P(RSS_1, RSS_2, \dots, RSS_N|\mathfrak{P}_i)$ can be simplified:

$$\prod_{i=1}^N P(s|\mathfrak{P}_i) \quad (11)$$

Thus, the target position given s is simplified to:

$$P(\mathfrak{P}_i|s) \propto P(\mathfrak{P}_i, RSS_1, \dots, RSS_N) \propto \mathfrak{P}_i \times P(RSS_1, \dots, RSS_N|\mathfrak{P}_i) \propto P(\mathfrak{P}_i) \times P(RSS_1|\mathfrak{P}_i) \times \dots \times P(RSS_N|\mathfrak{P}_i) \propto P(\mathfrak{P}_i) \prod_{i=1}^N P(s|\mathfrak{P}_i) \quad (12)$$

Algorithm 1 Hybrid algorithm: k -means and naive Bayes for three-dimensional indoor positioning in wireless local area networks

Input: $r = \{RP_1, RP_2, \dots, RP_N\} \in \mathbb{R}^3$ that represents the vector of reference points.
 Number of clusters \mathfrak{P} representing the number of sectors.
 A signal vector $s = \{RSS_1, RSS_2, \dots, RSS_N\}$.

Output: A 3D position from the centroid coordinate of the RP's.

- 1: Define a set of centroids $c_1, c_2, \dots, c_{\mathfrak{P}}$. Define a set of centroids with random coordinates for each cluster.
- 2: **repeat**
- 3: Calculate distances between the RP's and the centroids using equation (8) and assign each point to the cluster with the closest centroid.
- 4: Recompute the centroid of each cluster based on the coordinates of the RP's.
- 5: **until** converged (there is no movement of data between the clusters)
- 6: **for** $i=1$ to N **do**
- 7: Compute $P(\mathfrak{P}_i|s)$ based on equation (10).
- 8: **end for**
- 9: Allocate the target to the cluster that results in the maximum probability.
- 10: Get the RP's centroid.
- 11: Return 3D positioning based on the coordinates obtained in step 10.

Equation (12) is a simplified version of the Bayes theorem, known as the Naive Bayes. More details on this classifier can be obtained in [22]. After the cluster that result in maximum probability has been identified, the target position is estimated from the centroid coordinate of the RP's. Algorithm 1 and figure 4 summarize the proposed method.

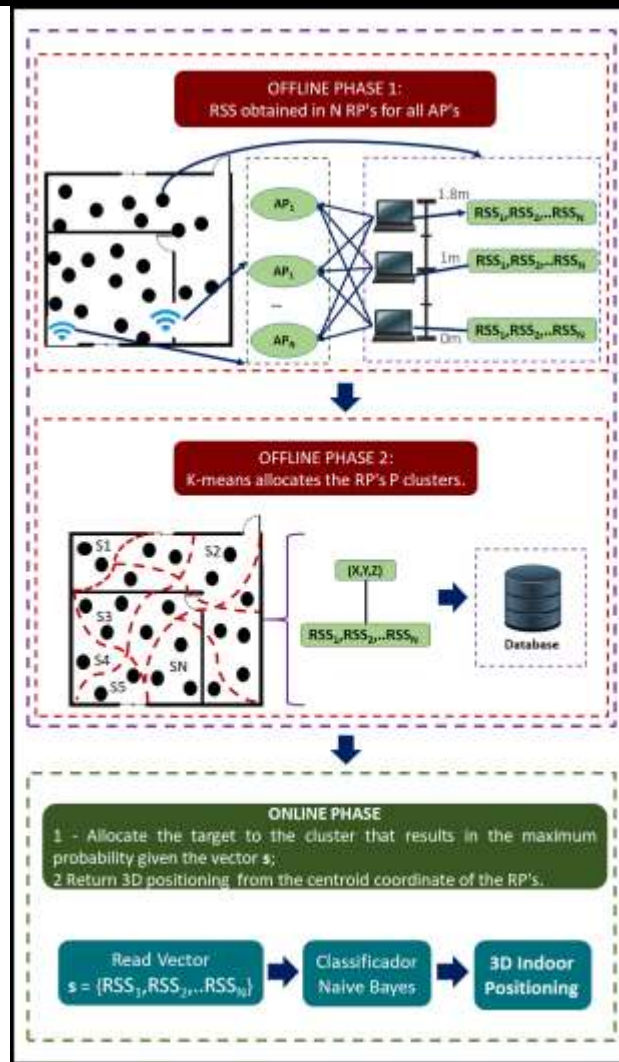


Fig. 4: IPS K Means-Bayes based on fingerprint method

IV. EXPERIMENTAL RESULTS AND DISCUSSION

4.1 INTRODUCTION

The experiments were conducted in two distinct scenarios, both in a typical build with a total area of 180m² (first floor 131m² and second floor 49m²) and four APs. In the first scenario, actual measurements were performed and the RSS values obtained in pre-defined

regions. Figure 5 shows the floor plan with for the two floors used in experiments. In order to make the developed IPS more realistic, all experiments were performed in the environment with people performing their normal activities.



Fig. 5: Floor Plan used in experiments and simulations

In the second scenario, the same build was considered, taking into account all the characteristics of this environment (for example, the quantity, position and transmit power of the Aps), with the difference that in the scenario in question no real measurements were. Instead, the Cost 231 multi-wall model (MWM) was used to simulate the behavior of the signal in this residence. This model considers the signal attenuation as the loss in free space added to the loss resulting from the numbers of walls and floors penetrated between the transmitter (Tx) and receiver (Rx). The model in question is given by [10].

$$L = L_{LF} + L_c + \sum_{i=1}^I k_{wi} L_{wi} + k_f \frac{k_f - 2}{k_f - 1} L_f \quad (13)$$

where

- L_{FS} = free space loss between transmitter and receiver;
- L_c = constant loss;
- k_{wi} = number of penetrated walls of type;
- k_f = number of penetrated floors,
- L_{wi} = loss of wall type;
- L_f = loss between adjacent floors,
- b = empirical parameter;
- I = number of wall types.

The total loss related to the floors is a non-linear function of the number of penetrated floors [10]. This feature is taken into account by the introduction of an empirical factor b . For practical reasons, the number of distinct walls should be kept low because the difference between

the various wall types in relation to the attenuation is small and its meaning in the model is not clear [10]. The types of walls in question are displayed in the table 1 [10], while the typical values of L_{w1} , L_{w2} , L_f , and b are shown in the table 2 [10].

Table.1: Types of walls used in the Cost 231 MWM

Wall type	Description
Light wall (L_{w1})	A wall that is not bearing load: e.g. plasterboard, particle board or thin (<10 cm), light concrete wall.
Heavy wall (L_{w2})	A load-bearing wall or other thick (>10 cm) wall, made of e.g. concrete or brick.

Table.2: Values for L_{w1} , L_{w2} , L_f e b in dB

Environment	Multi-wall model (MWM)			
	L_{w1} [dB]	L_{w2} [dB]	L_f [dB]	b
Dense one floor two floors multi floor	3.4	6.9	18.3	0.46
Open	3.4	6.9	18.3	0.46 ⁹⁾
Large	3.4	6.9	18.3	0.46 ⁹⁾
Corridor	3.4	6.9	18.3	0.46 ⁹⁾

4.2 PARAMETERS OF ALGORITHMS

As algorithms for comparison, the main solutions addressed in the literature were chosen. The following parameters were used:

- Triangulation: Let $D = (x, y, z)$ be the coordinate representing the location of the target, given by

the intersection of four spheres centered on four APs with known coordinates given by (x_1, y_1, z_1) , (x_2, y_2, z_2) , (x_3, y_3, z_3) and (x_4, y_4, z_4) whose distances to the target are given by d_i^2 with $i = 1, 2, \dots, 4$, estimated by the attenuation of RSS, we obtain the location of the target from the following relation:

$$\begin{cases} (x - x_1)^2 + (y - y_1)^2 + (z - z_1)^2 = d_1^2 \\ (x - x_2)^2 + (y - y_2)^2 + (z - z_2)^2 = d_2^2 \\ (x - x_3)^2 + (y - y_3)^2 + (z - z_3)^2 = d_3^2 \\ (x - x_4)^2 + (y - y_4)^2 + (z - z_4)^2 = d_4^2 \end{cases} \quad (14)$$

- KNN: For this algorithm, we considered the value of $k = 2$ and 3 . Where k represents the number of nearest neighbors. In addition, Euclidean distance was used as a measure of similarity;
- Artificial neural networks (MLP and RBF):

Table.3: Parameters Adopted for the Neural Networks

Parameters	Value
Number of neurons in the input layer	20
Number of neurons in the output layer	3
Number of neurons in the hidden layer	50,100,150 200,250 e 300
Number of hidden layers	2 MLP e 1 RBF
Activation Function	Sigmoide
Training algorithm	Backpropagation
Learning rate	0,04
Number of iteration	5000

Probabilistic Model (Pure version of Bayes theorem): In

this case, the IPS was developed through equation (2). using the histogram and kernel based versions. The kernel method was modeled by a distribution by a normal distribution, according to equation (6).

4.3 RESULTS OF SCENARIO I

For this scenario, it was considered 150 RP's distributed in the two floors. For each PR, 300 RSS values were collected, according to the following rule: Notebook with heights of 0.2m; 1.0m and 1.80m. In each height, 25 measurements were performed with a notebook with the Notebook facing toward the north, east, south, and west directions. The Vistumbler software [25] was used to acquire RSS.

After reading the RSS in all RPs, an experiment was conducted to verify the variation of the signal in the environment. At a fixed point (15.2.0.7 and 5.72m), for a period of 300s the signal strength Signal strength was observed with respect to the four APs. The results are shown in the figure 6. Note that even from a fixed position, the fluctuations in the signal level reaches 10 dB, which is the expected variability for indoor environments.

With respect to the performance of the algorithms, the method of lateration when compared with others was not efficient. This is an expected result, since methods based on traditional outdoor location are not suitable for indoor environments, which have a much greater variability [11]. The system implemented with this method showed a mean error e_m of 2.23m from the actual location with precision of 68 % and 80.1% relative to absolute maximum error e_a of 1.5 and 3.5m respectively.

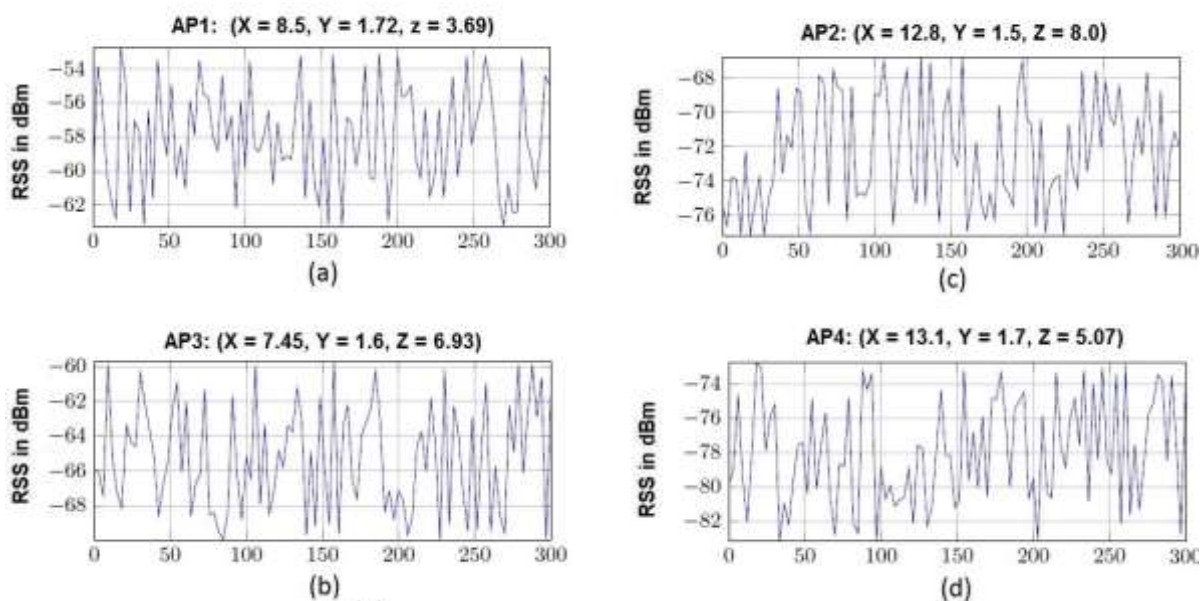


Fig. 6: Variations of RSS values from four APs in a fixed point

Table.4: Statistics of positioning estimates

ALGORITHM	ϵ_a (%) $\leq 1.5m$	ϵ_a (%) $\leq 3.5m$	ϵ_a (%) $\leq 5.5m$	ϵ_a (%) $\leq 7.5m$
Lateralation	68,2	80,1	87,8	95,1
kNN = 2	75,8	88	94,8	98,9
kNN = 3	76,1	88,7	95,3	99,1
RNA - MLP	76,2	89	95,8	99,3
RNA - RBF	76,65	89,6	96,5	99,4
HISTOGRAM	76,9	90,8	98	100
KERNEL	77,2	91,2	98,6	100
PROPOSED METHOD	77,9	93,1	98,9	100

Table.5: Statistics of positioning estimates (average, coefficient of variation, Q1, Q2, and Q3 quartiles in meters)

ALGORITHM	ϵ_m	C_v	Q1	Q2	Q3
Lateralation	2.235	59.70%	1.36	1.73	2.57
kNN = 2	1.919	45.22%	1.33	1.66	1.93
kNN = 3	1.916	44.16%	1.33	1.66	1.91
RNA - MLP	1.905	43.15%	1.33	1.66	1.90
RNA - RBF	1.883	41.89%	1.33	1.65	1.88
HISTOGRAM	1.843	37.97%	1.32	1.65	1.86
KERNEL	1.832	36.80%	1.32	1.65	1.84
PROPOSED METHOD	1.803	35.06%	1.32	1.64	1.81

