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THE BARRIERS TO THE IMPLEMENTATION OF GREEN ROOFS & POTENTIAL
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Abstract

Green Roofs are viewed by most of the planners, designers, and architects to benefit local amenity and help in enhancing the overall environmental conditions around buildings. In the context of broader urban the technical advantages about by these built form treatments in hot and temperate atmospheres also help in minimising the heat island effect. The concept of green roofs is comparatively a very recent phenomenon, although there have been a substantial amount of normal roof in building designed in the past five decades, at the same time as designers and architects have tried hard to deal with sun light and other whether conditions.

However, the basic objective of this research study is identification of the barriers to the implementation of Green Roofs as well as the potential solutions to promote Green Roofs. The study also aims to develop concepts on a comparatively new research domain for urban designers and planners.

Both primary and secondary research methods are used in this research study to collect most relevant qualitative data. So, the author of the study will conduct interviews with architects (n=15) and roofing contractors (n=15) who will be the subjects of this study. The study will also review the literature, including journal article, textbooks, and other academic materials to collect secondary information regarding the green roofs implementation, benefits, barriers, and promoting solutions.

The findings of the study are that 71% of roofing contractors already offer green roofs as a material, but a smaller number of architects (12%) have used green roofs in over 20% of their projects and of these projects a large proportion didn't make it to the construction stage. The common view amongst exhibitors is that grant funding and increased awareness is needed.

In conclusion, the benefits are widely recognised in the UK industry and across the world as well. The cost is putting the majority of people off. People do not want to have a negative impact on the environment; however, some people are willing to use green roofs and pay high amount for it. The governmental authorities need to subsidise the initial cost of implementing green roofs with financial support and should also start the programmes to promote the green roofs.

Chapter 1: Introduction

1.1. Introduction

Affecting both horticultural circles, architectural and environmental, green roofs have attracted much interest in recent years, especially in densely populated urban areas. Only in 2006 North America, an estimated 362 new projects emerged, for a total area of 254,513 m² (2.74 million ft²), representing an increase of 24% in 2005¹. Green roofs have also reached to the United Kingdom and Canada in the last few years and appeared to be a promising technology.

However, in the last few years as building form transformed in the bid to acquire efficiency, most of the designers and architects have not taken into account the opportunity for inclusions of green roofs in their building forms. The concept of green roofs is comparatively a very recent phenomenon, although there have been a substantial amount of normal roof in building designed in the past five decades, at the same time as designers and architects have tried hard to deal with sun light and other whether conditions.

A majority of the literature give examples of the earliest green roofs that acknowledged for vertical roof and modern roof top gardens and it has been observed as stemming from Germany. As far as the Post-European settlement in Australia, examples of green roofs and exteriors are there from the early era of twentieth century comprising residential flats in Perth (Figure 1). A very significant point is that it has been the development and enhancement of people understanding regarding sustainability and green roofs that has stimulated a recent rise in the people interest and implementation of green roofs.

¹ Pickard, A. J. *Research methods in information*. Facet Publications; (2013).



Figure 1

There were a majority of research work has been carried out in the field of green roof systems and the quantity appears to rise during the last few years as environmental concerns become more intensified across the globe. The research works that have been carried out in the green roof field can be divided into seven groups, including management of storm water, research on materials, research on barriers and opportunities or incentives, research on atmosphere, research on energy and building, research on insights and views, and research on guidelines. Researchers performed a research on Green Roofs for Stormwater Runoff Management as the study of storm water management. They reported in their research study that the green roofs are completely able to eliminate 50% of the rainfall annual volume through retention and evapotranspiration. Rainfall not maintained by green roofs is detained, efficiently enhancing the time to peak, and decelerating peak flows for a watershed². However, Carter and Jackson (2007) also performed a study on the subject of Runoff water quality from intensive and extensive vegetated roofs³. This

² Carter, T. and Jackson, C. Vegetated roofs for stormwater management at multiple spatial scales. *Landscape and urban planning*; (2007), 80(1), pp.84--94.

