02B010I
Project Number: JRK-E022

Sustainable Building Design:

Strengthening Capacities for Planning and Implementation

An Interactive Qualifying Project
Submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
In partial fulfilment of the requirements for the
Degree of Bachelors of Science
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Date: June 28th, 2002

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Keywords:
1. Sustainable Development
2. Policy
3. London

Abstract

The purpose of this project was to develop guidance for creating synergy among planners, city officials, developers, architects, and other interested parties, allowing them to identify and evaluate best sustainable building practices for particular locations. Success comes through extensive research into sustainable building design, policy and development, examination of communication channels utilised in developmental processes, and analysis of existing sustainable sites using an internationally viable case study template. The end result provides the London Borough of Merton and Asia URBS with direction for future project growth.

Executive Summary

The London Borough of Merton is a partner of the Asia URBS project entitled Sustainable Building Design: Strengthening Capacities for Planning and Implementation. This was a two-year European Union funded project that spans three countries, the United Kingdom, Spain, and India. The first step in the completion of this project was to determine the developmental processes that were prevalent or successful in terms of sustainable design, and to provide guidance for creating synergy among planners, city officials, developers, architects, and other interested parties that allows them to collectively identify and evaluate best sustainable building practices for particular locations. Our role was to determine the methods in which this goal could be achieved.

Several objectives were identified to achieve this goal. The first objective was to identify key components of the sustainable building practices manual, which will be the final product of the two-year study. The key components identified are background research, which led to pertinent sustainable development policies; these policies would be implemented in the 'development' process. From the process, the communication channels between developers, architects, planners, and other parties could be mapped. To do this, a template of analysis was created for the purpose of examining case studies of sustainable practices. After the template was applied, barriers to the implementation of sustainable design were identified, and recommendations for future research were made. The second objective was the creation of a source database, which listed contacts, case studies, documents, and web sites for further research.

These objectives were reached by a series of steps. The first step was to interview the key people involved to find the scope of the project. After these interviews were

exhausted, and a course of action determined, archival data was researched, leading to case studies such as BedZED and the Unitary Development Plan (2000) for the London Borough of Merton. From these and other various sources, the template for analysis of case studies was developed. Further interviews were conducted to gather the information necessary for analysis. Final analysis lead to key issues that would be addressed in future case studies.

Our research on sustainable development uncovered a large number of definitions, most of which focused on meeting the needs of both present and future generations. We also found that the definitions left considerable room for interpretation, and these interpretations took the form of local, national, and international policies and agreements. From these definitions, three key themes emerged, economics, society, and the environment. All three were broken down into a list of features that could be used to influence sustainability.

After researching sustainability and policies that affect sustainable development, the issue of moving from sustainability to implementation of sustainable practices arose. The primary concern, however, fell on to determining methods to develop local capacities for sustainable development through communication channels and local planning.

Building development process models were researched, yielding three major processes for new constructions, and one for retrofitting and renovation. The three major processes were the Enfield Council process, the Green Building Checklist, and the Tall Buildings report. From these three concepts came the template for analysis. The goal of the template is to evaluate the development process of a sustainable building site in terms of environmental impact, developmental process, finance, communication, and other

issues of interest. From the information gathered in the template, we found part of the answer to the question of the interaction of sustainability and the developmental process in the case of BedZED, and provided tools to the partners of the Asia URBS project that will help find a more complete answer. Each application of the template will result in more issues being raised, as different barriers will be overcome by different organisations, eventually leading to a more complete link between sustainability and development.

The template was applied to BedZED, a mixed use, zero emissions development in Sutton, London. BedZED exhibited excellent qualities in terms of sustainable development, but the process that was used in its creation is far from orthodox. The qualities exhibited were successfully reaching post construction zero-emissions, a sustainable transportation system; nearly 100% water recycling, and recycled/locally derived building materials were used in its construction. BedZED's development team understood the network of key players in the developmental process, as well as the financial institutions involved. The marketing campaign to sell the units to potential residents was also well conceived, and resulted in a successful development. In addition, we identified the challenges that were faced by BedZED.

