The possibility for Application of Advanced Geomatics Technology To Enhance the Current Techniques for Mine Detection Towards Achievement of Sustainable Development In Western Desert of Egypt

By

ADEL ALI MOHAMED ALI RASHWAN

B.sc. Civil Engineering Ain Shams University (1984)
Master of Science in Geodesy (1993)

A Thesis Submitted in Partial Fulfillment
Of
The Requirement for the Doctor of philosophy
In
Environmental Science

Department of Engineering Science
Institute of Environmental Studies & Research
Ain Shams University

2010

APPROVAL SHEET

The possibility for Application of Advanced Geomatics Technology To Enhance the Current Techniques for Mine Detection Towards Achievement of Sustainable Development In Western Desert of Egypt

By

ADEL ALI MOHAMED ALI RASHWAN

B.sc. Civil Engineering Ain Shams University (1984)
Master of Science in Geodesy (1993)

This Thesis towards a Doctor of philosophy Degree
in Environmental Science has been approved by:

1. Prof. Dr. **Mohamed Mohamed Ismail** , ----------
   Professor of Explosives,
   Faculty of Military Technical College (MTC),
   Vice Director of army research centre.
2. Prof. Dr. **Ibrahim Fathy Shaker**, ----------
   Professor of Surveying and photogrammetry,
   Faculty of Engineering, Ain Shams University
3. Prof.Dr. **Mohamed E. Eltoukhy**,
   Professor of Surveying and Geodesy, ----------
   Faculty of Engineering, Ain Shams University
4. Dr. **Mohamed Abdelmgaed Elnagaar** ,
   Chief of Development Sector , ----------
   National Organization for Military Production

2010

The possibility for Application of Advanced Geomatics Technology To Enhance the Current Techniques for Mine Detection Towards Achievement of Sustainable Development In Western Desert of Egypt

By

ADEL ALI MOHAMED ALI RASHWAN

B.sc. Civil Engineering Ain Shams University (1984)
Master of Science in Geodesy (1993)

A Thesis Submitted in Partial Fulfillment
Of
The Requirement for the Doctor of philosophy
In Environmental Science

Department of Engineering Science
Institute of Environmental Studies & Research
Ain Shams University

Under The Supervision of:	**Signature**
1. Prof. Dr. **Mohamed M. Nassar**, Professor of Surveying and Geodesy, Faculty of Engineering, Ain Shams University	Passed Away on 2004
2. Prof. Dr. **Mohamed E. Eltoukhy**, Professor of Surveying and Geodesy, Faculty of Engineering, Ain Shams University	----------
3. Dr. **Mohamed Abdelmgaed Elnagaar** , Chief of Development Sector , National Organization for Military Production	----------

2010

Acknowledgements

The author is ultimately indebted to soul of Prof. Dr. Mohamed M. Nassar for his continuous encouragement and support all over twenty years. This is not limited to the period of preparation of this thesis and previously the master thesis , hence before that was the period of the post graduate diploma and also the bachelor degree graduation year. This relation, which extends since my graduation on 1984 up to his passing away on 2004 was unbelievable, if measured with these days scale. The first lesson he taught us is (honesty is the first step towards any successful scientific research) .

My deepest appreciation for his dedication to scientific research and his colleagues' interests, for long years, which make him, deserves the title Egyptian Geodesy God father from all related people to this field in Egypt. My special thanks for his patience during the preparation of the research plan of this thesis, although of his sickness in his last months. I should admit my admiration for his open mind to listen to me, even if my research ideas looks strange or non traditional.

I would like also to extend my deepest gratitude and sincere thanks to soul of both of Prof. Dr. Osman Abou Beih & Dr. Mamdouh Ibrahim Mousa. My first teachers and masters in field of geomatics. Dr. Osman who takes my hand -20 years ago- to the field of scientific research, to publish my first technical paper , under his supervision. Dr Mamdouh also leads my first practical step in my first project after graduation -24 years ago- not only to learn geomatics observation techniques but also to understand, analyse and even to invent innovative procedures.

I am always remembering those three great masters Dr. Nassar, Abou Beih & Mousa and ask Allah great mercy and forgiveness for their souls. I cannot deny their favours to build my technical personality, but also, I should state if I achieved

anything in my life all the credit and thanks should go for them. May Allah reward their souls for all what they did for me and for many others of our friends and colleagues.

I would like also to depict my sincere thanks to Dr. Mohamed El Tokhey, who takes over the responsibility of this thesis supervision after passing of Dr. Nassar away. He is the main supervisor of this thesis and my master in geomatics field. Our relation extends for more than 20 years and he was always of great help to me. I even still remember his support during preparation of my M.sc thesis- 15 years ago - by providing me with the results of his PhD study and assistance in technical writing of the thesis. I am really appreciated his direct follow up and quick reply during his careful revision of the manuscript of this research. His interest, discussions and advices were constructive and helpful.