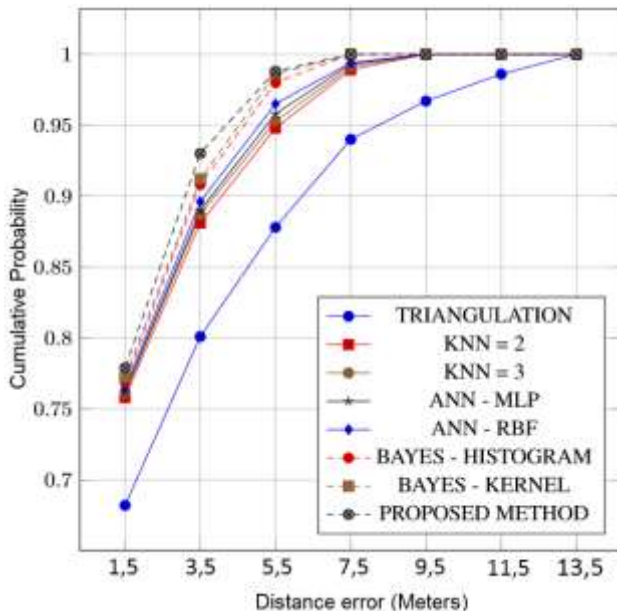


Fig. 7: Error in meters - cumulative

4.4 RESULTS OF SCENARIO II

In this scenario, equation (13) was used to simulate the signal behavior in the environment. In addition to the

estimation of the RSS attenuation applied to the lateration method, this simulation includes the estimation of the vectors RSS in each PR. It was observed that in the scenario in question, the lateration method presented performance superior to that implemented in scenario I. This better performance can be explained by the smaller variation in the signal compared to scenario I, because although the propagation model used in this work is considered more complete with respect to the others, in order to include the losses from the various obstacles, can not accurately represent the signal fluctuations in the various types of indoors environments. Even with better performance in this scenario, the lateration method was less accurate than the others, presenting e_m of 2.0m, against the most similar algorithm in terms of performance (kNN with $k = 2$) that it obtained e_m of 1.92m. In relation to the other algorithms, there were no significant differences in performance (Algorithms based on the fingerprint method, are less influenced by the variation of RSS in the environment). The proposed method presented e_m equal to 1.786m. The results are summarized in the tables 6, 7 and in the figure 8.

Table.6: Statistics of positioning estimates (average, coefficient of variation, Q1, Q2, and Q3 quartiles in meters)

ALGORITHM	ϵ_a (%) $\leq 1.5m$	ϵ_a (%) $\leq 3.5m$	ϵ_a (%) $\leq 5.5m$	ϵ_a (%) $\leq 7.5m$
Lateralation	72,9	87,4	93,70	97,8
kNN = 2	76	88,1	95	99
kNN = 3	76,05	88,5	94,98	99
RNA - MLP	76,5	88,7	95,55	99,7
RNA - RBF	76,66	89,5	96,3	99,8
HISTOGRAM	77	91	97,9	100
KERNEL	77,1	91,3	98,5	100
PROPOSED METHOD	79,1	93	98,8	100

Table.7: Statistics of positioning estimates (average, coefficient of variation, Q1, Q2, and Q3 quartiles in meters)

ALGORITHM	ϵ_m	C_v	Q1	Q2	Q3
Literation	2.002	51.60%	1.34	1.69	2.00
kNN = 2	1.924	44.89%	1.33	1.66	1.92
kNN = 3	1.908	44.92%	1.33	1.66	1.91
RNA - MLP	1.897	43.59%	1.33	1.66	1.92
RNA - RBF	1.880	42.38%	1.33	1.65	1.88
HISTOGRAM	1.841	38.13%	1.32	1.65	1.85
KERNEL	1.791	35.07%	1.31	1.63	2.00
PROPOSED METHOD	1.786	34.54%	1.31	1.63	2.00

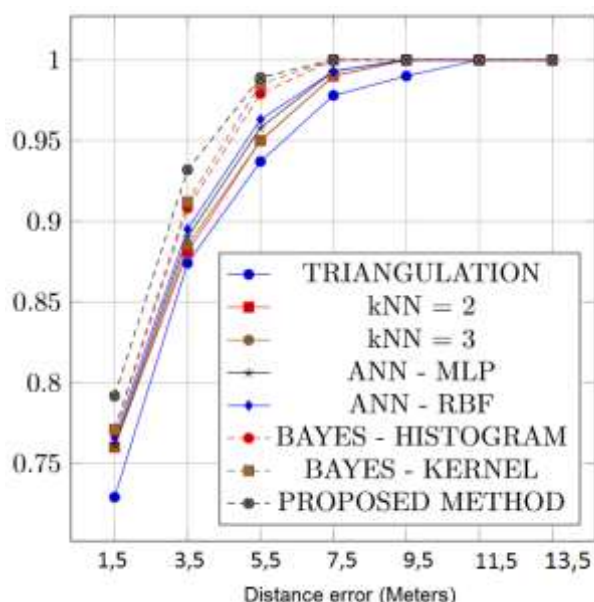


Fig..8: Error in meters – cumulative

V. CONCLUSION

In this paper, we propose a three-dimensional (3D) solution to this problem through a hybrid algorithm. In addition, a comparison was made with the main algorithms discussed in previous research papers, including with the lateration method, one of the most used in the outdoor context. With the exception of this method, all algorithms used a fingerprint recognition technique.

A lower variation in signal levels in Scenario II had a direct influence on the performance of the lateration method. In this scenario, the lateration obtained better performance than in scenario I (around 23cm in relation to ϵ_m). Even with better performance in this scenario, the lateration method was less accurate than the others, which also demonstrated better performance compared to scenario I, but not significantly. As discussed, indoors environments have high variability. IPS developed only

from simulations based on propagation models may not capture all the information regarding the signal variations in this type of environment and therefore, overestimate the results, as in the case of the lateration method implemented in this work.

The proposed algorithm exhibited a better performance than that of other algorithms, resulting $\epsilon_m = 1.80$ and 1789 for scenarios I and II respectively. Because the proposed algorithm is based on Bayesian inference, there is good integration with the fingerprint technique, this because it relates the current and past information efficiently, which results in good results in relation to the classification. However, one of the limitations of the techniques in question is related to the quality of the information, that is, a robust database is necessary for an IPS based in this algorithm to present good results.

As future work, we intend to develop the following solutions in order to maximize the precision of the location estimation:

- IPS based on angulation;
- Hybrid IPS based on triangulation and fingerprint;
- IPS based on multiple discriminant analysis.

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Study of Inelastic Behavior of Reticular Structures of Steel Bars - Phenomena of Plastification.

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Abstract — Technological advancement has increasingly helped solve engineering problems, but the designer who does not seek knowledge of the physical behavior of materials and mathematical techniques to solve them runs the risk of not being able to interpret the results provided by structural software. Computational techniques do not provide the exact solution of engineering problems, they provide approximations to the intervals where the solution of the differential equations governing the mechanics of the continuum are inserted. The engineer who does not know how to idealize the engineering problem in his mind will not be able to model the problem in the computer. One of the most intriguing and peculiar engineering problems is the plastification phenomenon of metallic objects.

Keywords— Steel Bars, physical behaviour of materials, plastification.

I. INTRODUCTION

Structural analyzes are made in first-order theory in which the equilibrium of the structure is studied in the undeformed position, and in second-order theory where equilibrium is studied in the displaced position. The stability of the structure can only be studied in second order theory. According to Chen (et. Al., 1996) in the study of the resistance and stability of structures it is necessary to do:

- Check the inelastic behavior of the materials;
- Check the flexibility of the connections;
- Check second order effects due to geometry change.

The consideration of physical and geometric nonlinearities are pre-requisites for the beginning of the understanding of the plastification effects of steel structures.

II. ANALYSIS TYPES

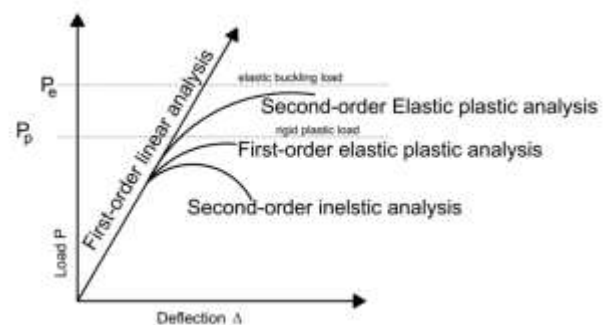


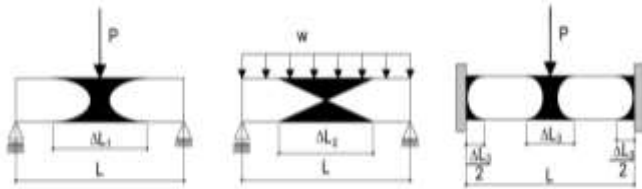
Fig.1: Load-displacement characteristics of general analysis types.

The types of structural analyses are the First and Second Order Elastic Analyses and First and Second Order Inelastic Analyses, as shown in the figure above.

In order to understand and delineate the plastification effects of steel structures, Chen (1) proposes the Advanced Structural Analysis, which consists of a technique that seeks to introduce into the behavioral models of the elements representative of the structure and its materials the closest hypotheses of reality and, together, sophisticated numerical and iterative procedures to estimate the non-linear behavior of these structures. In this way, the advanced analysis encompasses the nonlinear, physical and geometric analyzes in the studies of the structural systems and their members modeling the effects of plastification.

Three lines of thought for computational algorithms have studied the effects of second order as follows:

1. Second order inelastic analysis with formation of plastic hinge joints and fictitious loads National Loads Chen (et al., 1996);
2. Modified Plastic Hinge Joint Method - allows smooth degeneration of stiffness;
3. Distributed plasticity - sliced discretized bar where the inelasticity is modeled with the stress state at the center of the slice, Lavall 1996.



$$f = \text{shape factor} = \frac{M_p}{M_y} ; \Delta_{L1} = L \left(1 - \frac{1}{f}\right) ; \Delta_{L2} = L \sqrt{1 - \frac{1}{f}} ; \Delta_{L3} = \frac{L}{2} \left(1 - \frac{1}{f}\right)$$

Fig.2: Plastic-hinge lengths in beams with different boundary conditions and load CHEN et al. 1996.

III. ATTRIBUTES NECESSARY FOR THE STUDY OF PLATIFICATION - SECOND ORDER EFFECTS.

The study of plastification in steel elements should be done by accounting for second order effects, such as loss of physical capacity of steel sheets (inertia, area, thermal expansion, etc.), and changes in geometry due to the effects of forces. These changes during the action of forces must be inserted into the model. The following are the items that should be observed in the modeling:

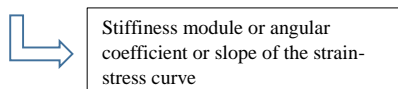
- Initial imperfections due to the curvature of the bars, frames and columns out of alignment, displacement of the bars.
- Residual tensions due to manufacturing and assembly processes - Welding action.
- Connection types: flexible, rigid, semi-rigid.
- Types of cross sections: symmetrical, non-symmetric, open or closed profile.
- Effects of loading: dynamic, variable, repetitive due to construction stages, etc.
- P-Δ moment: second-order moments due to axial force acting through displacements associated with member chord rotation.
- P-δ moment: second-order moments due to axial force acting through displacements associated with member curvature bending.

IV. FORMULATION

Engineering strains and stress:

$$\varepsilon = \lambda - l = \frac{l_c - l_r}{l_r} = \frac{\Delta l}{l_r} ; \sigma = \sigma_N = \frac{N}{A_r} \quad (1)$$

$$\sigma = \sigma(\varepsilon) \therefore D = \frac{d\sigma}{d\varepsilon} \quad (2)$$



Elastic phase: (load e unload);

$$(\sigma - \sigma_y) \leq 0 \therefore D = D^e = d\sigma/d\varepsilon \quad (3)$$

Plastic phase: (unload)

$$(\sigma - \sigma_y) > 0 \therefore D = D^e \quad (4)$$

(load)

$$D = D^{ep} \quad (5)$$

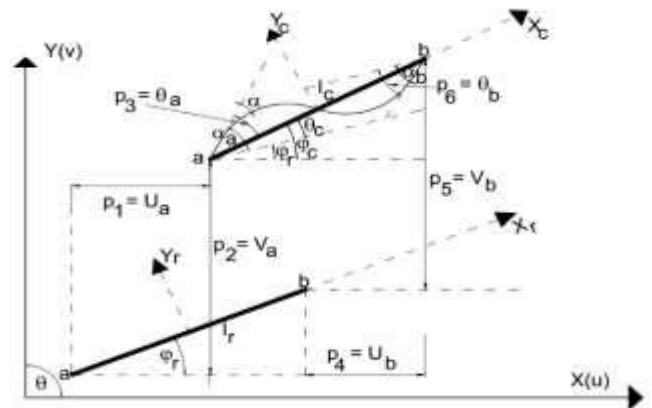


Fig.3: Coordinate system and degrees of freedom.