The information provided by the template identified many key issues for other developers from the BedZED development. The biggest issue raised from this question is based around the reputation of the architect firm behind BedZED. They already had contacts and developers willing to take on this project, so many of the doors in the developmental process were open for them. How can developers without these contacts

open these doors? The analysis of more developments may yield the answer to this question.

The best course of action from here is to perform more case studies on sites like BedZED to find answers to the issues raised by BedZED, as well as performing studies on industrial sites, commercial sites, renovation sites. For these cases, the template will need to be modified slightly to accept the differences in information. Additional recommendations would include assessing new ZED schemes e.g. the MorZED project in Merton. Since it will allow for a first hand perspective on the developmental process and communication channels involved in development.

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Chapter I: Introduction

1.1: European Union Involvement

Today, the European Union consists of 15 member states, 12 of which were original members. It is a democratic body that allows its members to exercise their own governmental rights, while still being responsible to the European family as a whole. In a sense, it is a co-operation of states in the interest of peace and trade.

The European Union works in the best interest of its member nations, having established several primary directives since its initiation in 1950. In 1993 it evolved from a series of trade agreements to a political body. One of its newest initiatives, known as Asia Urbs, is the governing body of this project.

1.1.1: Asia Urbs Project

Asia Urbs is designed to bring the European community closer to the Asian community. Its goals include strengthening the socio-economic scheme of Asian countries, as well as assisting in their development. Urban development in general is the primary focus of the Asia Urbs project. To accomplish this, the European Union helps fund either two-year projects or six-month studies in Asia. The requirements for these projects are the participation of at least two European states, one Asian state, and non-governmental organisations. The projects also need to be reproducible in other locations.

The European Union will fund 65% or up to 500,000 euros for a project, with the partners providing the remainder of the funds. This corresponds with their fund matching policies. It is because of this funding that makes a project like the one Merton is involved with so much more appealing.

1.1.2: Asia Urbs: Sustainable Buildings Project Summary

As part of the European Union funded Asia Urbs programme, Merton Council is engaged in a project aimed at improving urban environments through the introduction of sustainability measures in building design. The project is being jointly implemented with RENUE and TERI Europe in the UK, ICAEN (Institut Catala d'Energia) in Barcelona, Spain, and TERI (the Tata Energy research Institute) and Haryana State Energy Development Agency in Delhi, India. The project aims to exchange advice and good practice between the EU and India to assist the ultimate beneficiary of the project, Local Authority in Gurgaon, to formulate urban development strategies and develop sustainable building design plans.

The specific objective of the project is to bring planners, developers, building designers and practitioners together in different partner countries to work in removing barriers to sustainability in buildings.

This will be done through workshops, seminars and training programmes. As a result comprehensive 'guidance manual' targeted at various stakeholders (planners, architects, developers, technicians etc.) will be produced, emphasising the importance of an integrated approach to introducing sustainability in building design. Other outputs of the project will include CDs, learning modules, and marketing materials for dissemination through a dedicated website.

Merton Council's main role is to advise on the role of the local authority and especially the planning system in supporting the development of sustainable buildings. Merton Council is employing under-graduates from WPI, Massachusetts, in the USA to research and collect relevant information for the guidance manual on case studies (*note*

not all sustainable but 'bad practise' as well!) useful guidance and contacts. Their work will be completed in June 2002. It will also advise on the creation of a web site for information exchange.

1.1.3: Key players – responsibilities

- Merton
- RENUE
- Gurgaon
- HAREDA
- TERI
- Barcelona
- Institut Catalan d'Energie

1.1.4: European Union Interests

The European Union's interest in the sustainable buildings project lies in different areas. One area is the goal set forth in a draft directive on the energy efficiency of building. The goal of that directive is to have energy savings of 22% in the construction industry by 2010. The European Union requires that its member nations achieve this goal, although it has not discussed a specific method for doing so. Another area where the European Union's interest lies is the Kyoto Conference. At this conference, many emissions reduction goals were set forth. Again, these goals were not accompanied by specific methods for their accomplishment. The European Union understands the

complex nature of the tasks needed to accomplish its goals. Therefore it has chosen to fund the Asia Urbs Project and specifically the sustainable buildings project

The project is scheduled for two years. At the end, a manual will be produced to assist nations in fulfilling and potentially exceeding their goals set at the Kyoto Conference. It will also assist member nations in achieving goals set out by the European Union.