My deepest thanks extend to Dr. Mohamed Elnaggar for his continuous supervision of this thesis, as master of landmines science. His sincere interest and care along more than 5 years of preparing this study is highly appreciated. His continuous support and providing of many references was of great value to complete this work. His constructive criticism has helped in developing the concept of this research, which immeasurably improved both the style and contents of this thesis in addition to the invaluable discussions and comments. I owe him special respect for revising the technical papers prepared during this period.

I should also thank Dr. Prof. Mohamed Ismail, the professor in the technical military college for his effort during the first stage of this research and for introducing me to Dr. Mohamed El -Naggar to continue this work with him

and finally to judge the final thesis . Same thanks are extended to Dr. Prof. Ibrahim Shaker for accepting to join the thesis judgement Committee.Distinguished thanks to dr. Ashraf Mansour (MIM Owner &

General Manager), Mr. Abdel Maksoud Riza (Riza Owner & General Manager) & General. Abdelrahman (Mine

clearance Consultant) for their support and provided materials during preparation of this thesis.

Special thanks to Badreldin Petroleum Company Chairman, General Manager and colleagues in for their continuous support and assistance.

I would like to depict my sincere thanks and appreciation to my mother for her fruitful encouragement and my brothers for their continuous support.

Special appreciation goes to my wife for her patience, help, care and understanding. More thanks to my daughters for their help and support.

Finally I dedicate this dissertation to my father's soul, mother, brothers, wife and daughters.

Abstract

This research is concerned with environment maintenance and rehabilitation of the damage already happened during the conflicts and the wars. This environment damage is, unfortunately, not vanished with the end of these conflicts. The remnants of these wars are still there threatening all the life forms. Millions of unexploded ordnances and landmines are still buried everywhere around the world.

The mine detection and removal or explosion is the only available way to maintain the environment and get it back ready for different life activities. Demining methods and technologies are getting great enhancements during the last decades to cope with the international excessive needs in this regard.

Geomatics modern technology capabilities is playing great role to enhance and support Mine Detection activities. The author main concern is the evaluation of the currently adopted detection procedures in the western desert of Egypt and role of geomatics technology to enhance these procedures.

The thesis structure is divided to two main parts; first part is covering the global background of landmines problem in three chapters. First chapter includes invention history up to current status around the world. Second chapter is highlighting role of geomatics technology in both of mine action activities and development of mine detection technology. The international development in mine detection and demining fields and the progressive application of geomatics technology that is, Ground Penetrating Radar (GPR), Remote Sensing (RS) and Mobile Mapping Technology (MMT) is highlighted. Third chapter is covering the world trend to overcome the harmful effect on people and environment. This is mainly for both past and future activities in this field. Mine action is the approved trend to deal with the past activities for contamination of millions of mines and UXO planted

everywhere. Mine Banning is the other action for the future conflicts to avoid using this harmful weapon of landmines.

The second part of the thesis is also in three chapters; fourth chapter is evaluating western desert land mines dimensions, history and previous detection efforts and trials. This includes Technical, Economical and Social Evaluation of landmines on people and environment. Fifth chapter is highlighting the author experience in mine detection activities in the western desert and deploying geomatics technology to enhance these techniques. The author experience in handling and controlling this dangerous problem by implementation of advanced geomatics techniques is presented. The role of Geomatics technology to build information system for mine action is shown. The importance of the combination of current geomatics technology application i.e. Global Positioning System (GPS), Geographical Information System (GIS), Data Base (DB) and digital mapping (DM) to improve the different activities quality is focused. This includes the enhancement of mine detection techniques. The achievement of safe field navigation of different vehicles and heavy equipment in the cleared routes within the mine fields is discussed. The application of the adopted documentation system to produce accurate maps . The importance of comparison of these digital maps with original mine field maps to confirm or detect non mapped areas. The comparison between local and international techniques is carried out. The possibility of adopting more sophisticated ways to develop suitable alternative solutions of this problem is investigated. Finally, a Feasible and practical plan to overcome this problem based on the integration of different organization efforts is suggested.

Sixth chapter is drawing the future of western desert sustainable development in view of the country plan (2002-2022). The alternative Political strategies to deal with the existence of these explosives as main hazard towards investment and development of this region are investigated.

The author experience in Obaiyed pilot project is applied to check the feasibility of mine detection and removal plan. The overall technical and economical plan for clearing all the western desert development areas is presented. This proves the possibility of using geomatics technology to enhance the detection methods by building the geomatics information system for mine action GIMSMA. This system

is the main base of the future sustainable development of western desert.

The resultant clean & safe environment of such process is the main entrance to achieve sustainable development of this important region of Egypt. The current activities, experiences and successful projects, to invade the remoteness of this area are shown. This is reflected on the expected economical investment fields and will give practical dimensions to the future development plans.

Table of contents