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Designing Mind Map for a Good Research Proposal for PhD Student in the UK: Guidelines and Reviewing

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Abstract: ***At first glance, the research proposal may appear as challenges and inquiry for doctoral students, who seeking for funding to complete their degree and promoting their level of education. In this paper, we argue that a good research proposal with satisfying full documents that are required by University admission may help to obtain funding and improve the current research. This leads to enhance the research and create a new innovation to solve the current limitations in societies. Hence this paper will compare between different Universities and their requirements for a research proposal. Also, a guideline based on point of view will be highlighted. The mind map for research proposal was drawn to help to understand the contents of the research proposal with two real examples. The critical review of some publications was presented. Reviewing of literature review found that some Universities may not require a research proposal, while others are required research proposal with limited of words. This study found that the research proposal helps the University to consider the student's research area and it assesses if the University has a suitable supervisor in that area.***

Keywords: Research Proposal, Thesis, Mind Map, Freeze Water, Desalination water. Designing Mind Map, Detect the early fault, Diagnosis of a gearbox, Gunt-technology ET222

1. Introduction

In general, the most of the institutions provide guidelines for students in the preparation of research proposals. However, the writing a good research proposal is a critical issue, especially in the competition for research funding. The research proposal requires deep thinking about the researcher area and then followed step by step of the requirements of research and methodology to achieve the aim of research within a period of PhD course [1].

According to Cañado and Pennock-Speck [2], the application form is successfully completed if a full research proposal is accepted by the supervisor beside all documents are submitted to the relevant department. Although the author in [2] described the designing or planning phase of research that includes preliminary question, review of literature, research design, title, aims, research question and timetable, the research proposal would be more useful if the author highlighted the main elements of the research proposal and give a real example based on his knowledge.

Rothwell and Cloud [3] presented engineering- academic writing by creating formal documents of lasting value. It was discussed a strong writing project such as these technical reports and research proposal. The authors in [3] attempted to answer how to start and stay on track. It was found that writing can come naturally to engineers. However, one limitation of the approach in [3] is that does not explain what students will do if they are unable to write their research proposal.

Wentz [4] demonstrated how to write and present a successful thesis proposed. Some questions were given to recognise the research question. Although Wentz presented a good point that unknown aspect in the reading paper become the basis for the research proposal, the students who are unfamiliar with the topic how to recognise the unknown aspect. Perhaps the most serious disadvantage of methodology in [4] is that If author highlighted key points for students to recognise the limitation and challenges in the reading paper such as any assumption in the paper or impact of variation of elements. These items can help to recognise the research question which is a part of the research proposal. In this paper, the systematic procedure for writing a good research proposal for the PhD degree is presented in details. The example will be given to support students and clarify the procedures for writing a good proposal. This paper recognises as follows. The mind map for research proposal is designed and reviewed the content of the research proposal and followed by highlighted the advantages of a good research proposal. After giving the recommendation and advice for the research proposal, two examples for a real-life proposal will be discussed. The final section will summarise this paper and draw the conclusion.

2. Method of Mind Map for Research Proposal

The software that available at [5], was used to draw a mind map and flow chart for research proposal as shown in Fig.1.A and B. This figure includes five sections that are necessary for the research proposal and also the flow chart of research proposal was drawn.

3. Review of Contents of Research Proposal Based on Previous Studies

The research proposal should include research question that explains why the research is practically important. For

example, the proposal of freeze water distillation is important due to the demand of fresh water supply is exceedingly increasing. The freshwater sources are limited and many countries suffer from lack of fresh water. The fresh water is very useful for drinking, cooking, agricultures, and industry sectors and so further on. Furthermore, the research proposal should include the aim and objectives. These objectives should be clear with describing in two or more of key aspects. Therefore, the above two elements which are research questions and aim and objective should be written based on critical review of previous studies, which is considered as the third part of the content of the research proposal. The fourth section should describe the methodology of the project. The methodology of the project could be interviewed as primary research, questionnaire as secondary research. The methodology could be a framework, case studies, modelling, or experimental work or complementary of the numerical model with verification by experimental test. The fifth section should present the procedures to collect the data or acquired results, which should be followed with extensive analysis and discussion. The final section must have listed the references after presenting the timetable of the project for three years which is called a Gantt chart.