1.2: Problem Statement

With growing awareness of the potentially catastrophic effects of climate change, the importance of sustainability has become more prevalent in the last decade as a preventative measure. Current projections of resource use suggest that the depletion of all non-renewable resources across the globe will occur in less than a century (http://www.wri.org/climate/jm_oil_004.html). For instance, the world's oil sources are predicted to begin their decline in the next decade. Therefore, there is a need to govern sustainably over the world's resource production and consumption.

Urban areas are the biggest consumers of fossil fuels, and the biggest emitters of greenhouse gases. Specifically, the buildings in an urban landscape contribute approximately 72% of the carbon dioxide emissions worldwide. This project seeks to address these issues that range from international concerns, local concerns, and finally developmental concerns.

1.2.1: Global Issues

Global issues cover the broad range of topics that have become very important to the international community. These topics have been brought up at international world

summits, such as Rio de Janeiro (1992) and Kyoto (1997). The primary issues to be addressed are global warming, climate change, and natural resource depletion, as well as the economic and social concerns of equity and resource distribution.

1.2.1.1: Global warming and pollution

The threat of global warming has increased rapidly over the last fifty years. Global warming is the end result of greenhouse gases trapping solar radiation and heat in the atmosphere, resulting in a worldwide temperature rise. Global warming in itself is only a small threat. It has been argued that global warming is not real, or that a global rise in temperature will reduce heating bills, thus decreasing the use of fossil fuels to heat homes (http://www-acs.ucsd.edu/~ucsdgop/highcost.html). However, if global warming is real, and if it continues unhindered, it could spell disastrous results for the human race.

Links to building energy use and emissions information for the UK:

- Document states buildings use 46% of UK emissions. This does not include industrial processes. With industrial processes included, this percentage rises to 68%
  - http://www.wales.gov.uk/keypubassemecodev/content/energy/edc_05_02_p1-e.pdf
- Buildings account for half of UK energy use
  - http://www.ice.org.uk/navigation/index_know.asp?page=../know/eps/euib.asp
- Buildings account for approximately 50% of UK energy use
  - http://www.cabinet-office.gov.uk/innovation/2001/energy/submissions/Architects.pdf
- Buildings account for 50% of energy use and CO_2 emissions in the UK.
  - http://www.southsomerset.gov.uk/GENERAL/sustain/guidenote4.htm
- GLA (2002) p. xi In 1999/2000 buildings were responsible for 80% of London's CO_2 emissions.

1.2.1.2: Climate change

Climate change is one of the predicted end results of unhindered global warming. Where global warming may not have been a big concern, climate change will be. The theory behind climate change is that the added heat will shift weather patterns, and melt the polar ice caps. The weather pattern changes will ruin crops, and may turn some now fertile lands into deserts. At the same time, deserts may become fertile. In any event, the locations in which growing crops will be easiest may move, causing widespread famine as farmers struggle to resettle. The melting of the polar ice caps will cause flooding in coastal regions. Even more dangerous, with the melting of the polar ice caps, there may come a redistribution of the planets mass, shifting the gravitational axis, which can then further alter the climate and weather patterns on a global scale.

1.2.1.3: Depletion of natural resources

The depletion of natural resources will become an issue regardless of the reality of global warming. The majority of heat, electricity, and vehicle fuel comes from fossil fuels. According to the latest statistics, the Earth only has enough fossil fuels to last another century before all the stores are completely depleted. This project seeks to encourage the transfer energy generation and fuel to renewable resources before this event occurs. It will do so by promoting the use of sustainable practices, using less fossil fuel energy, and emitting less carbon dioxide as a result.

1.2.2: National and Local Issues

The international community itself cannot solve these problems on its own. Only with the co-operation of the national and local governments and organisations can these issues be approached and answered. The problems that need to be considered on the local level are that the concerns of the international community must be addressed, the community needs to understand the issues and the communication between all groups and organisations involved must be achieved.