Corrotational local system:

$$q_\alpha = \{q_1 \quad q_2 \quad q_3\} \therefore q_1 = l_c - l_r ; \quad (6)$$

$$q_2 = \alpha_a ;$$

$$q_3 = \alpha_b$$

Cartesian degrees of freedom: global system

$$p_i = \{u_a \quad v_a \quad \theta_a \quad u_b \quad v_b \quad \theta_b\} \quad (7)$$

The structural theory used in this work is based on the hypothesis attributed to Bernoulli-Euler, which states that: "The cross-sections flat and orthogonal to the axis of the bar remain flat, indeformable and orthogonal to the axis after deformation." The displacements u_c and v_c of a section point in the corrotational system (x_c, y_c) are then determined by:

$$u_c(x, y) = \bar{u}_c(x) - y_r \text{sen} \alpha \quad \therefore \quad (8)$$

$$v_c(x, y) = \bar{v}_c(x) - y_r(1 - \text{cos} \alpha) \quad (9)$$

$$\varepsilon = (1 + \bar{u}_c) \text{sec} \alpha - 1 - y_r \alpha \quad (10)$$

Equilibrium Equations: PVW

$$P_i = Q_\alpha q_{\alpha i} \quad (11)$$

$$Q_\alpha = \int v_r \sigma \varepsilon_\alpha dV_r \quad (12)$$

$$\frac{\partial P}{\partial p} = K_t \quad \therefore \quad (13)$$

$$k_{i,j} = q_{\alpha,i} D_{\alpha,\beta} q_{\beta,j} + q_{\alpha,i} H_{\alpha,\beta} q_{\beta,j} + Q_{\alpha} q_{\alpha,ij} \quad (14)$$

$$D_{\alpha,\beta} = \int v_r \varepsilon_{\alpha} D \varepsilon_{\beta} dV_r \quad \therefore H_{\alpha,\beta} = \int v_r \sigma \varepsilon_{\alpha\beta} dV_r \quad (15)$$

Constitutive Stiffness Matrix: Physical and Geometric

$$K_M = B^T D B \quad \text{Physical part} \quad (16)$$

$$K_G = B^T H B + Q_{\alpha} G_{\alpha} \quad \text{Geometric part} \quad (17)$$

$$\begin{cases} \sigma = E \varepsilon & \rightarrow \text{Elastic Regime} \\ \sigma = D \varepsilon & \rightarrow \text{Elastic - plastic Regime} \end{cases}$$

V. COMPUTATIONAL ALGORITHM

In 1996, Lavall proposed a computational algorithm for the study of the plasticity distributed in steel plates constituent of beam and frames members. This method was known as slicing method based on the formulation of item 4.

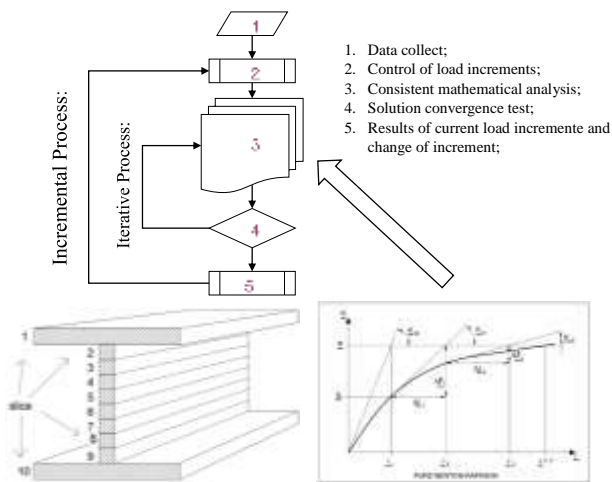


Figure 4 – Computational tool for evaluating plasticity.

VI. EXEMPLES

A static foundation pile test was carried out in the city of Rio de Janeiro in 2011 in which the reaction beam was a W1000x217 (ASTM A36, $f_y = 250\text{MPa}$) with 5 meters in length. The test load was 1697kN and so it was done. As a research objective to plasticize the bar, the load was increased to 2001 kN where from this point the lateral buckling mechanism started and the test was stopped. This reaction system (W1000x217) is studied in four different models:

1. Model 1 - Strength of materials;
2. Model 2 - Computational Algorithm of Nonlinear Analysis Lavall 1996;
3. Model 3 - SAP2000 v19;
4. Model 4 - Ansys 16.

6.1 Model 1 - Strength of materials:

$$M_{max} = \frac{PL}{4} = M_{pl} = Z_x * f_y$$

$$E = 20000\text{kN/cm}^2 \quad f_y = 25\text{kN/cm}^2$$

$$P = \frac{4 * M_{pl}}{L} \cong 2341\text{kN}$$

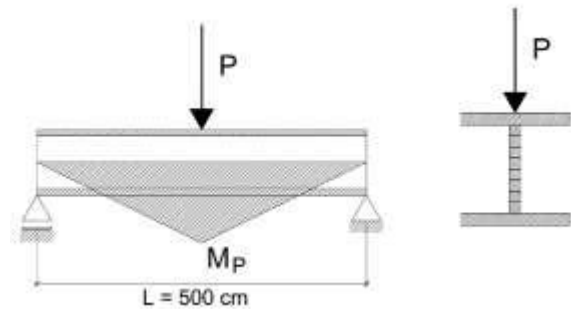


Fig.5: Maximum Plastic concentrated Load Beam

6.2 Model 2 - Computational Algorithm of Nonlinear Analysis Lavall 1996; – Plastic slices:

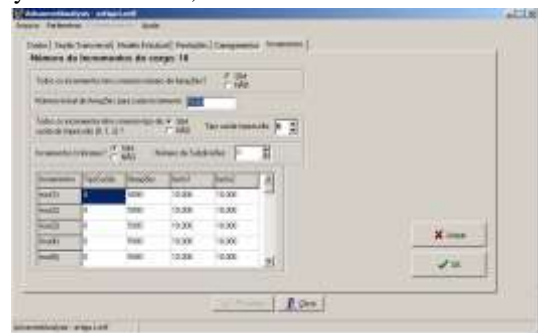


Fig.6: Interface Data Entry Lavall 1996

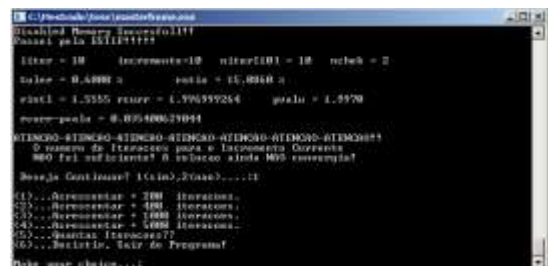


Fig.7: Processing Data, Lavall 1996

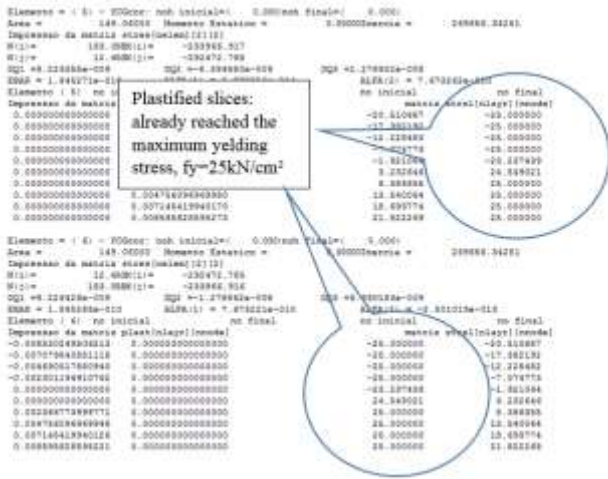


Fig.8: Results Data, Lavall 1996

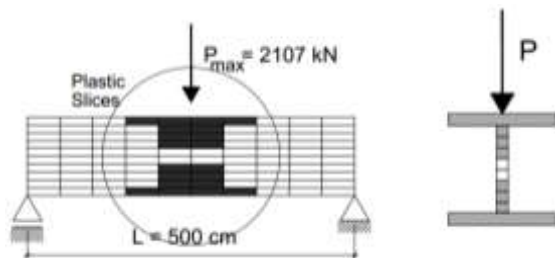


Fig.9: Plastified slices zone.

6.3- Model 3 - SAP2000 v19:

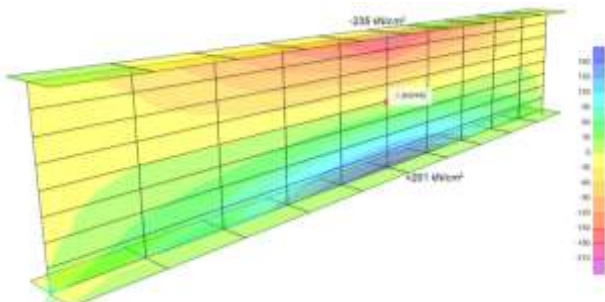


Fig.10: Longitudinal stress σ_{xx} web beam.

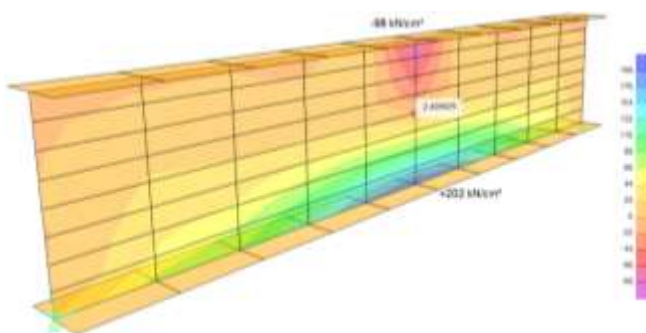


Fig.11: Shear stress τ_{xy} web beam.

6.4 Model 4 - Ansys computer program 16.

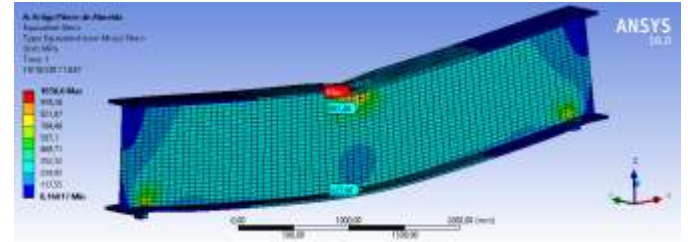


Fig.13: Maximum Von-Mises stress web beam.

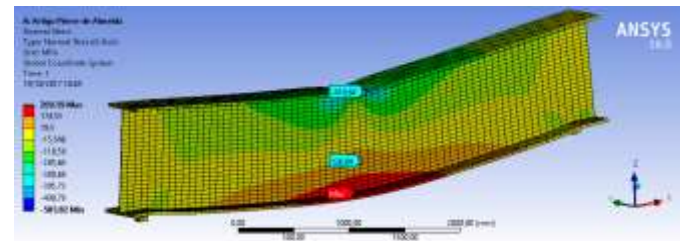


Fig.14: Longitudinal stress σ_{xx} web beam.

VII. RESULTS ANALYSIS

	Real Test	Materials Resistence	Lavall 1996
Maximum Load	2001 kN	2341 kN	2106,9 kN
Observations	beginning of lateral buckling and interruption of the test		Result until the ninth increment of load, from there the beam breaks due to plastification where the limit of the stress is of 25 kN/cm ² and the processing is interrupted.

	SAP2000 v19	Ansys 16.0
Maximum Load	2335 kN	2341 kN
Observations	Resolution of the problem up to the maximum load, however, elements with stress above the yielding are shown, ex. 235kN/cm ² (2350MPa), which does not occur in a real test.	Solving the problem up to the maximum load and the maximum stresses at the top and bottom of the beam are shown, however the stresses went beyond the ultimate tensile stress 550MPa.

Table 1 – Comments about the results.

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Processing Seismic Data with Open Source Software

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Abstract—open source seismic processing softwares provides a low cost alternative to commercial softwares and, with an appropriately directed development, an ability to adapt to the changing research needs. The best known example of such kind is Seismic Unix, a free reflection processing system developed at the Colorado School of Mines. It has been broadly used in research and teaching seismology and also in smaller scale seismic processing industry. Through this paper the seismic Unix was tested for the first time at Iraqi academic system by processing a real seismic data acquired at northern Iraq at Basra province. The test done by reliance a simple processing flow and the result show us high resolution seismic section and less noise ratio. According to the early mentioned results the seismic Unix recommended as a teaching tool for Iraqi educational system.

Keywords— *Processing Seismic Data, Open Source Software, Basra province.*

I. INTRODUCTION

Analysis of geophysical data nearly always involves application of sophisticated and multi-stage processing and inversion. With volumes of data and resolution of the datasets exploding in the recent years in nearly every field, the demand for computer packages facilitating, handling, processing, analysis, and interpretation of large and complex datasets is growing especially in exploration seismology [1].

Although highly advanced, commercial processing packages are still built for specialized industry users. For a broader geophysical community, reliance on such software may not be satisfactory because commercial packages often require installation of other systems (e.g., databases or rendering systems) whose support could be difficult or expensive in a university environment. And licensing costs are often prohibitive, particularly when utilizing large multi-processor computer systems [1].

Open-source seismic processing softwares provides a low-cost alternative to commercial software, with an appropriately directed development, and an ability to adapt to the changing research needs. There are many open- source seismic processing software which developed through of academics like Seismic Unix,

researcher like Madagascar, universities like SEP lib and companies like Free USP.

In this paper the focus will be on open-source seismic processing software ability in processing of real seismic data set. In order to evaluate the efficiency of open-source seismic processing software Seismic Unix was chosen to process real seismic data provided by local contractor and according to the deal with the contractor the original coordination of the data set will be obscure. The end result of this paper is the qualification of open-source seismic processing software which is represented by seismic Unix to be used in seismic processing with more flexibility and relevance to the requirement of scientific research.

II. THE SEISMIC DATA

As mention earlier that the coordinate of the data will be obscure because of the project didn't end yet. The data was acquired in south of Iraq in an area located in Basra province as in *Fig.1*. According to the survey report the seismic data was formed from 164 shot between two shots 100m shot interval. the survey layout type is split spread each record have one shot (source point) and 96 receiver (geophone) distributed evenly 48 receiver on each side of the shot between two receivers 50m receiver interval.



Fig.1: Basra province location.

III. SEISMIC PROCESSING SEQUENCE

Seismic data processing techniques are designed to discriminate, separate, or otherwise attenuate the noise and enhance the signal. Seismic data processing converts

the acquired seismic signals to a representation of the subsurface geology [2] as in Fig 2.

The processing sequence in Fig.2 represent the conventional processing sequence. In this paper the processing sequence will be depend on special test to detect the filters parameter and the trial and error this will led us to different processing sequence which improve signal to noise ratio and maximize the resolution of the subsurface section.

IV. SEISMIC DATA PROCESSING

4.1 Data Conversion.

The data format changed from seg-y to su (seismic Unix format) in order to be read by seismic Unix. The conversion done when the data trace header can be read by seismic Unix. The trace header information represent the first and primitive defined (in seismic Unix) information of the data as in Table.1.