³ Carter, T. and Jackson, C. Vegetated roofs for stormwater management at multiple spatial scales. *Landscape and urban planning*; (2007), 80(1), pp.84—94.

research explored the impact on runoff water quality from larger vegetated roofs. According to the findings, intensive and extensive vegetated roofs are a sink of nitrate nitrogen and ammonium nitrogen with comparable performance. In contradiction of the extensive roof, the intensive vegetated roof is also a sink of total nitrogen. While a comprehensive research study has been carried out by Rea et.al, (2012) on water quality assessment of green roof storm water treatment systems. They found in their research that the use of green roof storm water treatment systems for the enhancement of storm water quality is an effective option of treatment⁴. The results of total suspended solid were that the green roofs had a low level of concentration and lower standard deviation as compared to the control chambers.

However, the terminology to define green roofs system in literature and policy is enormous but inconsistent. Green roofs as a term that was emerged in early research works and discussions with Professor Robert Freestone which covered flora based roofs as well as walls. This term is employed throughout the research works including the use of a vertical and a horizontal green roof that holds flora. For this terminology, the preference is to identify a vital approach to identifying the method of integrating flora into the building's roof and facades. The research study found that most of the people were unsure of what "Green" was concerning about to, so to develop obvious definition of what is being researched and circumventing green washing⁵.

The biophilia concept, the instinctive need for interacts with nature; a term invented by E.O. As favourable circumstances to develop green roofs and spaces at the ground level, consistent with the growth of population, become more restricted the desire will alter the means green roofs and space that which green roofs and space is provided experienced.

Managing the anticipations and risks of the green roofs' users will also become more and more significant as the technology is integrated more extensively. The influence of the current and future environment, fire risk, pests and preservation are all fearful factors that have the ability to

⁴ Rea, L. M., & Parker, R. A. Designing and conducting survey research: A comprehensive guide. John Wiley & Sons; (2012).

⁵ Yang, J., Yu, Q. and Gong, P. Quantifying air pollution removal by green roofs in Chicago. *Atmospheric Environment*; (2008), 42(31), pp.7266--7273.

distress property owners, nevertheless the success of green roofs will to be make sure that the advantages out weight these fearful elements.

1.2. Objective of Research Study

The basic objective of this research study is to discover the barriers to the implementation of Green Roofs and potential solutions to promote Green roofs. The study also aims to develop concepts on a comparatively new research domain for urban designers and planners. There are the following research objectives to assist achieve these:

- Provide definition of what green roofs are and why they are vital.
- Address the benefits of green roofs.
- Address the major barriers to the implementation of green roofs.
- Identify the potential solutions to promote green roofs.

1.3. Research Questions

- What are green roofs and why they are vital?
- What are the core benefits of green roofs?
- What are the major barriers to the implementation of green roofs?
- What are the potential solutions to promote green roofs?

1.4. Research Methodology

Both primary and secondary research methods will be used in this study to gather qualitative data. In doing so, the author of the study will conduct interviews with architects and roofing contractors who will be the participants of the research. Besides interviewing method to collect primary data, the study will also review the article, journals, textbooks, and conduct other academic research to collect secondary information regarding the green roofs implementation. The interview questions will be based on the above research objectives.

1.5. Research Design

This research study is based on the following chapters:

- **Chapter 1** is the introduction chapter that reflects the overall approach of the study through defining the research topic, research objectives, research questions, research methodology, etc.
- **Chapter 2** is the literature review section where secondary analysis will be conducted through reviewing past research works and developments of different authors.
- **Chapter 3** is the research methodology part of the study that will describe the overall method of data collection, identify the participants and overall approach how to collect relevant data.
- **Chapter 4** will present the research results and findings as well as analysis of such findings.
- **Chapter 5** is the section of discussion in which the collected information will be thoroughly discussed.
- **Chapter 6** is the conclusion section where findings and major conclusions will be presented in a concise manner.