1.2.2.1: Addressing global issues on a local scale

Attempting to solve the problems of the international community cannot be done on a macro scale. The problems that face organisations attempting to accomplish the goals set out by organisations such as the United Nations are two-fold. The first issue stems from needing the co-operation of all the other local and national organisations in the world as well. This problem is not easily solvable. The second issue is one that can be solved within the scope of a city, region, or country. The question is how can a city or region do its part to slow or halt the problems that plague mankind? What kind of legislation, policies, or ideals will have to be incorporated or promoted? These two questions are daunting on their own accord. Unfortunately, if these questions are answered, it will have to face scrutiny by the communities involved.

1.2.2.2: Community understanding of issues

The next challenge is to help the community and nation understand the problems that a solution is being sought for. Many citizens are not aware of the dangers that they

could face from these potential problems. The sentiment is often felt that these issues will not affect this generation. If it does not affect this generation, it may affect the next generation, and will most certainly affect the generation after that.

This is not the only community based problem that must be faced. Even if the members of the community understand the issues confronting them, an attitude of apathy may come from the overwhelming scale of the problems at hand. What need to be accomplished are organisational structures that can spread out the focus of attention, allowing the populace to come to grips with what is happening in the world.

Finally, with the implementation of sustainable developments, members of the community may be left asking why the solutions to these problems must look so foreign and out of place. The concept of sustainability, or the shapes that it may take, may not be understandable to all. Efforts need to be made to communicate the reasons behind the actions taken by governments or organisations to the residents that may become affected.

1.2.2.3: Communication between sectors

Within the community, many different organisations, governments, and companies begin to get involved in coming to terms with the problems that face the national community. Unfortunately, these structures have often not been able to communicate their concerns and goals to each other. A prime example of this is the environmental movement, which strongly supports the move towards a sustainable planet. Whether it is an issue of approach, understanding, or apathy, environmental groups have not been able to spark serious environmental reform (Source: Adrian Hewitt). Finding better ways to communicate, as well as communication paths and

structures, will be a major concern in solving the larger problems of global warming and resource depletion.

1.2.3: Development issues

The communications problems reach further than just concerned organisations and governments. In sustainable development, communication lines are necessary between developers, architects, city planners, financial institutions, and other various organisations. There is a need to identify these communication chains, to clarify the developmental process of a sustainable development scheme.

1.2.3.1: Defining the development process

The final developmental process that results in a sustainable building or community is not well documented and recorded. The reason for this is that all of the separate groups, the architects, developers, planners, etc. have separate methods and goals that they feel need to be accomplished. The difference in priorities contributes to the overall lack of known communication channels.

The developmental process must be determined. The communication networks need to be deciphered, and the steps that each group needs to take in order for a development to move from conception to completion need to be determined. With all these processes and information, the potential to achieve more for developments will be enhanced.

1.3: Developmental Process

1.3.1: Introduction

This section provides a discussion of the methods used to complete this project will be discussed, starting with the methods for getting data, the processes we used to analyse that data, and finally some conclusions and recommendations.

1.3.2: Research

Many of the issues that are vital for the development of sustainable buildings and sites have already been researched in detail. Many parts of this manual are bringing together the separate concepts and ideas to determine how they can interact with one another. Although the goals of this project are not the same as the research materials that may be found, if a topic has already been studied and experimented with, there is no reason to do it again. There are four means that were used to obtain information. They are online sources, reports, documents, and interviews.

1.3.2.1: Online

Online information is very easy and usually fast to obtain. The only problem with using online material is understanding the risks. The Internet gives anybody who has access to it the ability to spread information online. This means that potentially useful facts may be biased, misleading, or wrong. Another problem is sorting through 'junk sites' that might have a few key words but no valuable information. These risks have to be considered when including them in any work. The online information used was limited

to sites that were trustworthy, like the Building Research Establishment, or contained general information. Online sites were also used to obtain quotes.