- | |
|--|
| <p>(1) Preprocessing:</p> <ul style="list-style-type: none"> • Demultiplexing • Reformatting • Editing • Geometric Spreading Correction • Setup of Field Geometry • Application of Field Statics <p>(2) Deconvolution and Trace Balancing</p> <p>(3) CMP Sorting</p> <p>(4) Velocity Analysis</p> <p>(5) Residual Statics Corrections</p> <p>(6) Velocity Analysis</p> <p>(7) NMO Correction</p> <p>(8) DMO Correction</p> <p>(9) Inverse NMO Correction</p> <p>(10) Velocity Analysis</p> <p>(11) NMO Correction, Muting and Stacking</p> <p>(12) Deconvolution</p> <p>(13) Time-Variant Spectral Whitening</p> <p>(14) Time-Variant Filtering</p> <p>(15) Migration</p> <p>(16) Gain Application</p> |
|--|

Fig.2: Seismic Processing sequence[9].

Table.1: The trace header before geometry setup.

Information	Details
Traces number.	15744
Trace sequence within survey in su format (tracr).	(1 - 15744)
Trace sequence within survey in seg-y format (trafc).	(1- 15744)
Shot number sequence (fldr).	(1 – 164)
Trace sequence within shot (trafc).	(1 – 96)
Trace identification code (tride).	1
Sample number (ns).	3000
Sampling window (dt).	2 msec

At this status the trace header not have the advance geometry information like (source and receiver coordinate, common depth point) which is used to velocity analysis.

4.2 Viewing and editing the data.

The seismic data should be cheeked to identify the missing shots, bad shots and noisy and variable traces length if they are available. The data set contain many bad shots as in Fig.3 which are rejected from the data. After rejection the bad shots the trace and shots number will be reduce. The numbering sequence also differ so the data should be reset.All the data set will be shifted after the rejection the shot number 16 will be 15 when the shot 15 reject and so on. The data will be continuous without missing the traces length are equalized also.

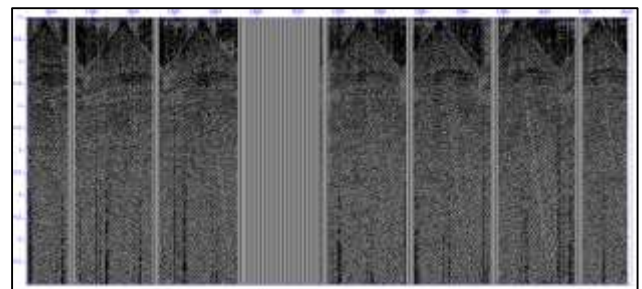


Fig.3: Missing shot in data set.

4.3 Geometry setting.

At this stage the geometry of the data suffer from many losses because of early processing like rejection as in Fig.4and the limited traces header information. The normal move out correction and velocity analysis need the data to be sorted in the common depth point domain (cdp) and offset domain. In order to calculate these domains need to shots (sx,sy) and geophones (gx,gy) position. According to the early knowledge about the

survey area the dip of it gentle dip which have minimum effect on data so the (sy,gy) will be neglected. As result (sx,gx) will be defined in relative way by projection them on imagery x-axes of cartesian coordinate system.

fldr = 22	has	96	trace(s)
fldr = 23	has	96	trace(s)
fldr = 24	has	96	trace(s)
fldr = 25	has	96	trace(s)
fldr = 26	has	96	trace(s)
fldr = 27	has	96	trace(s)
fldr = 28	has	96	trace(s)
fldr = 29	has	96	trace(s)
fldr = 30	has	96	trace(s)
fldr = 32	has	96	trace(s)
fldr = 33	has	96	trace(s)
fldr = 34	has	96	trace(s)
fldr = 36	has	96	trace(s)
fldr = 37	has	96	trace(s)
fldr = 38	has	96	trace(s)
fldr = 39	has	96	trace(s)
fldr = 40	has	96	trace(s)
fldr = 41	has	96	trace(s)
fldr = 42	has	96	trace(s)
fldr = 43	has	96	trace(s)
fldr = 44	has	96	trace(s)
fldr = 45	has	96	trace(s)
fldr = 46	has	96	trace(s)
fldr = 47	has	96	trace(s)
fldr = 48	has	96	trace(s)
fldr = 49	has	96	trace(s)
fldr = 50	has	96	trace(s)
fldr = 51	has	96	trace(s)
fldr = 53	has	96	trace(s)
fldr = 54	has	96	trace(s)
fldr = 55	has	96	trace(s)
fldr = 58	has	96	trace(s)
fldr = 59	has	96	trace(s)
fldr = 60	has	96	trace(s)

Fig.4: disordered geometry result of reject bad shots.

The geometry of the data wrote in the traces header as a result the new trace headers formed as in Table.2

Table.2: Reset trace headers geometry.

Header information	Details
Traces number	14304
Trace sequence in survey (tracl)	(1 - 14304)
Trace sequence in original seg-y (tract)	(1 - 14304)
Shot number (fldr)	(0 - 148)
Trace sequence with shot (tracl)	(1 - 96)
Cdp number (cdp)	(1 - 540)
trace number within cdp (cdpt)	(1 - 32)
Trace identification code (trid)	1
offset	(-2375 - 2375)
sx	(0 - 14800)
gx	(-2375 - 9775)
Number of sample (ns)	2777
Sampling window (dt)	2 msec

4.4 Amplitude recovery.

The amplitude recovery is adjusted to seismic data to compensate for attenuation, spherical divergence and other effects. The goal is to get the data to a state where the reflection amplitudes relate directly to the change in rock properties giving rise to them[3].The most important energy losses are due to geometrical spreading, absorption of the rocks and transmission losses. Geometrical spreading is spreading of the wavefront since the energy of a wave is inversely proportional to $1/r^2$ (in a homogeneous medium).Two gain function are applied exponential and time power gain many combination of them tested until get the appropriate one as in Fig.5. In order to calibrate the amplitude recovery of the data and because the huge size of the detail in the data set it is better to view the processing results on one seismic shot or in the shot domain.

4.5 Frequency Filter.

Frequency Filter Permit filtering in accord with arbitrarily chosen characteristics that might prove difficult or impossible to achieve with physical circuit components [4]. Digital filter takes the form of an arithmetical operation carried out on the string of numbers that represents the signal [5].

The seismic data suffer from noise which is any disturbance on the seismic record that tends to obscure primary reflections from rock strata. It may be conveniently divided into two sorts random noise and coherent [5]. The noise can be eliminated by filtering. After test many frequency values set for the bandpass filter we find the satisfying as in Fig.6. while other frequency values which are tested ware not satisfying because of over filtering weaken the reflectors, bad noise eliminating and sometime create artifact when the tapering amount not suitable

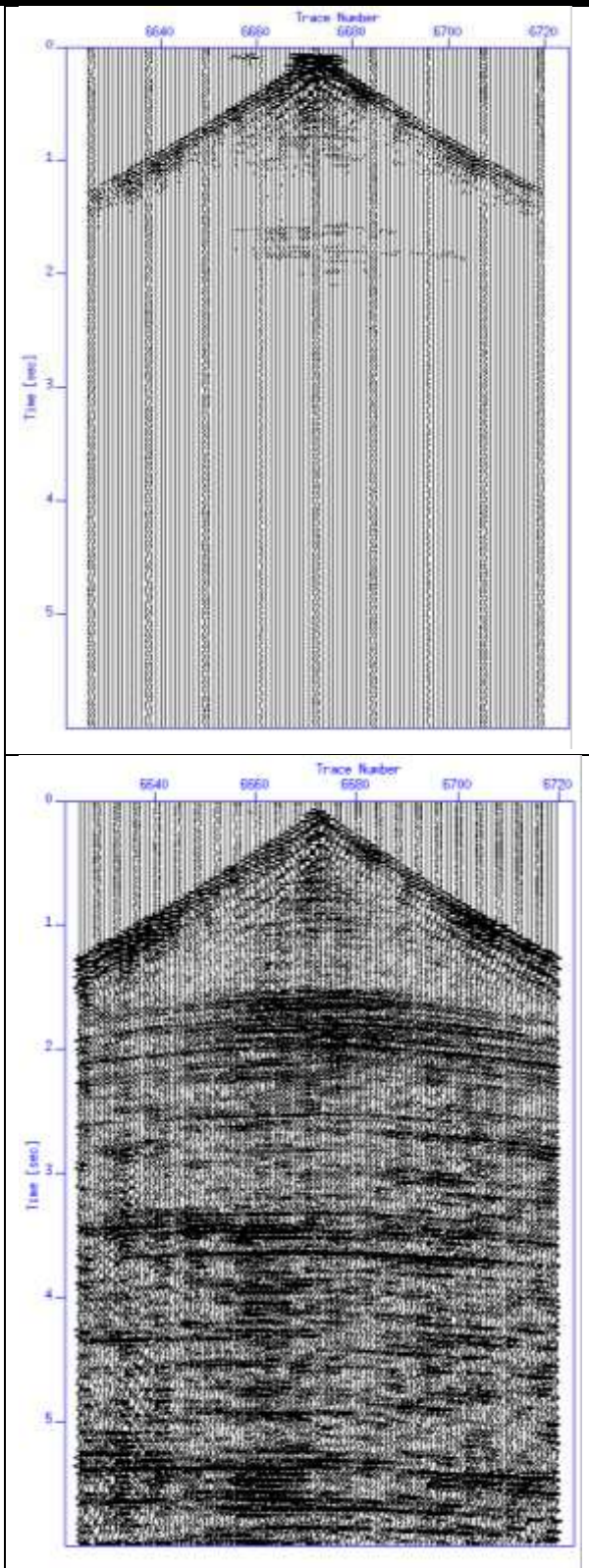


Fig .5: Amplitude recovery of seismic shot upper before gain lower after gain.

4.6 Velocity filter (Dip filter).

An F–K filter is designed to suppress unwanted events in the frequency-wavenumber (F–K) domain. When applying multidimensional Fourier transforms, such as

from (t, x) to (f, k_x) , linear events in the original domain will also be linear events in the transformed domain, except that the orientations of each event in the two domains are perpendicular to each other [6].

If there are linear noises, or if there are noises with dip (offset or time) less than a certain angle, such as ground rolls, we can mute such noise in the F–K domain, and then transfer the remaining data back to the t – x domain. Hence F–K filtering is also called dip-filtering when it is used to remove linear events of certain dip angle [7]. The best method of designing dip filter is to create the frequency – wave number spectrum of the data the noise will appear as slopes in F-K domain as in Fig.7.

When the seismic data in the T-X domain the noise be hard to detect while in the F-K domain the noise obvious as a slopes which then muted by selecting appropriate window of rejecting the noise. The window or zone of rejection defined by selecting the velocity or slope values as in Fig.8.

4.7 Muting.

Muting is the process of excluding parts of the traces that contain only noise or more noise than signal. The far geophone groups are quite distant from the energy source. On the traces from these receivers, refractions may cross and mixed with reflection information from shallow reflectors. However, the nearer traces are not so affected. When the data are stacked, the far traces are muted (zeroed) down to a time at which reflections are free of refractions. The mute schedule is a set of time, trace pairs that define the end of the muting. Mute changes the relative contribution of the components of the stack as a function of record time. In the early part of the record, the long offset may be muted from the stack because the first arrivals are disturbed by refraction arrivals, or because of the change in their frequency content after applying normal moveout. The transition where the long offsets begin to contribute may be either gradual or abrupt [8].

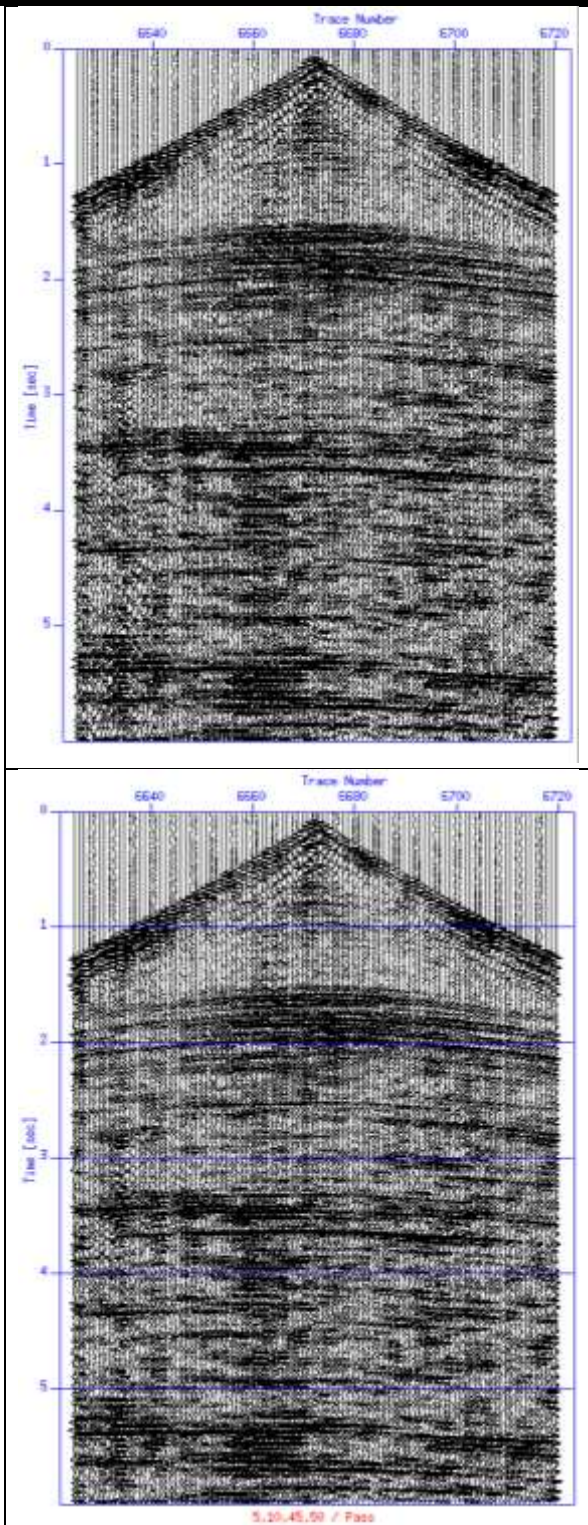


Fig.6: Frequency filter. The upper before filter and the lower after filter.