Table 1: Template for research proposal provided by Coventry University

Project Title The title of your project must reflect the content (20 words)
Aim and Objectives Supply an overall aim and approximately 3 or 4 objectives that the research will address (300 words)
Relevance to Professional or Academic Field/Literature review Describe using referenced material (no more than six key texts) • How your proposed research will fit into the existing body of academic knowledge and practice in the professional field. • How your research will enhance knowledge or contribute to new understandings in the subject (1000 words)
Research Approach or Methodology 1. Describe the methods you intend to use to deliver your aim and objectives. 2. Provide detail of data source and any specialist resources or facilities you may require (400 words)
Expected Outcomes Summaries the outcomes/personal development that you hope will result from the project (280 words)

Some examples from different higher institutions in the United Kingdom will be discussed to facilities writing the proposal for the PhD degree. Coventry University provides specified guidelines for writing a research proposal which is presented in ref. [6] as the template. Although this guideline as listed in table 1 [6] is very useful and provide proposal guidance, but it is limited the words by the maximum of 2,000 words and does not show the Gantt chart of a proposal. However, the University of Nottingham [7] has word account limited that in ranges from 1,000 to 3,000 words. Also, the University of Oxford [8] has a limited research proposal no longer that 3000 words.

The university of Leicester provides the checklist with a good starting point for writing a proposal as listed in table 2. This table is part of the project, which will help students to write a research proposal [9]. However, this checklist needs to address the timetable for the project. It is important to bear in mind that there are some researchers, depending only on the experimental work and fact. Hence, the requirements of experimentations are required to be included in the checklist along with the timetable for three years.

Table 2: Checklist is provided by the University of Leicester

Questions	Answers
Topic:	This project will study...
Question/problem:	To find out...
Significance:	So, that more will be known about...
Primary resources:	The main data will be...
Secondary sources:	Additional data come from (e.g. books/journals etc)….
Methods:	The research will be conducted as follows...
Justification:	The method is most appropriate because...
Limitations:	There are some matters that this methodology may not help me to explain. These might include...

On the other hand, some universities do not require the research proposal. For example, the University of Cambridge encourages students to write a brief research proposal, but **is not required** to do so as shown in Fig. 2 [10]. Some universities require specific template such as the University of Edinburgh [11].