Obtaining online information in this project for the most part meant using the Google search engine. The remaining online information was gathered by visiting certain web sites that were mentioned either via interviews and discussions or on business cards. However, there are only a few sections where the majority of the information was derived from online sources. These sections included defining sustainability and retrofitting. By understanding the risks of using online material, the information was used carefully and sparingly.

1.3.2.2: Reports

Reports are a valuable source of information. Learning about the existence of the reports can sometimes be hard though. Usually one might consult with a library about finding informative reports. Now the Internet can be used for the same function.

Reports also contain information regarding other information. Depending on the design, they may have reference sections, or posted web sites that the reader can use to gather more information. This 'word of mouth' approach can usually link one report to another.

The government released some reports used. While some people may claim that any work is biased, using a government-released document was acceptable

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1.3.2.3: Documents

Documents can be thought of as being very short reports. Sometimes only a few pages long, they provide the reader with basic information. Some, especially ones released by the government, may mention names or organisations that are related to the topic of the document. They serve as foundation or small parts to a larger topic or issue. They may also contain key ideas and facts that are vital to the topic.

1.3.2.4: Interviews

Interviews were scheduled to inform us about the background of the cases as well as information on policies and barriers. They can provide valuable 'story line' information that might not be documented elsewhere. By talking with people, one could learn more about the barriers involved in sustainable buildings, as well as potential solutions to circumvent them. Interviewees can also suggest other contacts that may be even more valuable.

One of the biggest problems with interviews is trying to get in touch with people who were busy or on vacation. One of the problems on this project was scheduling interviews around the Golden Jubilee celebrations and the World Cup games while in London. It meant that during the scheduled interviewing weeks, many people were on vacation for the Jubilee week. For those that were not, it also meant trying not to schedule between 11 a.m. and 2 p.m. each day.

1.3.3: Analysis

Now that the data has been collected, a method of analysing it must be determined. For this we have developed several processes. The first is a template that will be used for the case studies. Next is categorising the data. This will be used for the databases. Identifying key issues is next. This will be used for informative sections, those that aren't case study or database related.

1.3.3.1: Case study template

To analyse case studies uniformly a template was developed. The reason why this template was developed was because the information for the case studies was collected using different approaches. This meant that the information was not in the same style. To bring the information forward, the template needed to identify common themes that were important to the cases.

These themes were:

- The developmental process
- Financial considerations
- Community benefits
- Marketing
- Transport
- Technology incorporated
- Barriers.

These were important features because they identified the major areas of the process. It might be that the case explained in extreme detail the development process behind it, so that any uninformed person could reproduce it.

The developmental process answered the question of how the building was constructed. Since three types of building were assessed, residential, commercial, and industrial, it would be important to explain the how for each of them. That would cover most types of buildings thus improving our effects. The specific information in this section would most likely come from interviews. From that, a general flow chart could be developed for constructing other buildings

The financial considerations section evaluates the process of obtaining funding for the site. It also identifies the key incentives in constructing the building. The funding part is important because it is usually hard to acquire for conventional projects. Incentives are also important because it gives people more motivation to get the building constructed. Without incentives, some people would not be willing to do anything because it would seem to be a waste of time. The more incentives that are made public, the better.

That leads into the next area, community benefits and marketing. This section details some of the benefits the community may get from the sustainable building. The more the community is aware of the benefits, the less inclined they will be to complain. If some of the benefits actually result in higher property values, then the community will probably have very little reason to complain. Marketing is trying to sell all the good points about the building. It may be something like, “Even though it costs a little more now, 10 years down the road, your savings will be higher compared to a conventional

building." Some people may even be interested simply because of the radical, futuristic designs. Whatever the case, marketing is very important to understand in the region where the building will be located.

The next section is transport. This covers the travelling portion of the development. It explains how the site takes advantage of existing public transportation systems either by being close to a bus stop, or by not having many parking spots. If a building encourages car-pooling or public transportation use, it will be mentioned here.

Technology incorporated is next. This involves unique features that complete the sustainable building. It includes methods for emissions reductions, minimising water usage, energy use reduction, etc. Any technique or appliance that was used to make the building more sustainable is mentioned in this section.