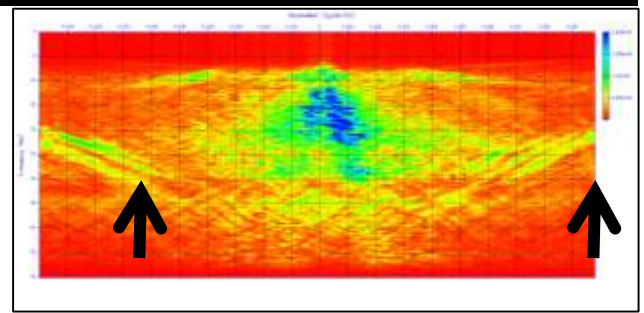


Fig.7: Frequency-wave number domain the noise shaded by the two black arrows they refer to the slopes which represent the noise.

4.8 Deconvolution.

Deconvolution is process designed to enhance the vertical resolution of the seismic data by attenuating the undesirable signals such as short period multiples. It is also called inverse filtering [4]. In order to apply deconvolution the autocorrelation function should be applied at first to decide the deconvolution parameters. The autocorrelation is simply the cross-correlation of a signal with itself. The predictive deconvolution applied in this paper which is use of information from the earlier part of a seismic trace to predict and deconvolve the latter part of that trace. Some types of systematic noise, such as reverberations and multiples can be predicted so noise eliminated as in Fig.8.

4.9 Sorting.

Seismic data acquisition with multifold coverage is done in shot receiver coordinates. Seismic data processing, on the other hand, conventionally is done in midpoint offset coordinates. The required coordinate transformation is achieved by sorting the data into CMP gathers. Based on the field geometry information, each individual trace is assigned to the midpoint between the shot and receiver locations associated with that trace. Those traces with the same midpoint location are grouped together, making up a CMP gather [9].

4.10 Velocities Picking and Normal moveout correction.

The time correction applied to reflection times because of normal moveout. The normal moveout formed because the difference in reflection arrival time which is result from the geophone is not located at the source point. Usually applied to common-midpoint gathers, it is the additional traveltime required because of offset,

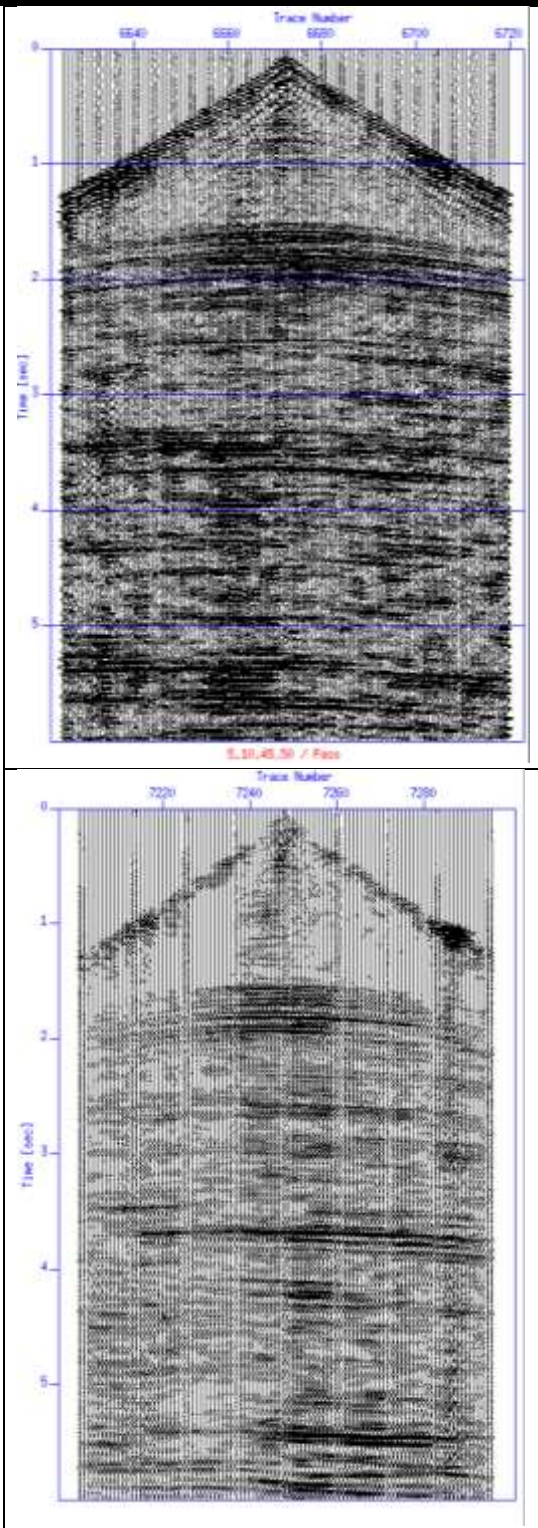


Fig.7: Applying F-K filter to lower section while upper section before filter.

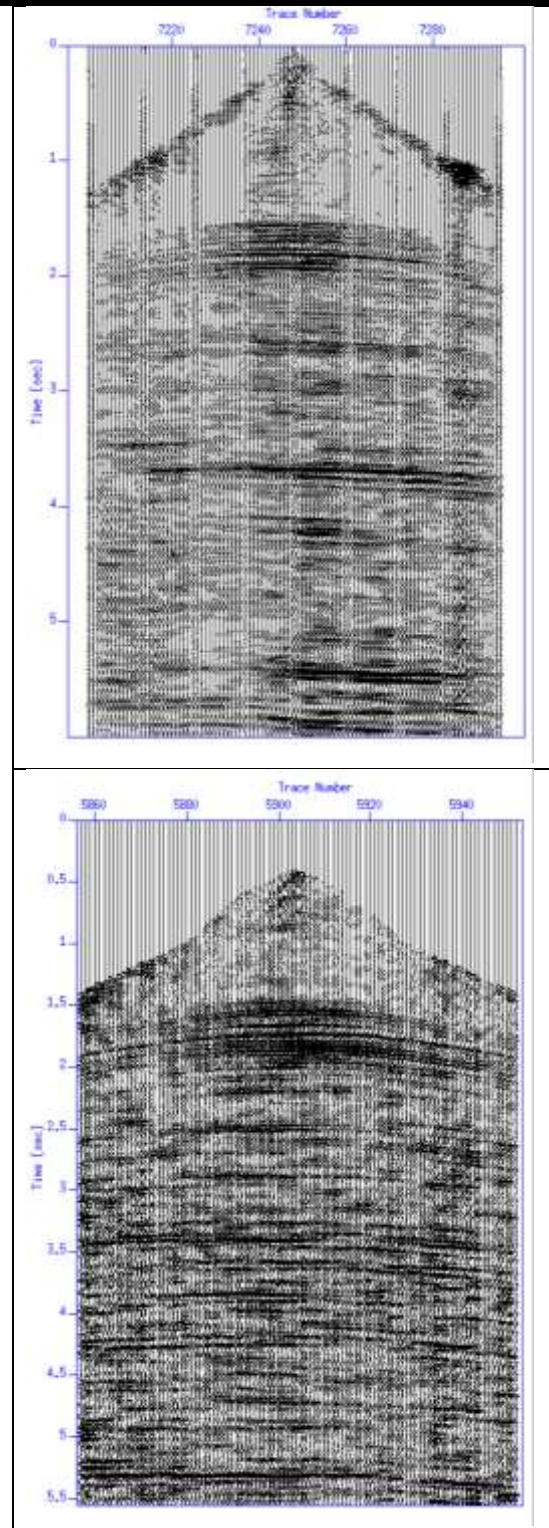


Fig.8: Enhance the vertical resolution after predictive deconvolution in lower section. Upper section before deconvolution.

Assuming that the reflecting bed is not dipping and that raypaths are straight lines. this leads to a hyperbolic as in Fig.9 shape for a reflection. The normal move out correction done through velocity analysis is the process

Whereby the velocity that flattens the reflection hyperbola on a CMP/CDP gather is determined. The velocity is called the stacking velocity. In velocity analysis, velocities are picked at selected locations along the seismic section and the results are linearly interpolated from one analysis location to the other as long as the

picks are from the same reflector and the same reflection time [10] as in Fig.9.

4.11 Stacking.

It is a process includes algebraic sum of the all seismic traces from different shot records with a common reflection point, such as common midpoint (CMP) data are stacked to form a single trace during seismic processing [11]. For stacking the NMO correction must be applied to these seismograms to get on map of zero offset travel time. Since the traces from different offsets contain information for a common point of the horizontal reflector, the redundant information can be summed up constructively to generate a stacked section of higher S/N ratio as in Fig.10, since the stack consider best filter to attenuate the random noise [12].

V. CONCLUSION

The open source seismic processing software (seismic Unix) was useable in processing real seismic data as seen in the end of the processing in this paper at the stacking where seismic section was high resolution and less noise. Seismic Unix because it is open source and has a wide range of developer which they are researcher so this makes it highly adapted to many uses in seismology, exploration, and engineering seismic and also updated. The seismic Unix not needs license it is a free software this make it favorite for academic and researcher community. Seismic Unix is open source the permits accesses to its source code this enhance the student knowledge about the seismic processing routines.

The open source softwares like seismic Unix have limitations such as Seismic Unix do not support the user interface, it is built on pipe system call of Unix which cause spending time on writing orders, seismic Unix relatively slow because of pipe system call and seismic Unix not able to process big seismic data in normal circumstances.

These advantages and limitations led as to the possible applications of open source processing softwares such as reliance then as educational courses in colleges, institutes and other scientific organization of Iraq, use them by Iraqi student and researchers for the development of new processing algorithms and tested it and using the open

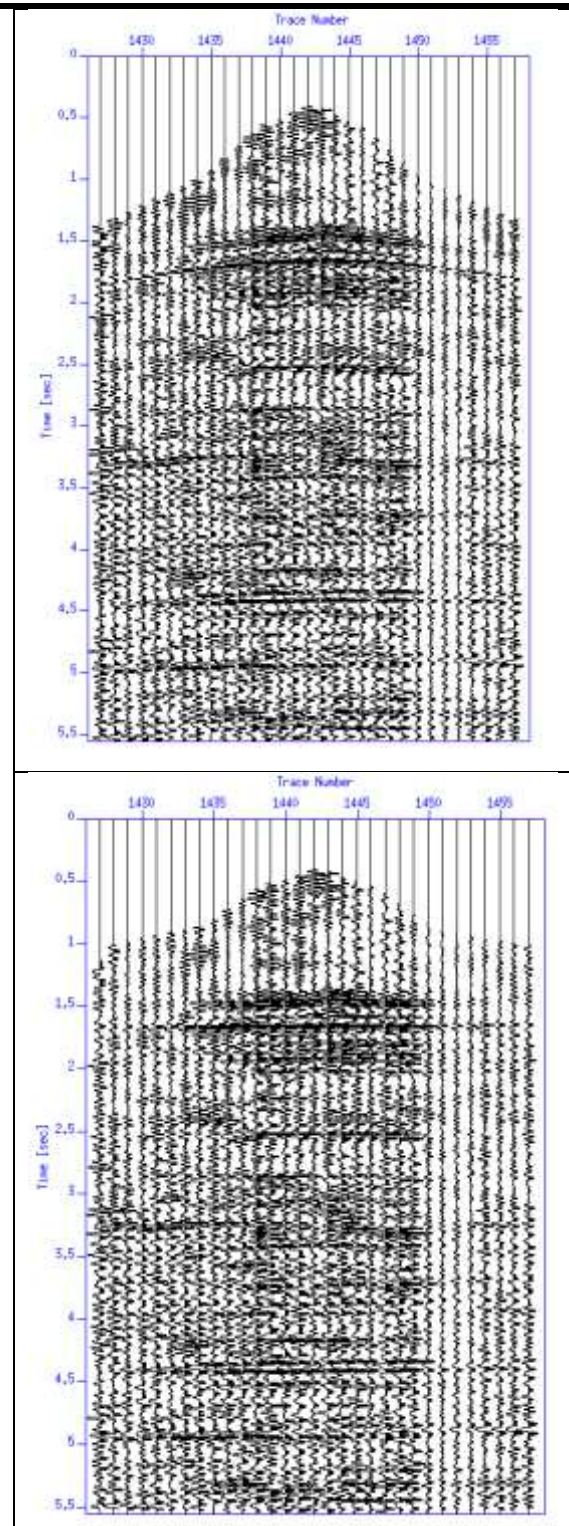


Fig.9: NMO correction in lower section while in the upper section the reflectors look like hyperbola.

Source softwares in Iraqi educational foundations connect the Iraqi academic community with the software's developers community so that enable shearing problems and solutions which led to developing the Iraqi academic community.

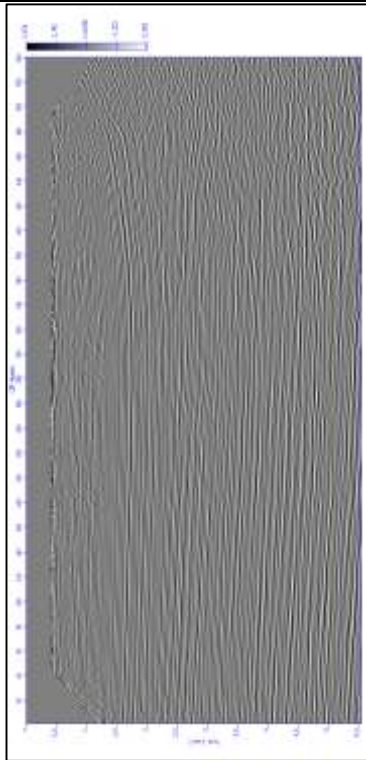


Fig.10: The stack section.