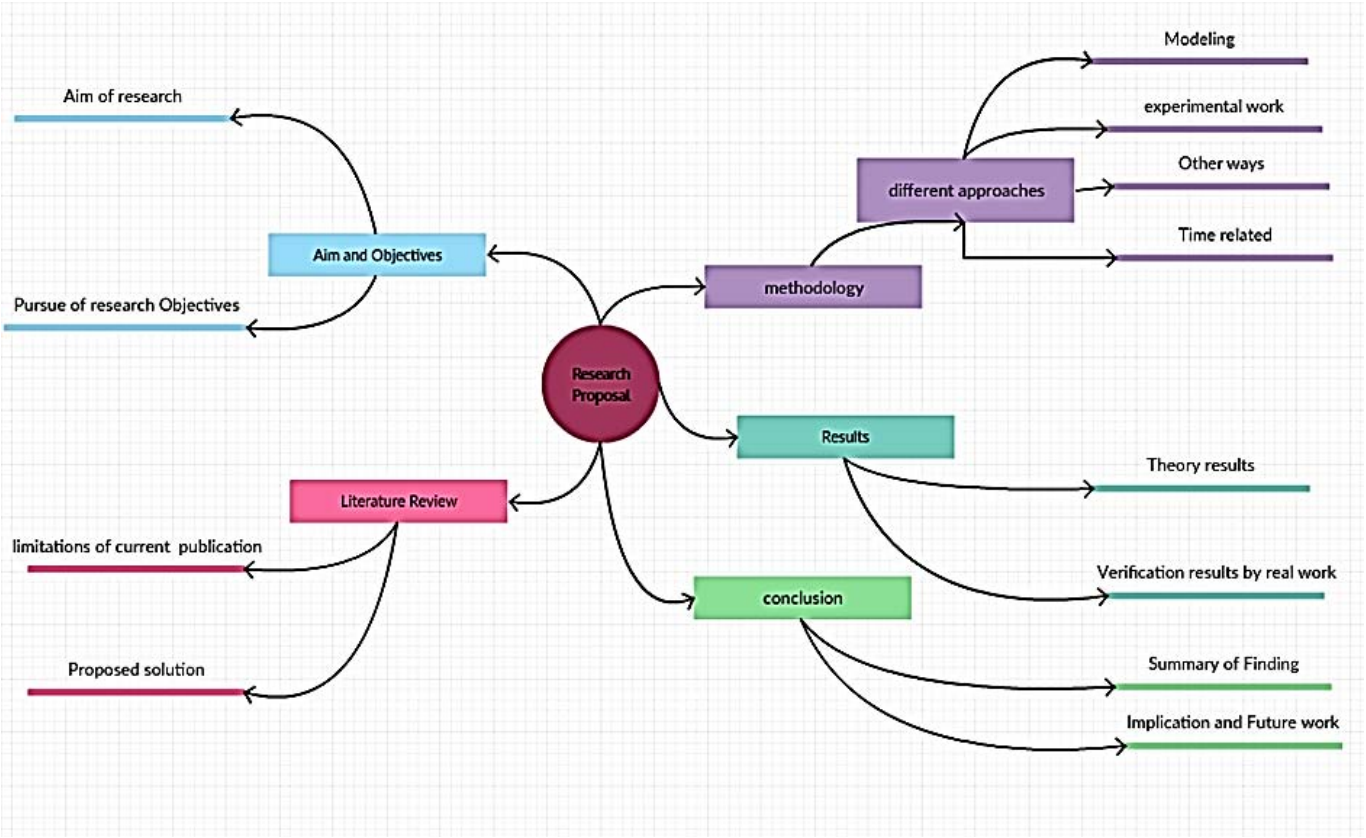

Figure 1: A. Mindmap for research Proposal

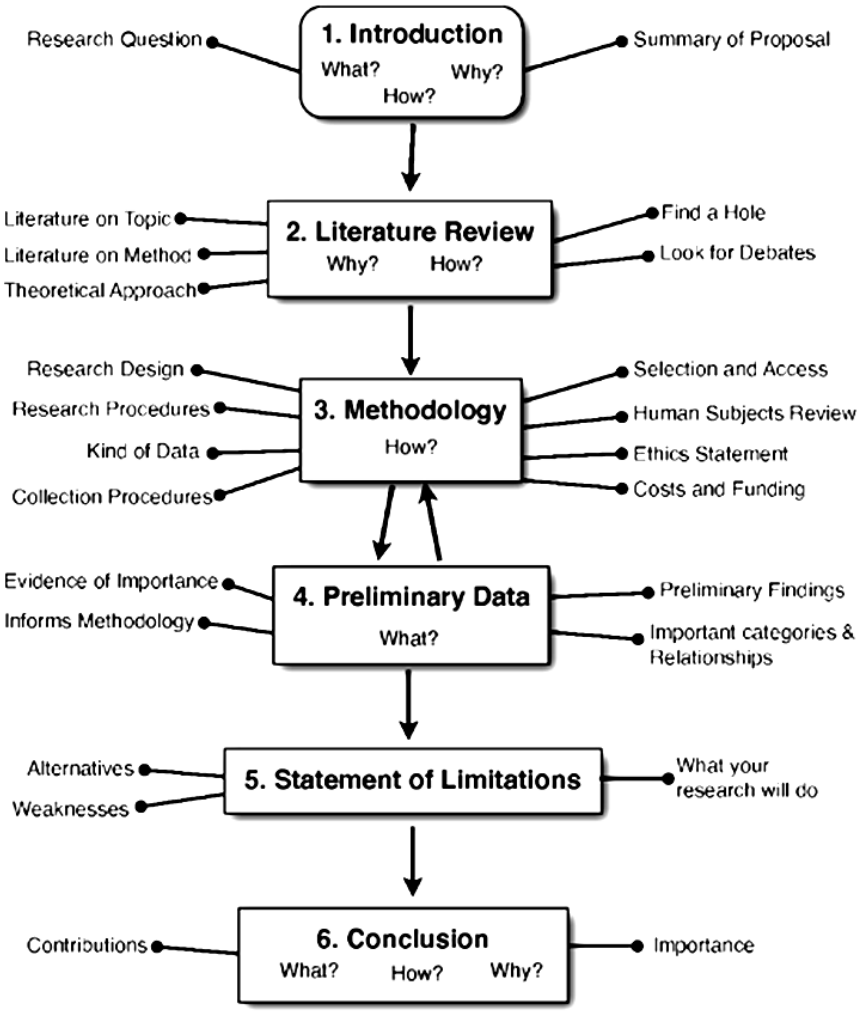

Figure 1: B. Flow chart of research Proposal

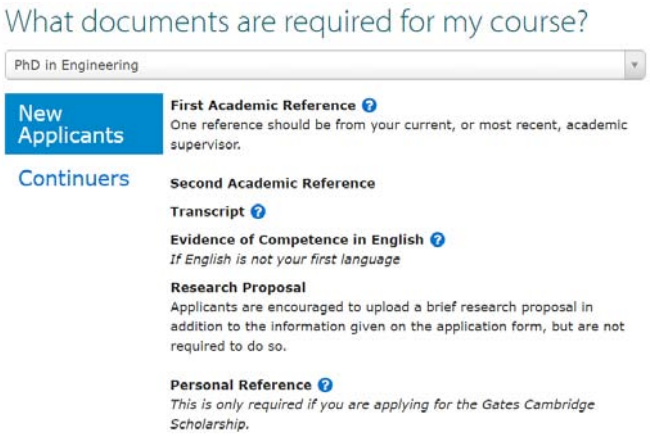

Figure 2: Research proposal is not required to do so by the University of Cambridge.

4. Benefits of Research Proposal

A research proposal is a concise and coherent summary of proposed research with intelligent content [12]. A research proposal highlights the general area of study which describes the current knowledge of research and the research proposal should be included recent debate topic. The proposal is the most important to following [8]:

1) It demonstrates the originality of proposed research. Also, it demonstrates that the research proposal is significant, necessary, and feasible to be taken.
2) It gives an opportunity for students to demonstrate the aptitude for graduate level research.
3) The research proposal also helps university's staff to match the research of student interest with an appropriate supervisor.
4) According to [11] a research proposal helps the university to assess the suitability of researcher for a research degree and determine who will be the supervisor.
5) It can also be utilised to apply for funding. In the other words, a good research proposal can persuade potential supervisors and/or funders of the importance of the work, and why the supervisors are the right person to undertake it.

5. Advice and Recommendation Based on Point of View for Research Proposal

In writing the research proposal, the first step to check, the website of a university that the students would like to study at, and then searching for the potential supervisor, where the website will help the student to find the most publication and the research that the supervisor is interested in. Find the most recent publications for the supervisor. This all should be done after contacting by university admission and asking if they required research proposal or no? Some departments or universities do not require the research proposal as mentioned above. Once the recent papers have been completed reading, the following steps are required to follow and there are ten steps are very useful in [1, 13, 14]:

1) Make the template for research proposal and break down research proposal into sections, as described in the section below. Hence, the content should include a title, introduction, aim and objectives, research question, literature reviews, methodology, data collection, results and discussions, time table and references.
2) The topic of the project should be clearly defined where the researcher keen to demonstrate research area.
3) Set out some questions that the research proposal will be addressed.
4) Establishes the relevance and value of the proposed research question in the context of current academic thinking.
5) Describes and evaluates the data or source material of research requires.
6) All students are recommended to use the following website in ref. [15]. It contains a variety of examples that will help to start writing.
7) Summaries a clear and practical procedure, which enables the researcher to answer the research question. Advise all students while reading an academic paper to think about structure and the thesis or proposal, which almost is nearly the same title, introduction, aim and objectives, literature review, research question, approach, results and discussion and conclusion along with references.
8) Advise students who have a limitation in vocabulary, especially international students to use the tool online in ref. [16], where the text that needs to be paraphrasing to paste on the top and answer the mathematical question, where the below the paraphrasing will appear after the Go icon is pressed.
9) Clearly, state what the researchers hope to realise at the end of the research and what new areas it might open up.
10) Check the university or department are required research plan and timeline. Some department may not require a research plan [17]

6. Real Example of Research Proposal

According to [18] for the Freeze Water Desalination "The demand for fresh water supply is exceedingly increasing due to the rapid growth of global population and economic development. With limited fresh water resources, desalination of sea water offers potential to meet the increasing water demands. Generally, most current water desalination technologies are energy intensive and have a high carbon footprint. This project aims to investigate the use of stored cold energy in cryo fluid (liquid air, liquid nitrogen or liquid natural gas) to develop the freeze desalination system. During the freezing process of sea water, salts will naturally separate as the clean ice crystals form. The work will involve developing the computational fluid dynamic modelling of the freeze desalination process and investigate the effect of the various parameters affecting the water production. The work also involves the development of a representative prototype to validate the simulation and prove the concept. A major advantage of this technology is the exploitation of cold energy stored using surplus electricity at off-peak hours thus minimising cost and carbon footprint". Based on the structure at the University of Oxford and authors in ref. [1, 14], the structure will include:

6.1 Title of Research Proposal: Freeze Water Desalination

This project will be considered for the PhD degree. Thesis proposal title "evaluating different methods to convert salt water to fresh water with the extensive investigations of freeze water desalination".

6.2 Statement of Research Proposal

The demand of fresh water supply is exceedingly increasing due to the rapid growth of global population and economic development. With limited fresh water sources, desalination of sea water offers potential to meet the increasing water demands. The fresh water that fetches from the wells after periods of time become salt water as in my country Libya, which highly affects the agriculture sector and the variety of aspects of life. Generally, most current water desalination technologies are energy intensive and have a high carbon footprint.

6.3 Research Aim and Objectives

This project aims to investigate the use of stored cold energy in cryo fluid (liquid air, liquid nitrogen or liquid natural gas) to develop the freeze desalination system. During the freezing process of sea water, salts will naturally separate as the clean ice crystals form. The specific work will involve developing the computational fluid dynamic modelling of the freeze desalination process and investigate the effect of the various parameters affecting the water production. These parameters will include the impact of variation temperature and other materials. The work in this thesis also involves the development of a representative prototype to validate the simulation and prove the concept. A major advantage of this technology is the exploitation of cold energy stored using surplus electricity at off-peak hours thus minimising cost and carbon footprint.

6.4 Review of the literature

The initial research will brief review of the current research in the field of developing the freeze desalination system. The history of this technology will be investigated in depth with constructive criticism of existing research in this field. This will help to develop a real framework to test the impact of variation of parameters, where the optimal value for the most parameter will be determined to develop a system that able to accomplish advantages of the exploitation of cold energy stored using surplus electricity at off-peak hours. This will help to use energy during the off-peak, where the control system will be implemented to sensor the off-peak hours and respond for this period. By this way, the project will reduce the cost and will be a friendly environment. Not only this, but also will help the distribution network to manage the system and make the distribution network is more stable and balance.