Lastly is barriers, which is the section identifying the barriers that existed either before construction or during construction of the building. This is important to developers because it can give them a warning about what to expect. It would also be ideal to include in this section any methods for circumventing barriers, but these would have to be general tips and could not be specific because of the sheer number of different barriers that may exist.

Upon answering all of these questions about a case study, the information gathered could be used to determine exactly how sustainability and the developmental process related for this particular instance. The goal of this is to raise key issues that can be addressed by applying the template to further cases, resulting in a wealth of valuable information for the end user of the manual.

1.3.3.2: Categorisation of data

Categorising data means distinguishing one piece of data from the next. It is the procedure that we used when inputting data into the databases. The three databases, web sites, contacts, and documents each have their own way of categorising the data.

Web sites

In order to describe what the web sites were about and how to find them, the following system was used. First the name of the web site is documented. This becomes the first column. Next is the subject of the web site. This identifies what kinds of information the web site has. The next column is the URL of the site. This creates a paper trail for Merton. Lastly a notes column is used to write any other important information regarding documents or people.

Contacts

The columns for the contact database start with the last name and first name of the person. Then we documented their phone, fax, and email information in case they had to be contacted. The profession of the contact was also noted. This would have allowed us to modify our questions if we had held interviews with them. Then the organisation and position was noted. The address and web site for the organisation were documented as well in this section. This allowed us to get further information either by going online, or being able to call other people in the company using the original contact as a reference. There is also a notes section in case more information needs to be taken down.

Documents

This database holds information on the documents we used. It includes the name of the document, the author, and publisher. This was mainly based on the needs of the reference section. However, it also could allow someone to contact the authors for more information on the topic. Again, the notes section is included.

1.3.3.3: Key issues

For the written sections that were not case study or database related, key issues were used to create a single style for each section. They basically summarise some issues in the section, and also the major points. One useful feature is that they are located at the front of every section. This means that if the reader wanted to come away with something from a certain section, he or she could focus on the key points. Of course, the key points do not detail the entire story of the section, but cover important topics.

1.3.3.4: Recommendations for future analysis

Continued effort is needed in order to fulfil the goal of the Asia Urbs project. The following recommendations are based on the information collected in this proposal as well as incomplete topics. The recommendations will provide Merton with the tools they need to advance our work forwards.

The first recommendation is obtaining the developmental process behind tall buildings. This will complete the tall buildings case study, providing valuable information on how a tall building is constructed and what steps are needed to ensure

completion. Fulfilling this section is crucial since it may be a larger part of the future of sustainable buildings.

The next recommendation is obtaining an industrial case study. The industrial case study would round out the case study section because analysis has been completed for a residential site and for a commercial site. This case study should be completed via the template so that the developmental process, incentives, barriers, etc. are covered in detail.

It is important to try obtaining some of this information by means of an interview. Interviews can give the case studies more of a personal touch to them. They can also contribute valuable information, lead to new contact information, and potentially more information regarding these recommendations.

Another recommended action is obtaining a retrofitting case study. This would let the reader know that other developmental processes exist besides the one outlined. This case study would also detail some of the incentives and barriers in greater detail, especially if an interview was used.

Lastly, as a general recommendation, more case studies should be mentioned, most likely as appendices. The studies need to discuss best practices and other informative detail. The MorZED and RENUE projects are examples that could be very informative. Also the technical aspect of this project should be built further. Issues like technology transfer, features, issues, etc. could be developed in greater detail. The communications section could also use improvement, as it is an aspect of sustainability that is very important and crucial to the implementation of the manual.

1.3.4: Conferences

Conferences will be held to spread work about the manual as well as the work contained in this project. These conferences should let people know where Merton feels they are in terms of the entire Asia Urbs project. The conferences should also allow for a critique of this project, suggestions for improvement and additional information.

The contact database developed for this project should be used and improved as an invitation list for the future conferences. This will allow contributors to this project know where it is headed. It may also provide the manual with an up to date resource so that sections can be updated when interested contributors discover new information.