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Structural and Stratigraphic 3D Seismic Study of NahrUmr and Zubair Formations in Kifl oil field _ center of Iraq

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Abstract—this research is a reflection seismic study (structural and stratigraphic) of a 268.7 km² area located in the central Iraq within the Karbala province (Kifl area). The study area was interpreted by using 3-D seismic data from the Oil Exploration Company. Synthetic traces are prepared by using available data of the four wells (Kf-1), (Kf-2), (Kf-3) and (Kf-4), in order to define and picking the reflector on seismic section, These reflector are: (NahrUmr, Shuaiba, Zubair and Ratawi Formations) which are deposited during the lower Cretaceous age. Faults were picked using instantaneous phase attribute of seismic section across 3D seismic volume of the studied reflectors. The study area affected by a major fault and minor normal faults, Two fault system has been observed in the study area; the major normal fault of (NW-SE) trending, this trending conform with Najd fault system in Iraq, and minor normal faults of (NE-SW)trending, with a small displacement are influenceing the studied reflectors. The time slices were studied across 3D seismic volume of the studied reflector, they proved the presence the structural anticline at lower cretaceous reflection level. Time, velocity and depth maps are prepared depending on the structural interpretation of the picked reflectors, the structural interpretation of these reflectors shows a structural anticline extending in NW-SE trend and plunges to the southeast, and the general dip towards the east. Using seismic attribute techniques including (instantaneous frequency, RMS amplitude maps and reflection strength section), these attributes showed decreasing in frequency, amplitude and strength values. These reflect rocks of low velocity and indicate the presence of hydrocarbon accumulation area. The study of seismic facies of the picked reflectors distinction parallel seismic configuration. The results show the Zubair and NahrUmr facies are clastic depositional system deposited on delta platform, Zubair represents delta platform facies consisting of shallow-water, high-energy marine (delta sandstone, channel-fill sandstones).Pinch out is picked and interpreted by using cosine instantaneous phase attributes, these phenomena

can be regarded as Pinch out stratigraphical traps. It's the main factor to explain the difference in thickness of the oil column between well Kf-4 and well Kf-1. Mound and Flat spot phenomenon has been observed within Zubair reflector by using the seismic composite attributes (Band pass filter on an instantaneous phase attributes, as mound stratigraphic traps and flat spot which is represent of Direct Hydrocarbon Indicators (DHI) that refers to the presence of hydrocarbons. Where the use of this techniques has helped to identify the (DHI) for hydrocarbon accumulation and have not been previously identified.Finally 3D seismic model for Kifl field show the extension of structural anticline and its plunge and the distribution of hydrocarbons accumulations in the Kifl field.

Keywords—Structural anticline, Seismic attributes, Seismic stratigraphy.

I. INTRODUCTION

Seismic reflections surveying is the most widely used geophysical techniques, and has been since 1930s. Its predominant applications are hydrocarbon exploration and research into the crustal structure with depth of penetration of many kilometers (Reynolds, 1997). The basic idea is simple, low-frequency sound waves are generated at the subsurface by using high-energy source. They travel down through the earth, and reflected back from the tops and bases of layers of rock where there is a change in the properties of rocks, the reflected sound travels back to the surface and recorded by receivers microphones (Bacon and Redshaw, 2003).Seismic reflections come from interfaces where the acoustic properties of the rocks change, and this fact is the basis of understanding of the nature of seismic data (Brown, 2011).The seismic reflection exploration method passed through numerous stages from mid last century to the present time including the field survey, data processing and interpretation (Yilmaz, 1987).The studied area (Kifl oil field) is located in south of Baghdad to the south-west of Hilla city at a distance approximately (35km), and lies

within the tectonically stable Mesopotamian basin between the Zagros fold belt and Arabian shield. The study area lies in the middle of Iraq between Najaf and Karbala governorates (west of the Euphrates River) as shown in the Figure (1) it limits from east the Euphrates River to the north Karbala city and to the north-west Razaza lakes. The aims of study is to Update the structural picture of NahrUmr and Zubair Formations in Kifl field, Re-interpretation seismic stratigraphic phenomena and facies change within NahrUmr and Zubair Formations by using all available data of 3D seismic survey in oil Exploration Company to detect the appropriate location of hydrocarbon accumulation for the two Formations. And Using the seismic attributes, to predict the hydrocarbon accumulations that may present in NahrUmr and Zubair Formations.

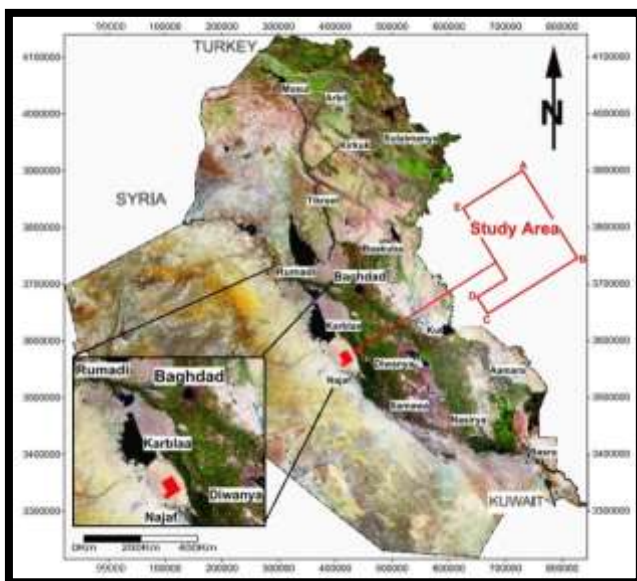


Fig.1: Satellite image of the Study area show location map of the study area(Nasa, 2008).

II. DATA ACQUISITION

2.1 Base Map Preparation

Basically, the base map defined its quality map for geological and geophysical data analysis and interpretation includes the location of wells, seismic survey points, and geographic reference such is latitude and longitude or Universal Transverse Mercator (UTM) Figure (2). A processed seismic data are loaded in interactive workstation of interpretation in SEG-Y format and before, starting special subprograms must be operated to define the required data to loading. This process is called (project creation) to achieve the process of interpretation. this process includes entering the first and last the inline number, the first and the last cross line number, the separated distance between bin sizes along the inline and cross line direction, also includes definition

of the geographic coordinates in UTM coordinate system of the study area.

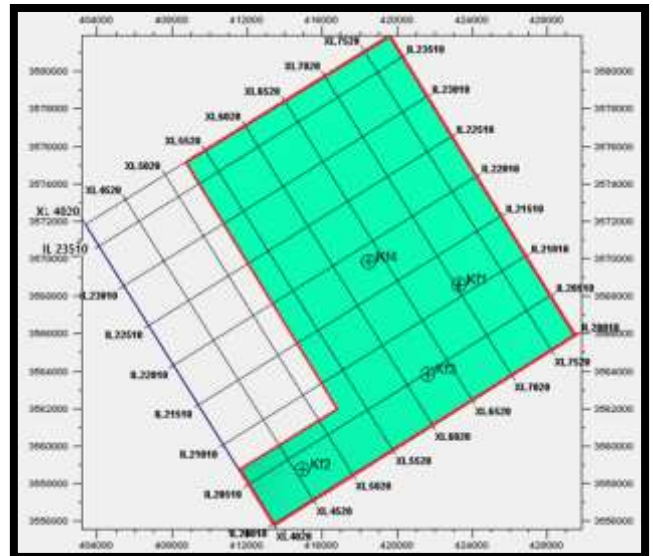


Fig.2: Illustrates a base map of a study area, (3D Kifl survey).

2.2 Synthetic seismogram generation

(Onajite, 2014) referred to the synthetic seismogram is a seismic trace created from sonic and density logs and it is used to compare the original seismic data collected near the well location.

- Using digital sonic and density logs to generate an acoustic impedance log.
- Using velocity data (e.g check-shot surveys).
- Using acoustic impedance log to derive reflection coefficients.
- Convolve reflection coefficients with a wavelet that approximates wavelet in the seismic data (phase, frequency content).
- Compare synthetic with seismic data (Hart, 2004).

In the current study, synthetic seismogram was generated for well Kf-1, Kf-2, Kf-3 and Kf-4 as shown in Figure (3), (4), (5), and (6). The matching between seismic section and synthetic traces is good. The picked reflectors appeared as peaks on synthetic trace (positive reflection) but in different intensity. The Shuaiba and Ratawi Formations correspond to a peak while Zubair and NahrUmr Formations Correspond to a trough. This is very reasonable because the rocks Over Zubair are sandstone. the sandstone is characterized by high porosity; therefore, the density of limestone is more than that of sandstone under the natural conditions. For this reason, any interface separating two media, the first contains limestone as (Shuaiba Formation) and the second contains, sandstone as (Zubair Formation), so the reflection coefficient of this interface is negative (trough) and under it a positive (peak).

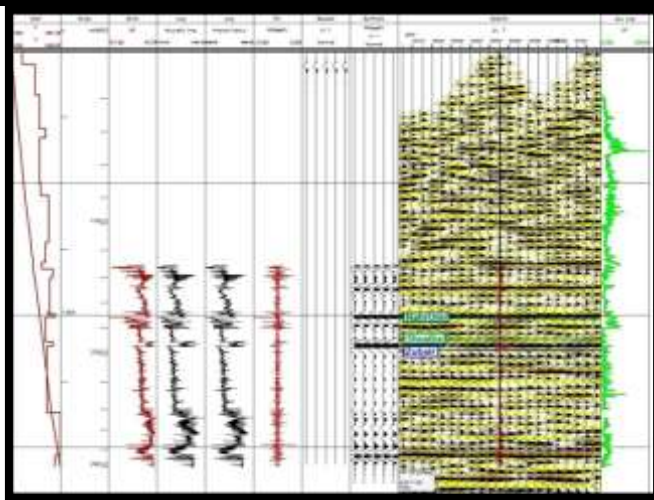


Fig.3:Illustrate the synthetic seismogram of well Kifl 1.

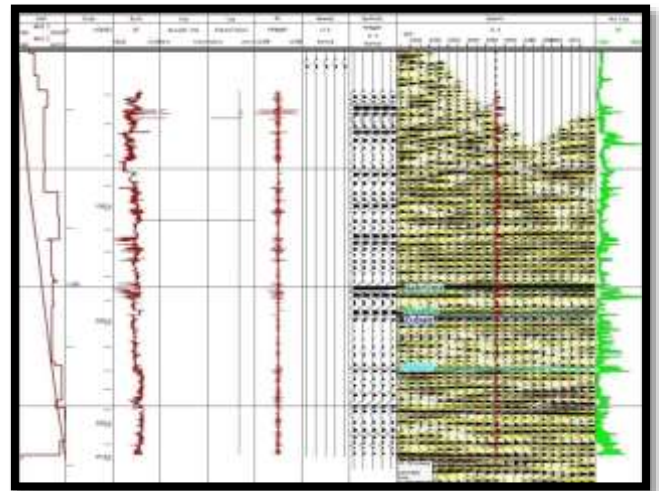


Fig.6:Illustrate the synthetic seismogram of well Kifl4.

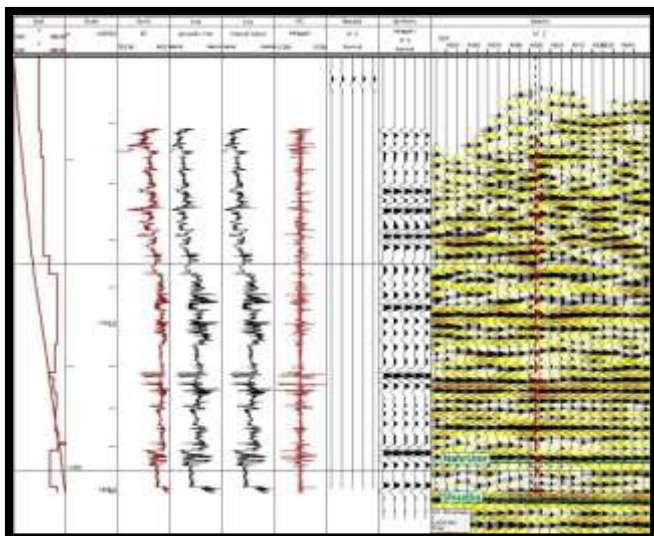


Fig.4:Illustrate the synthetic seismogram of well Kifl 2.

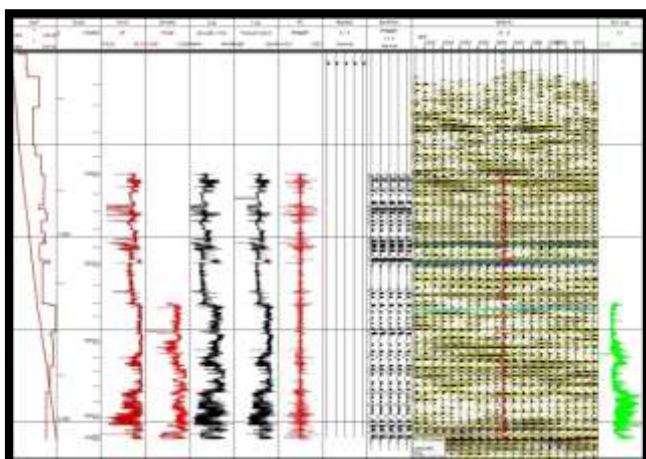


Fig.5:Illustrate the synthetic seismogram of well Kifl3.

III. INTERPRETATION OF SEISMIC DATA

Structural interpretation

(Taner et al., 1979) has indicated that seismic attribute sections, especially the instantaneous phase are very important for the distinction of surface reflector continuity, instantaneous phase attributes technique has applied for the seismic sections in 3D volume. The faults were picked in all the area along each inline, cross lines and arbitrary lines Figure (7). The instantaneous phase section shows that the study area to be affected by a major fault and minor normal faults, The observed faults is parallel to the collision suture between Arabian and Iranian plates, It extends from deep levels to influence the NahrUmr, Shuaiba, Zubair and Ratawi Formations, Two faults system has been observed in the study area; the major normal fault of (NW-SE) trending, this trending conform with Najd fault system in Iraq, and minor normal faults of (NE-SW) trending, with a small displacement, these faults system played important role in the distribution of oil in the area. Normal fault form as a result of some tensional force tend to pull the rocks apart. An intrusion may have bent the rock up so the rock breaks, and one part drops down lower than other. Most kind of traps encountered in oil exploration is normal faults.