6.5 Modelling and Theoretical Orientation of Research Proposal

This section should outline the theoretical approaches that take on the topic and indicate which approaches propose to use in research and why? For example, the Freeze Water Desalination Proposal will be used as follows. Frist of all, the desalination has become one very important topic nowadays for most counties that lack of a resource of water and extended on the sea water which is brine water. This desalination topic is very substantially due to many advantages such as low energy requirements, immunity of fouling and corrosion or scaling [19]. Furthermore, this process can produce various salts from sea water and reduce the reject brine. The desalination process is based on the fact of that ice crystal is very important to obtain pure water. Although there are many advantages of freezing water desalination, it requires many steps such as the separation of ice crystal from the brine, cleaning of this ice where the adhering salts on the crystal surface are required to remove, and finally melting process of ice to obtain the fresh water. In other words, the processes are freezer, washer, Melter and heat removal system. However, until 2010 and based on the literature review of the desalination by freezing that studied so far, there is no attempted for commercial application has been successful to establish freeze water desalination [19]. Hence this study of freeze water desalination requires more investigation and building real systems with considering the cost of energy where it reduces at an off-peak time.

6.6 Research Methods of Freeze Water Desalination

This section must give a brief description of proposed research methods, including the type of information and sources to be used, the main research methods to be employed, any resources needed and any ethical or safety issues identified [14]. This methodology is described as shown in Fig. 3. The extensive study of Freeze Water Desalination will be considered in firstly and then the model of the system will be implemented to study the impact of variation of parameters under different conditions.

6.7 Tentative chapter outline

This thesis will consist of seven chapters.

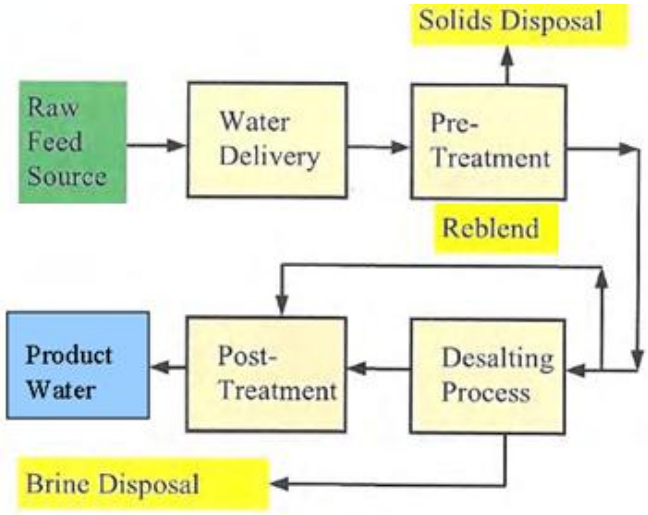

Figure 2: A simple diagram of Freeze Water Desalination [20].

Chapter one presents an introduction of thesis while chapter two will be criticised the existing and recent publications in the field of freeze water desalination. Chapter three describes the methodology of the project and following by chapter four where the different procedures of the experimental work will carry out with the acquired results of experimental work. Chapter five will show the modelling framework of the system and display the obtaining results of this framework. Chapter six will extensively discuss the obtain results from the modelling and experimental work where the comparison between them will include in this chapter. The final chapter will draw conclusions and implication of project with extending of future work. Also, the limitations of the project with answering research questions in chapter one will be answered in the final chapter.

6.8 References/Bibliography

The list of references of Research Proposal should be included in this section. However, since this is part of paper, all references are listed in the references section.