Chapter 2: Literature Review

2.1. Green Roofs and Their Importance

Green roofs are not a new phenomenon. This is a standard construction method that most of the countries worldwide have adopted for hundreds and even thousands of years for excellent insulation layers of vegetation (grass) as well as soil. In the winter season of Iceland and Scandinavia, the grass roofs assist keep structures warm, while in warmer climates such as Tanzania they assist keep cool. The initial examples of green roofs in Canada dates back to Viking times, which were adopted later by the French architects and planners in the provinces of Newfoundland and Nova Scotia⁶.

Le Corbusier and Frank Lloyd Wright, well-known architects in the history, are two ardent defenders of modern green roof technology. If Le Corbusier supported the use of green roofs in urban areas and Wright advocated this system as a tool to better integrate in buildings scenery, they did not realise the deep environmental and economic impacts that this technology could have on the city scape.

Until the mid of 18th century, there were no green roofs as a construction method. Nevertheless, in the 1960s, growing concerns raised degradation of environmental quality and rapid depletion of green spaces in city areas have revived interest in green roofs as an ecological solution in North Europe⁷. More technical studies were taken from those on anti-root agents, membranes, and the drainage of the substrates light up growth studies relevance of certain plants.

In Germany, the market of green roof has expanded with fast pace in the 1980s, annual growth while reaching between 15 and 20% and the number of square meters going from one to ten million. Much of this massive level of growth is the result of laws passed by the State, Municipal Aid and allotting 35 to 40 DM per meter square roof. Most of the European states have

⁶ Williams, N., Rayner, J. and Raynor, K. Green roofs for a wide brown land: Opportunities and barriers for rooftop greening in Australia. *Urban Forestry & Urban Greening*; (2010), 9(3), pp.245—251.

⁷ VanWoert, N., Rowe, D., Andresen, J., Rugh, C., Fernandez, R. and Xiao, L. (2005). Green roof stormwater retention. *Journal of environmental quality*, 34(3), pp.1036--1044.

introduced incentives like. Several municipalities have integrated green roof technology to their policies and regulations. As an instance, Stuttgart in Germany requires the application of this technology to all flat roofs of new industrial buildings. Vienna, on the other hand, also provides grants to the construction of green roofs for new buildings during planning, installation and the construction, to make sure the maintenance in the long-term. At present, according to Mees et al. (2013), more than 75 European municipalities provide incentives or regulations for the implementation of green roofs. The main reason for this support is the core benefits comprise the reduction of storm flow and enhancing the quality of air and water. So, a new sector has established construction industry, and green roofs have become a most common feature of the urban areas⁸.

2.2. Benefits of Green Roofs

Green roof can facilitate with numerous advantages. They can be employed as a tool of storm water management wherein they minimise storm water runoff. They could facilitate with amenity space for the owner of building, and even cultivate fruits, vegetables, and flowers, filter air contaminants and carbon dioxide (CO₂) in air, filter impurities and hazardous metals out of rainwater. Plants on the roof may have the ability to minimise the effects of urban heat island (which is city temperature warmer as compared to the neighbouring area) by facilitating with shading and evapotranspiration⁹.

According to the study of Chen, green roofs can make the rooms cool due to the absorption of sunny heat by moist substrates and plants; therefore considerably play a role to save energy in buildings. The research study of Mees et al. (2013) pointed out that green roofs are capable of retaining water or rainwater and work as a mitigation system wherein some portion of

⁸ Ndebele, M. An Analysis of Newsday and Zimeye coverage of the Mthwakazi liberation front treason trial: a reception study; (2013).

⁹ Oberndorfer, E., Lundholm, J., Bass, B., Coffman, R., Doshi, H., Dunnett, N., Gaffin, S., K\"ohler, M., Liu, K. and Rowe, B. Green roofs as urban ecosystems: ecological structures, functions, and services. *BioScience*; (2007), 57(10), pp.823--833.

precipitation are absorbed by them and then release it into the drainage systems, softened urban streetscapes, enhanced oxygen output and minimised the effects on the surfaces¹⁰.