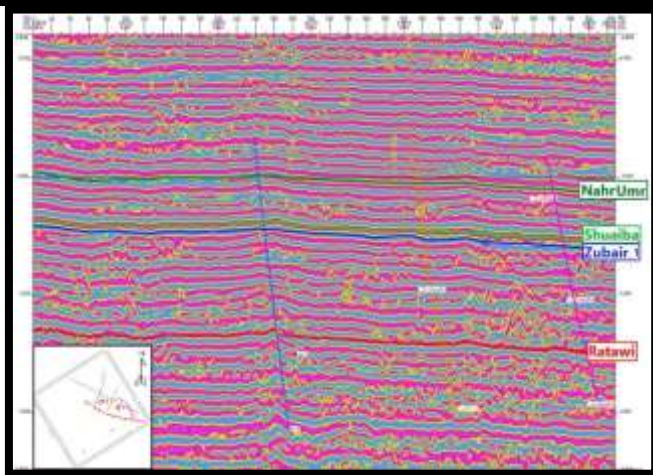


Fig.7: Traverse seismic section with instantaneous phase attributes shows the picked faults in the study area.

IV. TIME SLICES

A map view of 3D seismic data having certain arrival time, time slices convenient way to evaluate change in amplitudes of seismic data. The time slices may give important information on subsurface geology features, the primary idea about the subsurface structural anomalies, specially the areas of anticlines and synclines and their extension and the directions, Figure (8) and (9), show time slice of Nahr Umr and Zubair reflectors.

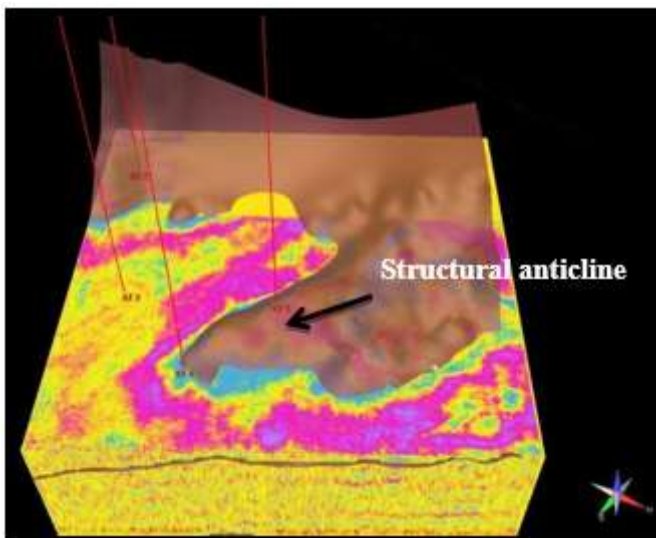


Fig.8: Show time slice of NahrUmr reflector (3D Kifl survey).

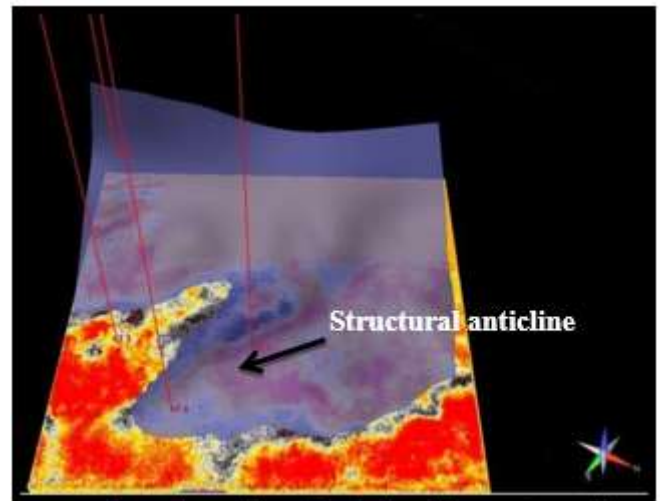


Fig.9: Show time slice of Zubair reflector (3D Kifl survey).

V. STRUCTURAL PICTURE OF THE PIKED HORIZONS

5.1 Time Maps

Four TWT maps has been prepared for the studied reflectors (NahrUmr, Shuaiba, Zubair and Ratawi). TWT Maps of the study area dominated by structural anticline trending NW-SE. the plunged anticline trending to the southeast, the two wells (Kf1-Kf-4) located within the plung. The general dip tend to the E, the reflectors are influenced by a Major fault and minor normal faults with small displacement, the major fault of NW-SE trending, this fault separates well Kf-4 and Kf-1 area from Kf-3 and Kf-2, and minor faults of NE-SW trending, these faults separates well Kf-4 area from well Kf-1. Figures (10) shows the TWT map for the NahrUmr Formation.

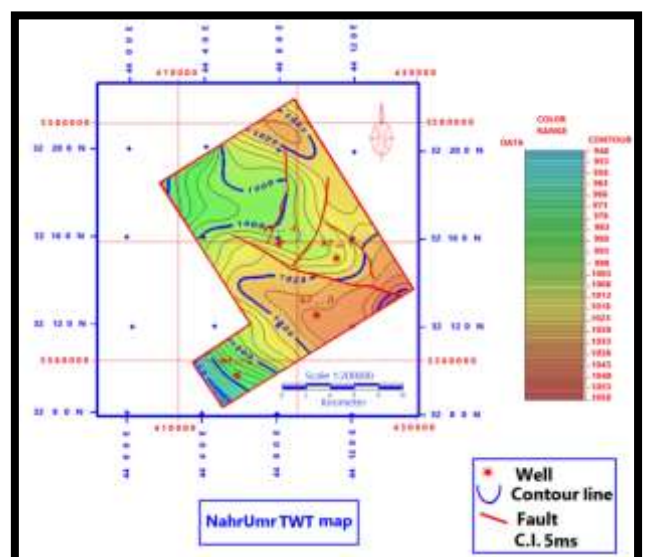


Fig.10: Shows the NahrUmr two way time map (3D Kifl survey).

5.2 Velocity maps

The average velocity is the suitable velocities which are needed to convert the TWT maps to depth maps. The average velocity was used for the four wells (Kf-1, Kf-2, Kf-3, Kf-4) to conversion from time to depth, the average velocity map is drawn by using data acquired through check shot survey of the adjacent wells. The velocity maps are prepared by using a contour interval (5m/sec). The average velocity value of NahrUmr reflector increases in N trend of Kifl field, Shuaiba reflector increases in the north east trend of Kifl field, Zubair reflector increases in the north east trend of Kifl field, while Ratawi reflector increases in the south east trend of Kifl field. Figures (11) shows the velocity maps for the Zubair Formation.

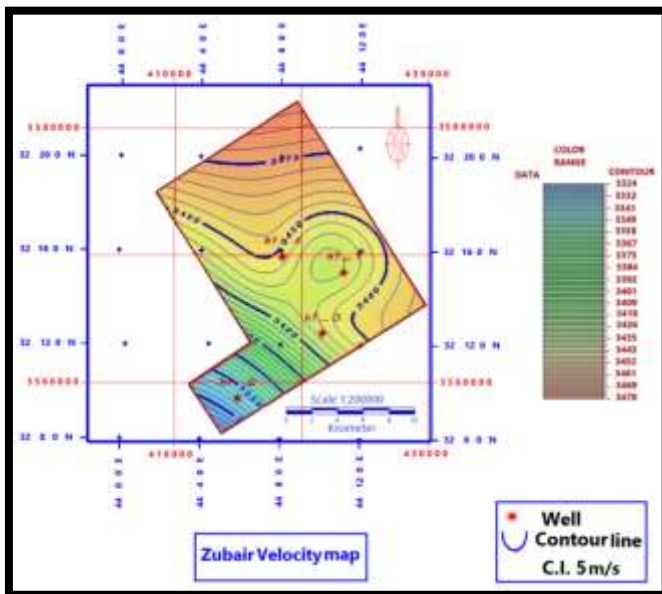


Fig.11: Shows Zubair velocity map (3DKifl survey).

5.3 Depth maps

Depth maps were prepared for the studied reflectors (NahrUmr, Shuaiba, Zubair and Ratawi). Depth maps dominated by structural anticline trending NW-SE, and plunge trending to the southeast. The well Kifl-3 lies in a syncline area while the well Kifl-2 lies within a high and plane area. The minimum depth values are noticed at the west and gradually increase toward the east and northeast. The reflectors are influenced by a major fault and minor normal faults with small displacement, the major fault of NW-SE trending, this fault separates well Kf-4 and Kf-1 area from Kf-3 and Kf-2, and minor faults of NE-SW trending, these fault separates well Kf-4 area from well Kf-1. Figure (12) show depth map of NahrUmr reflector.

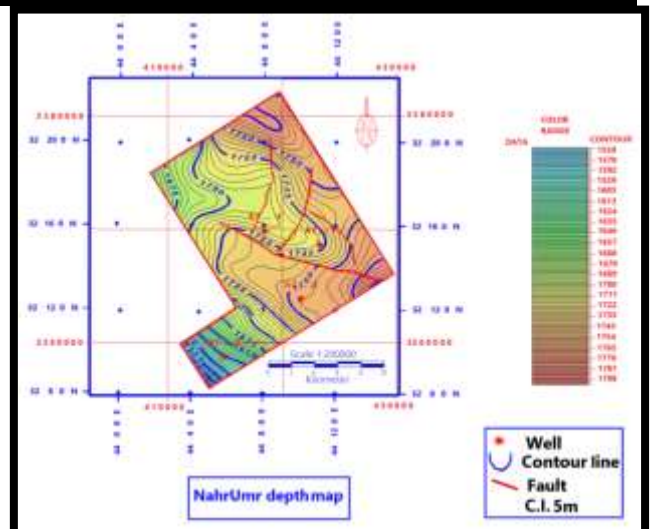


Fig.12: Shows NahrUmr depth map (3DKifl survey).

VI. Attributes interpretation

Seismic attribute techniques were applied on 3D seismic volume for Kifl oil field, which include, instantaneous frequency, RMS amplitude, and Reflection strength attributes in time domain these types of attributes are important to detect the hydrocarbon accumulation on seismic sections, (Alridha and Muhsin, 2015)

6.1 Instantaneous Frequency attributes

(Sheriff, 1980), refers to rate of change of instantaneous phase from one time sample to the next (first vertical derivative of the phase). It is used for visualizing regional depositional patterns. The results of application of attribute is to determine sites changes instantaneous frequency and their relationship to changes in petrophysical qualities, is linked frequencies of low-lying areas to zones communities of hydrocarbon. The 3D seismic volume was processed and converted from seismic signal in time domain to frequency attributes Figure (13), explain the lateral variation of frequency at the reflector, the red and yellow color reflect the area of low frequency this indicates hydrocarbon accumulation areas near the four wells sites, The dark purple color reflects an area of high frequency, which indicates weak probability of hydrocarbon accumulation.

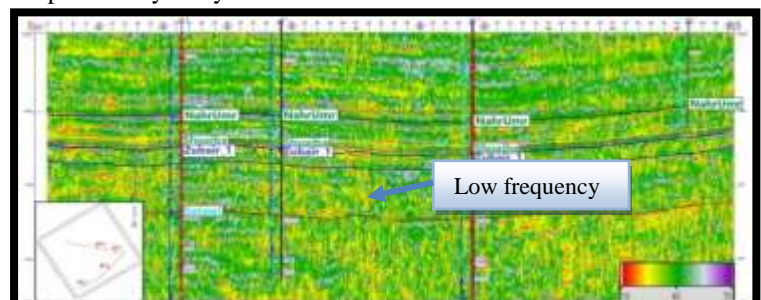


Fig.13: 3D seismic instantaneous frequency attribute of 3D Kifl survey.

6.2 RMS amplitude attribute

This attribute is a measure of the reflectivity within a time window or depth window. and may be used to map direct hydrocarbon indicators in a zone (Schlumberger, 2004)The color variation in the maps reflects the relative variation in the reflectors amplitude between traces, Figure (14) represent Nahr Umr RMS amplitude map with contour interval 5db. Figure (15) represent RMS top Zubair amplitude map with contour interval 5db. These maps show three main areas, the first is a blue color area (high amplitude), the second is a white color area (moderate amplitude) and third is pink color area (low amplitude). The white and pink areas of low to moderate amplitude have high probability to be a hydrocarbon reservoir within the Nah Umr and Zubair Formations.

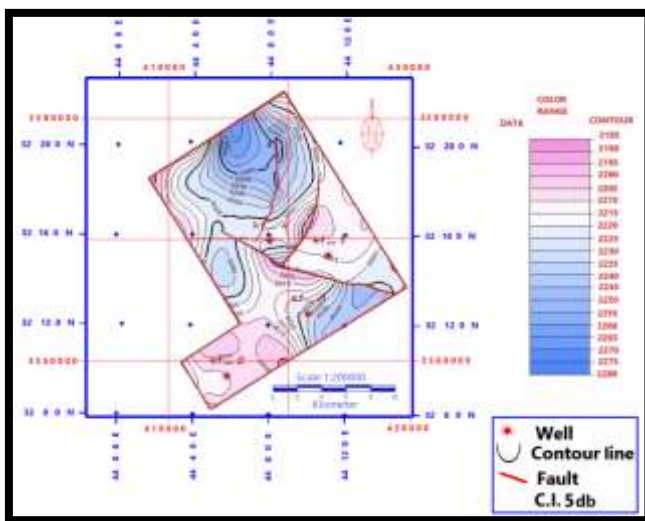


Fig.14:Shows NahrUmr RMS amplitude map (3D Kifl survey).

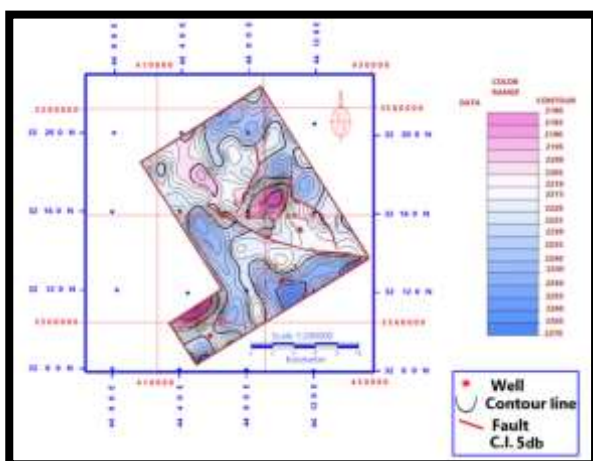


Fig.15:Shows top Zubair RMS amplitude map (3D Kifl survey).