7. Another Example of Research Proposal

A real example of research Proposal for PhD degree is given as shown in Fig.4 as it introduced to Nottingham Trent University

Condition Monitoring of Wind Turbines for Condition-Based Maintenance

Abstract
The maintenance cost of wind power has been increased due to the variety of weather and strong wind. Also, the wind power is expected to be 8%from the world total energy by 2018. This all show the importance of monitoring and predicting the fault in wind turbines before occur.
This project will focus on the condition monitoring of wind turbines for condition-based maintenance and develop the approach to predict the early fault to reduce the challenges and serious problems in wind power. Particularly, the sensor of vibration, sound, speed and torque will be used to diagnose the early fault such as lack lubrication and improper installation. If the wind turbine breaks down, it will significant impact on the normal power generation and waste the time and money during the repair period. Hence, this project will also find the way to protect other wind turbines if one wind turbine has occurred fault due to any reason with electrical or mechanical faults.

Keywords: Wind Turbines, detect the early fault, diagnosis of a gearbox.

Introduction:

The project topic is monitored and intelligent diagnosis of a gearbox system in wind power. This topic is very important to detect the early fault and it is very useful for all rotating types of machinery. A gearbox is subjected to improper installation, lack of lubrication and damage due to breakage part. Therefore, the sensor such as vibration and sound and several stages of signal processors are required to explore the early fault [1]. Although many studies attempt to find a suitable procedure by using sensor and multiple of analysis in the time domain and frequency domain for the error, it still needs more investigations. In the other words, it is still difficult to find effective sensor parameters to detect abnormal events in gearbox system, which will be used as a simulator for a wind turbine. Therefore, this will be part of future work, where the worst case for the gearbox system will be tested and produce a novel contribution such as design a feedback control to avoid this problem. In fact, there are many aspects in this field and this rig is ready in the laboratory as mentioned in the paper [2, 3], as shown in figure 1.

Summary of the-state-of-art:

Recently, the fossil fuels cause harm environment and global warming issues and it may deplete soon. An alternative option is renewable energy as it is clean and renew with the timely and friendly environment. Hence the renewable energy is very important and reduces the pollutions [4, 5]. Among all renewable energy sources, wind power is the fastest of renewable energy growing in the term of the capacity and exploitation[6]. In 2014, the European and Energy Association invested $18.6 billion in offshore wind projects where produce 8 GW [4, 5]. The global wind power mounted $2.746X10^9$ MW, while $2X10^7$ MW is only the part accomplished users [4,8]. Hence, it is still $272.6X10^7$ MW. Also, according to [5], the wind power is expected to be 8%from the world total energy by 2018. Recently, an investigation into using and perspective of renewable energy, including the PV system and wind farms were discussed by Mohamed, et al. [7]. It is shown that by 2020, the renewable energy. In Libya, will share with10% of energy where the wind power will be 1500 MW. The fault in wind power could be electrical or mechanical faults. The electrical fault as the SCADA data that obtained from an operator of wind farms was used by Cross and Ma [8] to detect grid and power electronic faults, while Alkhadafe et al.[2] used the automated sensor and signal processing approach, for the design of condition monitoring systems for developing an effective monitoring system for gearbox fault diagnosis. Therefore, the faults in this project will be classified into mechanical and electrical faults. An intelligent condition-based monitoring and maintenance system for the wind turbine was presented by Fan and Zhan [9]. The system can reflect wind turbine in real time and give a quick warning and maintenance plan before the equipment dysfunction. However, the acquired results were based on simulation and were not verified experimentally, which may have challenged in practice. Conduction monitoring and fault reflections in wind turbine were presented by Merabet, et al. [10]. It shows that the main obstacle in [10] that the back of an accurate analytical model to describe a faulty of doubly-fed induction generator. Although it was used fuzzy logic technique and the proposed technique was unified by simulation, the results are ignored the various non-linear elements in the wind turbine and it assumed as a linear system. Therefore, the further information and study are required for the predict the serious fault. According to Frangopol, et al. [11], there are some applications to condition-based maintenance optimisation, which are reviewed. This was predicted by studies department of renewable energy Authority in Libya. Since the Libya is interested in deploying wind powers, therefore, these wind powers are required to predict the fault in advance to avoid the serious problem and prepare the spare part in advance. There are some sensors in wind turbines that are used in the control loop. These sensors could be in blade root torque or the generator or rotor speed. Therefore, it is very useful to detect faults in the corresponding sensor with a view to fault –tolerant control. These techniques were presented by the authors in [12-15], which may be difficult in practice.