Hui (2011) conducted a research on planted green roofs and concluded that green roofs can enhance the thermal atmosphere in city areas by minimising solar absorption, thermal variation on the daily basis and thermal fluctuations annual as well. The researcher also reported that green roofs provide large vegetated surfaces that play a vital role to the enhancement of building's thermal performance¹¹. This finding has also supported by Driscoll et al. (2011) who investigated the building's indoor temperature values with green planted roof that are lower throughout the day. The roof temperatures were measured by them in non-insulated structure with and without planted roof. The findings reveal that that the roof temperature of non-insulated structure devoid of green roof differs from 42 to 48⁰C while 28 to 40⁰C were the temperatures of the green roof upon non-insulated structure building. Moreover, they summarised that there were big difference of temperature owing to the implementation of planted roof that could save energy¹².

A well organised and well-designed green roof could act as an insulation device of high quality and minimise the heat fluctuation through the roof in warm atmosphere. A Japanese group of research workers has carried out the roof measurements planted on non-woven material on a pre-cast concrete structure of three-storey. They confirmed that the amount of heat entering the room was minimised by a green roof. They observed 60 to 30⁰C as the reduction of roof slab surface

¹⁰ Mees, H., Driessen, P., Runhaar, H. and Stamatelos, J. Who governs climate adaptation? Getting green roofs for stormwater retention off the ground. *Journal of Environmental Planning and Management*; (2013), 56(6), pp.802--825.

¹¹ Hui, S. Green roof urban farming for buildings in high-density urban cities; (2011).

¹² Driscoll, D. Introduction to primary research: Observations, surveys, and interviews. *Writing Spaces: Readings on Writing*; (2011), 2, pp.153--174.

temperature. They also estimated 50% heat flux. Another study performed by ¹³ reveal that the implementation green roof on a five storey structure can result in 1 to 15% saving of energy on the annual basis, 15-80% in the peak space load and in space cooling load, and bushes were determined to be the most effective energy consumption¹⁴.

2.3. Major Barriers to the Implementation of Green Roofs

2.3.1. Risk and in New Technology

There are many barriers which prevent the green roof system from becoming more common in the UK and risk and uncertainty of technology is one of them. Risk factors in several domains related to the green roof implementation means a much greater opportunity is there for something to go wrong in a green roof as compared to traditional roofs. The big obstacle in the green roof implementation process is observed financial risk related to event beyond the building owner's control owing to lack of examples and research. According to Williams, Rayner and Raynor (2010), a large majority of the developers want green building, and many of them consider for their future buildings. However, the fact is they want to get profit. People need more local evidence to reveal them that planted roofs pay in the long-term¹⁵.

The study of Sailor (2008) highlighted that the potential barriers like the spread of weeds, increased fire risk, unwanted smells from rotting organic matter, and breeding of rodent.

2.3.2. Economic Cost

¹³ Niu, H., Clark, C., Zhou, J. and Adriaens, P. Scaling of economic benefits from green roof implementation in Washington, DC. *Environmental science & technology*; (2010), 44(11), pp.4302--4308.

¹⁴ Mentens, J., Raes, D. and Hermy, M. Green roofs as a tool for solving the rainwater runoff problem in the urbanized 21st century?. *Landscape and urban planning*; (2006), 77(3), pp.217--226.

¹⁵ Boyce, C. and Neale, P. *Conducting in-depth interviews*. 1st ed. Watertown, MA: Pathfinder International; (2006).

Most of the planners and developers would favour low cost and lower risk facades. Although the costs for green roofs could be minimised by increasing knowledge and understanding from experience there will always be a major level of cost in the roof design and requirement because of treatment nature requiring professional input. According to Getter (2006), the Australian Property Institute (API) were operating towards comprising green roofs in their guiding principles for building valuations, nevertheless searches for records of this failed to identify any finding by the API. No any study was found on the financial costing of green roofs, either as methodology or as average costs¹⁶.

As site specific design is required by green roofs so as to be effective, the consultancy costs will always be higher as compared to those setting conventional treatments and materials. The inadequate knowledge and lack of education on this subject implies that just a few numbers of consultants are there with skills and experience in the green roof implementation. This lets these consultancy people to charge some amount therefore placing extra costs as labour charges.