6.3 Reflection strength sections

Reflection strength associated with the geological changes as unconformity surfaces or gas content in the

rocks. Figure (16) illustrates reflection strength composite section between Kf-1 and Kf-3 wells, In general, there are zones of high reflection strength, as between Kf-1 and Kf-3 wells of NahrUmr and Shuaiba reflectors which becomes blue color represents high of reflection strength value as according to color scale in the section it likely indicates of gas accumulations area, it represents the surface separating the calcareous rocks of Shuaiba Formation from the sandstone of NahrUmr Formation. The red and green color between Kf-1 and Kf-3 represent low of reflection strength values as according to the color scale in the section, it likely indicates of oil the accumulation.

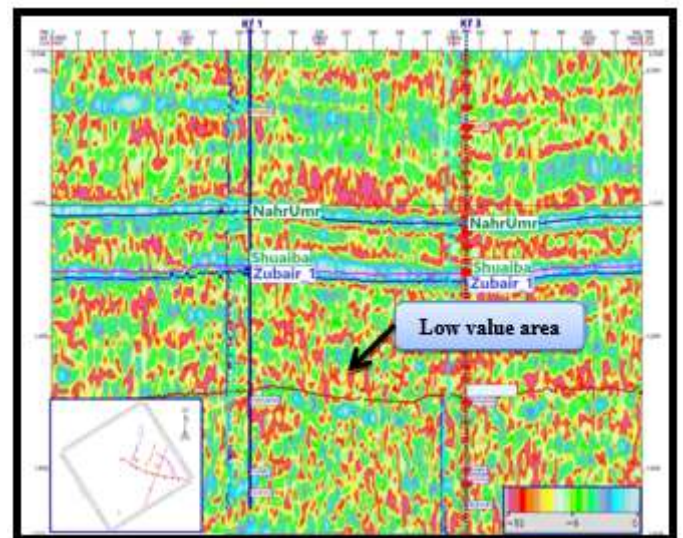


Fig.16: Shows reflection strength section of the studied reflectors between Kf-1 and Kf-3 wells (3D Kifl survey).

VII. Stratigraphic interpretation

Seismic stratigraphy is a geologic approach to interpret regional stratigraphy from seismic section. It is a powerful technique, especially suitable for less explored or virgin basins with no or sparse well data. The seismic stratigraphy method is based on analysis of reflection patterns of stratal surfaces (Nanda, 2016).

VIII. SEISMIC REFLECTION CONFIGURATION

In the studied interval of Kifl (NahrUmr- Ratawi), two main types of seismic reflection configuration are observed.

NahrUmr, Shuaiba, Zubair, and Ratawi reflectors display parallel configuration.

The NahrUmr, Shuaiba, Zubair and Ratawi reflectors characterize high to moderate amplitude and continuity. Reflection configurations of Shuaiba and Zubair indicate wide, relatively uniform lateral extent in sedimentary basin. It can be inferred that Shuaibafacies are deposits on a broad relatively stable shelf, while Zubairfacies are

deposited on delta platform. The shelf facies consist of neritic shale and limestone strata; sandstone is rare and generally transgressive. While Zubair represents delta platform facies consisting of shallow water, high-energy marine (delta sandstone, channel-fill sandstones) Figure (17), the detection of channels is an important part of seismic interpretation for oil and gas exploration.

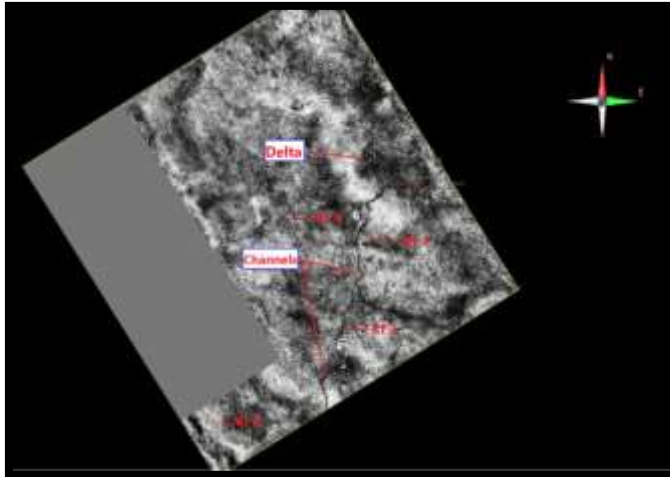


Fig.17: Illustrate time slices shows Zubair channels and delta (3D Kifl survey).

Figure (18) Show a type of Stratigraphic traps has been observed between wells Kf-1 and Kf-4. Termination by thinning or trapping out (Pinch out) of reservoir against a nonporous sealing rock creates a favorable geometry to traps hydrocarbon if the adjacent sealing rock is a source rock such is shale. These phenomena can be regarded as Pich out stratigraphical traps. Seismic attribute has applied to clarify it (Cosin instantaneous phase). Theseismic section show that the thickness of the oil unit has been decreased toward well Kifl 1, and it's the main factor to explain the difference in thickness of the oil column between the two wells.

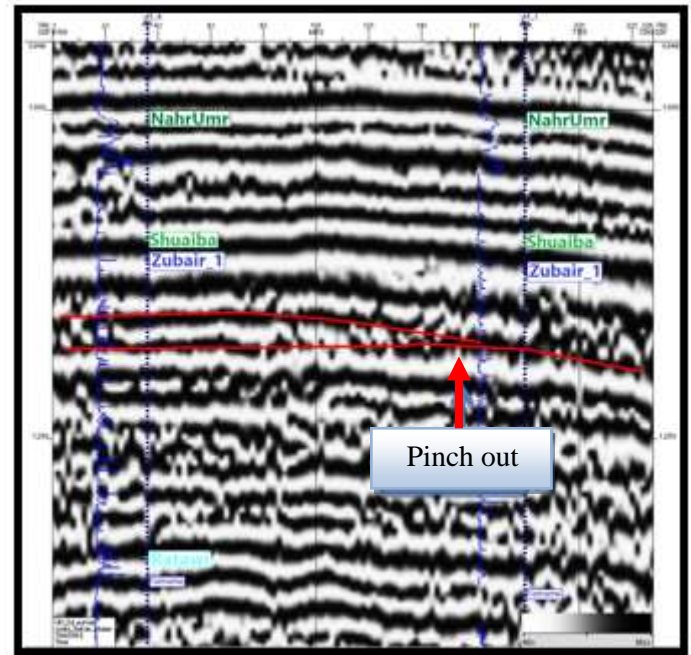


Fig. 18: Illustrate Zubair pinchout at (3D Kifl survey).

IX. DIRECT HYDROCARBON INDICATORS

The determination of DHI (Direct Hydrocarbon Indicator) which were difficult to identify it on the normal seismic sections, but using the seismic composite attributes (Band pass filter on an instantaneous phase attributes) has applied in order to clarify it. Where the use of this technique has helped to identify the (DHI) for hydrocarbon accumulation and have not been previously identified, this type of attributes has not been previously used.

- 1- Mound phenomenon has been observed in Inline 2185, these phenomena can be regarded as mound stratigraphical traps, underlying by flat spot which represents direct hydrocarbon indicator, Sands associated with channels often make good reservoirs for hydrocarbons. For this reason, the detection of channels is an important part of seismic interpretation for oil and gas exploration as shown in Figure (19).
- 2- Figure (20) show flat spot and channel in inline 21705.

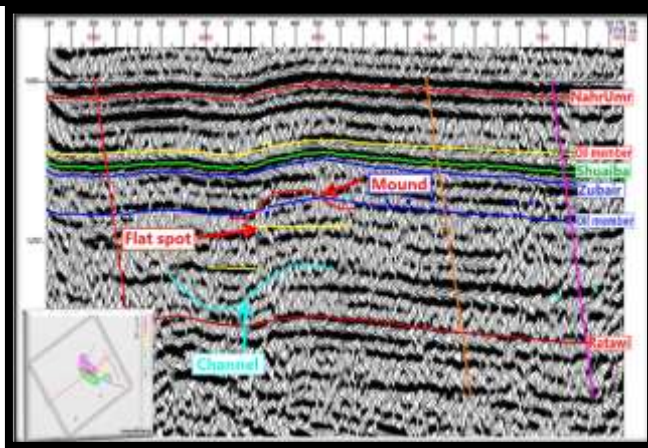


Fig.19: Composite attribute section of the Mound , flat spot & channel in Inline 21805.

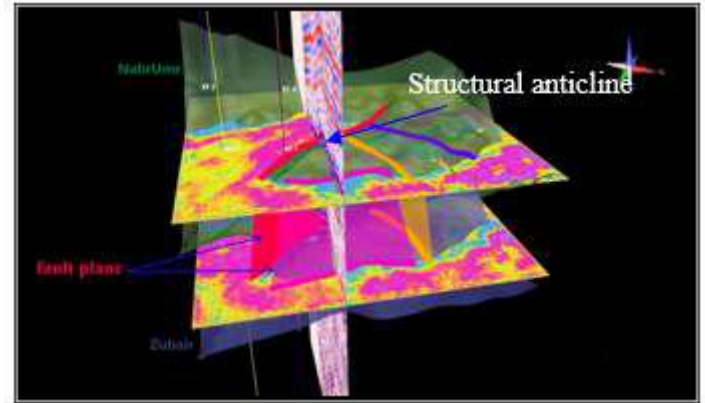


Fig.21: Show geophysical structural seismic model for Nar Umr and Zubair Formations with TWT map of them (3DKifl survey).

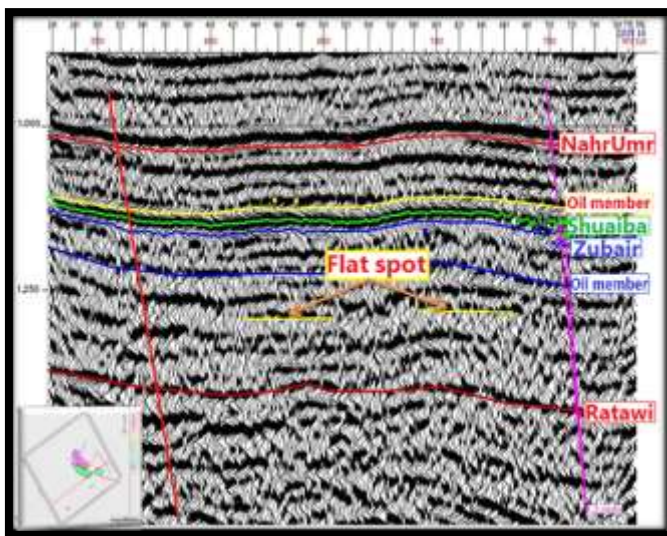


Fig.20: Composite attributes section of the flat spot in Inline 2115-21005.

X. GEOPHYSICAL MODEL

Geophysical models of the Kifl field were constructed based on the structural and stratigraphic interpretation of the 3D Kifl seismic data. The distribution of the oil in the area is not clear, several models have been developed with depended on the hydrocarbon indicators shows the distribution of oil in the area, The model capture essential structural features within the lower Cretaceous reservoirs, in order to do initial strategy for the future seismic work of Kifl field. TWT grids of the studied reflectors and 3D seismic volume of Kifl field were used as input in visualization program that are available in Geoframe software to construct the structural seismic model for Kifl field. Two faults system has been observed in the study area; the major normal fault of (NW-SE) trending and minor normal fault of (NE-SW) trending. Figure (21) seismic structural model show the extension of structural anticline and its plunge and the distribution of hydrocarbons accumulations in the Kifl field.

XI. CONCLUSIONS

- 1- A faults of NW-SE and NE-SW trending was picked. It extends from deep levels to influence the NahrUmr, Shuaiba Zubair and Ratawi Formations. It represents a normal fault has formed due to compression stress and vertical loading of sediments accumulations in the basin, these faults system played important role in the distribution of oil in the area.
- 2- The TWT, average velocity, depth maps of the studied area interpret the structural picture of the Kifl field. These maps Show the Kifl field is a structural anticline of trending NW-SE, the general of dip of formations tend to the E,
- 3- The average velocity maps show increasing of velocity value to the E and NE direction for (NahrUmr, Shuaiba, Zubair Formations), and to the SE for top of Ratawi Formation.
- 4- The depth maps for NahrUmr, Shuaiba, Zubair and Ratawi Formation were constructed which leads to illustrate the structural configuration of Kifl area. Depth maps reveal that the minimum depth values are noticed at the west and gradually increase toward the east and northeast.
- 5- Seismic attributes techniques were applied on Kifl oil field 3D seismic volume, which include, instantaneous frequency, cosine instantaneous phase, RMS amplitude, and reflection strength , these attributes show low values near four wells site areas, this indicates hydrocarbon accumulation
- 6- Seismic facies were determined NahrUmr, Shuaiba, Zubair, and Ratawi reflectors has parallel configuration, Zubair and NahrUmr facies are clastic depositional system deposited on delta platform Zubair represents delta platform facies consisting of shallow- water, high-energy marine

(delta sandstone, channel-fill sandstones), Sands associated with channels often make good reservoirs for hydrocarbons. For this reason, the detection of channels is an important part of seismic interpretation for oil and gas exploration

- 7- There are stratigraphic phenomena in Kifl field, seismic attribute (Cosin instantaneous phase). has applied to clarify it these phenomena can be regarded as Pinch out stratigraphical traps. The seismic section show that the thickness of the oil unit has been decreased toward the well Kifl1, and it's the main factor to explain the difference of the oil column between the two wells.
- 8- The seismic composite attributes (Band pass filter on an instantaneous phase attributes) has applied in order to clarify the (DHI). seismic reflection Mound and flat spot phenomenon has been identified, These phenomena can be regarded as mound stratigraphical traps, flat spot which represents direct hydrocarbon indicator. These can be either gas/oil, gas/water and oil/water contacts
- 9- Finally 3D seismic model for Kifl field show the extension of structural anticline and its plunge and the distribution of hydrocarbons accumulations in the Kifl field.

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