This proposal is an investigation of condition monitoring of wind turbines for condition-based maintenance. It is organised as follows: problem definition is presented in brief details followed by the aim of the project. The five objectives of the project are highlighted, while the methodology and project plan so far have been described respectively. These the methodology and project plan may change in

future that depend on the availability of equipment. The final section drew the conclusion of this proposal with a list of references.

Problem Definition:
There is no effective method to predict the fault in wind power. The wind is varied and may cause a serious problem which leads to dysfunction of the wind turbine. For example, the erratic wind environment creates a challenging issue in wind turbine [16]. Therefore, there are many gap and limitation in wind turbine that needs further investigations and improvement.

Aims:
The main aim of the work is to investigate Condition-Based Maintenance of the gearbox and the generator.

Objectives:

- Detailed objectives (e.g. Literature review, experimental work, building a system, analysis, etc.)
- To conduct a literature review on wind energy turbines and their condition monitoring and condition-based maintenance.
- Select suitable sensors (e.g. vibration, acoustic emission, forces, torque, current) to monitor the system.
- Conduct experimental work.
- Develop image/signal processing and artificial intelligence system to accurately identify the progression of faults.

Methodology:
The test rig as shown in figure 1 from gunt-technology ET222 (the first of its kind): which includes a motor to simulate wind energy, a gear box and a DC motor to generate electricity.
The procedure of this work will carry on the workGunt-technology ET222 simulator will be used to conduct the experimental work and investigate Condition Monitoring of Wind Turbines for Condition-Based Maintenance.

Figure 1: WorkGunt-technology ET222 simulator that is available at Nottingham Trent University

Project plan:

The project is expected to be completed within three years (full time). An example of the quarterly plan of three years' duration could be shown in the following table, which may change in future:

Year Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Year 1	Review of current literature Milestone: Report	Milestone: e.g. software, paper, report, algorithm, etc. Developing the numerical model of wind turbine	Testing the simulation model with the effect of various faults Prepare for the first-year report Publish reviewer paper	Improve the report after peer review Assessment of the first year
Year 2	Starting real experimentation to develop the system	Verify the acquired results	Writing a journal paper	Milestone: MPhil to PhD Transfer Report
Year 3	Thesis structure	Completed thesis chapters	Preparation for Viva Voce	Milestone: Submission of the PhD thesis Writing more a journal paper

Conclusion:
With a wind turbine, many problems, where it requires periodic maintenance. Although the wind power produces more energy than, the photovoltaic system, but it required observation and monitoring such as Lubrication. We identify some problem in a wind turbine. Therefore, the rig in the laboratory of Nottingham University will be used as a simulator or emulator for wind turbine after three months of the period of study, the author will explore the full details of wind turbine and model the wind turbines to be able to match with real wind turbines. Hence, it will help to predict the early fault, where this model will test the impact of change parameters in a wind turbine.

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Figure 4: Simple Research Proposal as a real example.

8. Conclusion

This paper is very useful for the most students prior starting PhD degree. This work facilitates procedure to writing a good research proposal. In general, a thesis is critical investigation and evaluation of recent study in field of proposed study. A thesis is independent and original contribution and fact to the knowledge's. Also, the student should have ability to undertake the research without supervision. Hence, a research proposal is considered an important element as it part of a thesis. The comparison between a different institution in the UK was presented where some universities do not require a research proposal, while others require no more than 3000 words. An example was given which it helps with construction the research proposal sections. From point of view, the eight sections should be included in the research proposal. Also, some institutions have a specific form that is required to complete a research proposal. Hence, during the written research proposal, the students are recommended to read through the website of the university to be familiar with regulations and policy of this university. Also, I advise all students to read and check the most references in this paper, where there are some references are very useful such as some websites. As part of future work, the simple presentation will be posted on YouTube to help disable people.

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