According to Goode (2006), the failure of establishing productive, widely circulated solar water heating in the UK houses to cost, insufficient financial benefits, comprising the financial support of government to support research and development (R&D) at the time of implementing and insufficient knowledge. Moreover, lack of a critical mass is also there in the green roof's demand in the UK that increases overheads for professional green roof consultancy as well as contributing to governmental agencies not providing financial assistance for R&D.

2.3.3. *Lack of Common Standards*

The lack of a British Standard is frequently referred as one of the main obstacle to the implementation of green roofs. The main green roof suppliers are completely contracted

¹⁶ Getter, K. and Rowe, D. The role of extensive green roofs in sustainable development. *HortScience*; (2006), 41(5), pp.1276--1285.

Goode, D. Green infrastructure report to the Royal Commission on Environmental Pollution. *Royal Commission on Environmental Pollution, London*; (2006).

members of the German FLL, the Landscape Research, Development & Construction Society, providing landscaping standards¹⁷.

Almost all the facets of green roofs are covered by the FLL, ranging from vegetation, waterproofing, soils, intensive green roof treatment, implementation procedures and maintenance. These standards are considered by some people to be over demanding that also acknowledged by the FLL. For that reason, the lack of standards in the country is only a potential concern where a roof supplier is either not an associate of, or does not comply with, the standards of FLL.

2.3.4. *Fire Risk*

Even though there is a view, that dry vegetation at the time of summer seasons could cause fires and the standards of FLL also have strong guidelines on this growing concern. These comprise high degrees of fire resistance and fire proofing for membranes underneath the soils and vegetation. Moreover, firm guidelines also are there concerning the use of fireguards and the amount of flammable material allowed in green roofs¹⁸.

2.3.5. *Maintenance*

Maintaining procedure of a green roof will solely rely on the roof system and what is required from it¹⁹. Green roofs, intensive and semi-intensive, in several means a lofty form of a garden, and hence will need same maintenance level.

¹⁷ Duda, J. Incentives and Barriers impacting the Implementation of Green Building Exteriors. *Unpublished Thesis, University of New South Wales, Bachelor of Planning; (2009)*.

¹⁸ Dunnett, N. and Kingsbury, N. *Planting green roofs and living walls*. 1st ed. Portland, Or.: Timber Press; (2004).

¹⁹ Fioretti, R., Palla, A., Lanza, L. and Principi, P. Green roof energy and water related performance in the Mediterranean climate. *Building and Environment; (2010)*, 45(8), pp.1890--1904.

Chapter 3: Methodology

3.1 Introduction

According to Beatley (2009) a research methodology is a systemic way to solve a problem²⁰. The way in which research is conducted may be conceived of in terms of the research philosophy subscribed to, the research strategy employed and so the research instruments utilized (and perhaps developed) in the pursuit of a goal – the research objective(s) - and the quest for the solution of a problem - the research question. I have defined the research questions and research objectives in Chapter One.

Nonetheless, in this section, I would discuss the methods to answer those research questions. Both primary and secondary research method would be discussed here, along with brief information regarding the participants of the research. Finally the apparatus used and procedure for measurement would conclude this section.

3.2 Primary Research Method

In similar term, Primary research is defined as a method that is gathered at first hand instead of finding in the books, database or journals. The application of this particular method vary from field to field, however as Driscoll once wrote that the decisive aim in conducting primary research is to learn about something original that can be confirmed by others and to eliminate our own biases in the process. Primary data can be collected through surveys, in-depth interviews or focus groups.

The advantage of this particular method is that the data collected is much reliable and valid than secondary research methods (describe later in the chapter). However, it is time consuming, and as it is based on targeted audience there is risk that inaccurate feedback could be gathered.

²⁰ Beatley, T. Biophilic urbanism: Inviting nature back to our communities and into our lives. *Wm. & Mary Env'tl. L. & Pol'y Rev.*; (2009), 34, p.209.

Primary data may be collected through surveys, focus groups or in-depth interviews, or through experiments such as taste tests²¹.

3.2.1 Qualitative Research Method

Qualitative research is referred with developing explanations of social phenomena. This approach takes into account of complexity by incorporating the real world conditions and can take different perspectives on board. Moreover, it also studies behaviour in natural settings or uses people's accounts as data and usually no manipulation of variables.

3.2.1.1 In-depth Interviews

In-depth interviews are the foundation of this research study, Boyce and Neale (2006) defines this as a qualitative technique which comprises of conducting detail individual interviews with a smaller number of participants to investigate and explore their perspectives on a particular idea, program or solution. For instance, the researcher using in-depth interview might ask the interviewee about their any past experiences and future recommendation related to the program, the thoughts they have concerning program operations, processes, and outcomes, and about any changes they perceive in themselves as a result of their involvement in the program. There are mainly three types of in-depth interviews, namely; semi-structured, open ended and close ended interviews²².

The advantages of in-depth interview are several however the most significant advantage is that, this is one method from which detail information could be gathered as compared to surveys and focus groups techniques. But there are few limitations and pitfalls regarding this method such as the amount and time to analyse the interview can be difficult for the researcher. Moreover, the varied nature of responses could be another factor, which can raise its validity. Finally, interview approach can cause confusion either because of the lack of understanding of the

²¹ Burgess, H. An assessment of the potential of green roofs for bird conservation in the UK. *Research report; (2004)*.

²² Chen, C. Performance evaluation and development strategies for green roofs in Taiwan: A review. *Ecological Engineering; (2013)*, 52, pp.51--58.

question by the informant or by the lack of understanding of the respondent's answer by the interviewer.

3.3 Secondary Research Method

As compared to primary research method, the secondary research is established on the findings from other people's research. This approach comprises on collecting information from other researches such as books, journals and internet. Researcher use secondary data to gain initial insight into the research problem.

There are various advantages of using secondary research method. For instance, the secondary research method is much cheaper and can be easily accessed. Secondly, it provides the researcher many perspective of scholar and authors regarding an issue. However, along with its benefits, there are limitations to this method such as its reliability and accuracy. Inaccurate information gathered through secondary method can distort researches scope and nature of study. Moreover, this method can also elevate factors such as authenticity and copyrights.

3.4 Participants of the Research

In this research, a total number of 30 individuals participated, where 15 participants were architects and 15 were roofing contractors, all aging from 28-52 year old. Nearly every architect, except two had a master degree in their relevant field, while only 5 of all roof contractors possessed bachelor in construction. The rest of 10 roof contractors had no educational background in reference to construction. All selected subject who participated in interview worked in the reputable organisations across United Kingdom.

3.5 Procedure

As mentioned earlier this research is based on results drawn from the interviews conducted with the industry actors. In order to obtain valid and reliable observations the author made sure that the subjects have adequate expertise in their respective fields and their profession is related to the research topic. The academic qualification of all architects was masters whereas contractors did

not have high academic qualifications yet it is important to note that the input provided by the contractors has high validity and reliability because of their working experience.

In order to find relevant information from the interviewees which are particularly related to the research objectives the researcher chose to use structured interviews. Since architects are highly qualified they do understand the requirements of a research and therefore they are able to understand research objectives and answer the questions within the context while the contractors who are not highly qualified academically therefore the researcher feared that they may deviate from the research questions and objectives while answering unstructured questions. Therefore the researcher used structure questions in the interviews to gather relevant and focused information from the participants.

Interviews were conducted on the workplaces of the participants. This enabled the researcher to observe various barriers in real life scenario for example one of the barriers is lack of industry standards and the researcher's visit to different work sites particularly demonstrated this barrier. This also increases the ability of the researcher to analyse the answers of the questions from different perspectives.

In order to improve the quality of answers researcher made contacts with all and explained the purpose of the study as well as the nature of questions and scope of answers prior to interviews. This helped the participants to gain context of the research and on the other hand helped the researcher to save total time period of an interview. Since participants had sufficient information regarding the activity therefore they were mentally prepared and it also helped them to schedule the interviews without disturbing their professional duties.

3.6 Limitation of Research

Although the research methodology suits the purpose of the research and has led to concrete conclusions yet there are certain limitations to the results of this research. This section elaborates the limitations of the research that have impacts on the scope, validity and reliability of the research results so that the readers and future researchers are able to use the results properly. There are certain inherent limitations of mixed methodology. First of all, when qualitative data is quantified, the flexibility and depth of the data is compromised. Qualitative data is

multidimensional while quantitative data is one-dimensional. When researcher converts the qualitative data into quantitative data, he or she must have expertise in both qualitative and quantitative research methods while avoiding significant challenges. This is inherently time-consuming and expensive. The reader must realise that the author of the researcher has limited budget and limited time period to conduct the research and thus the results and conclusions drawn in this research are limited.

Since the budget available to the researcher was limited therefore the research includes limited number of interviews. In addition the researcher could not hire statistical experts to reduce inherent limitation of the methodology as explained earlier. Limited time frame also forced the researcher to conduct limited number of interviews. Another limitation is that economic conditions and government regulations have huge impact on the barriers to implementation of the green roofs. Since economic conditions change in due course of time and formulation and enforcement of government regulations also require significant amount of time therefore changes economic conditions and government regulations in future may impact the results and conclusions of this study. Thus reader of this research must keep in mind that the reliability and validity of the research is limited to the time frame of the study.

The reliability and validity of the research results and conclusions could be enhanced by making observations in mid-term and long-term periods taking into consideration the changes in that emerge in technology, economic conditions, government regulations, consumers' choice and preferences and lifestyle and change of attitude of public and practitioners related to green roofs. If aforementioned variables that affect the results and conclusions of this study are changed the author believes that there may be significant changes in results and conclusions of the study. This is because all these factors have direct and indirect connections with various barriers that have been discussed in previous chapters. Since they affect the barriers therefore they also affect the results and conclusions of the study. A significant change in any or a combination of these factors will not only lead to a change in literature review but also change in the practices and opinions of the participants that are involved in the study.

3.7 Ethical Consideration

Research ethics refer to the principles that guide the researcher during the researcher regarding various ethical aspects of the research. These principles address the issues of study design, choice of subjects of the study such as human subjects, animal subjects, issues of confidentiality of the subjects, respect to the work of other authors used by the researcher etc. These principles are formulated to prevent unethical conduct for example fraud, fabrication of data, plagiarism, whistleblowing, etc. The research ethics are particularly important in scientific research such as medical researches. There are a number of codes of conduct such as 1964 Declaration of Helsinki, the Nuremberg Code etc. It is important to note that scientific researches and social researches have different set of rules and ethics and also have some common ethics (Pickard, 2013).

Another important aspect of academic research enterprise is trust. When researchers use work of other authors they trust that their results are trustworthy and other authors have followed research ethics while conducting their researches and have presented honest and unbiased results. The best way to build the trust is to ensure that the research community exemplify and transmit the values determined in the ethical codes of conduct through their researches (Ibid). The researcher realises that truthfulness and accuracy of data and honesty and subjectivity in reporting the information derived from the data is utmost important in research community. Thus the researcher has ensured that proper credit is given to all authors whose work is used in the secondary research to show that authors respect and appreciate the hardwork of fellow authors, experts and academics.

Confidentiality in researches refers to the attempts made by the researchers to hide the identity of the respondents. For example in scientific research for AIDS the respondents may be patients who are not willing to declare their identity and the researcher has to ensure that the information provided by the participants can, in no way, be used to identify the respondents. In this research the researcher has had interactions with various officials in of the bank and the researcher is obliged to conceal confidential information about the bank and/or the identity of the respondents if is requested by the respondents. In this research, at various occasions during the interaction with the participants the researcher gained information and opinions of the participants which they may not want to be published. The researcher acknowledges importance of confidentiality

and therefore the researcher has not published personal opinions and comments that the participants requested not to be published or shared with other participants.

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