The conferences ultimately are the tool that can be used by the participating countries to communicate to their experts exactly what to expect when the manual returns from India. They can be thought of as being a preparation to a major change in building design.

1.3.5: Implementation in India

Asia Urbs is looking for something that will assist India in improving the urban development. That something is the manual. The manual, by that time, should be very informative about the type of building to be constructed in Gurgaon. Whether it is residential, commercial, or industrial, whether new or existing buildings will be used, the majority of the information should be provided in the manual. However, it is important to realise that all the information is not always usable as specifically stated. It may, and

probably will, be necessary to implement techniques from the technology transfer section so that ideas and processes can be modified for Gurgaon's needs.

Once the process has been completed in India, it can be documented in the manual as a case study of application. This will allow other countries to know exactly what may change from the original manual when they decide to apply practices to a different location. As the countries continue to practice the processes outlined in the manual, it will become more efficient until, hopefully, sustainable developments are as normal in the future as conventional developments are now and as easy to implement.

1.4: WPI's Challenge: Developing the Framework

1.4.1: Project Goal

The project goal has changed constantly and has been developing alongside our work throughout the weeks the work took place. It was first changed as soon as the project work started because India's needs assessment had not arrived yet. Then as different parties involved in the project began to give their points of view it was continually reshaped. The following is the final project goal:

> Develop a process that helps create synergy between planners, city officials, developers, architects, and other interested parties, and allows them to identify and evaluate best sustainable building practices for particular locations.

1.4.2: Developing Framework

The development of the framework for the manual was one of the greatest challenges faced. There was no clear goal at the beginning and this is an ongoing project, so it could not be decided what the structure of the manual was going to be. There were several drafts made and meetings to discuss them. A few preliminary frameworks gave

the base for the research of the material for the manual. Once most of the material had been researched and written, it was a matter of rearranging it the best way to get the best result for the manual. The current framework was finally decided and it sets a base for Merton Council and the partners of the Asia Urbs project to continue with it for the next two years.

1.4.2.1: Identifying the important issues

The first step for developing the framework was identifying the key issues that were going to be addressed in the manual. This involved plenty of brainstorming and having meetings with our liaison, project partners, and advisor to decide what these issues were.

The main topic in the manual is sustainability. This is why the first issue discussed in the manual is defining sustainability. This is a very important issue for the project because there is no set definition for it and it had to be clear under what definition the manual was going to be based on.

The most important issue about the manual is probably creating sustainable developments. This is the next important issue, which was identified. There are two main parts to this section, which are new sustainable developments and retrofitting buildings for sustainability.

Given that the goal of the project is to create synergy between developers, architects and people in general, the next key issue, which was identified, was communications. The aim is to develop channels at different levels so co-operation can

take place between people that usually do not communicate and because of that sustainability is not always implemented.

1.4.3: Researching and categorising large amounts of data

One of our main tasks was to develop a set of databases to collect data found during the research of the project. This data will be helpful later when other people continue working on the project. This is because the paper trail will be much easier given the databases contain the websites and documents that were used to develop the manual.

The following sections explain the way the databases are arranged and the information they contain. It gives a brief overview of their uses, mainly the databases give references and contacts for anyone interested in sustainable developments. The main purpose is to keep record of the information that is often used by people involved in developing the manual. Having information such as documents, policies, contacts and websites available is very important to have a good workflow. There are some recommendations on improvements that could be made to improve them; the most important issue to address would be to create a comprehensible search option to look for data more easily.

1.4.3.1: Books, Documents, and Policies Database

This database consists of mainly the documents that were used, their author or organisation that published it and its subject and any relevant information in the form of notes. This is to be used as a reference so that people can see what were the documents used while developing the different sections of the manual. It is important to continue to

update it as the project moves on so relevant documents that are used along the project get recorded.

1.4.3.2: Websites Database

This database is designed to keep information from websites that are relevant to the manual. The different organisations contained in the database are NGO's, Green Organisations, Government agencies, Constructors, Architects and many more related to design, construction, green technology, and sustainability. The different fields of the database are the title of the website, their subject, any relevant notes giving more detail and the web address of the page.

This database is very useful because it provides a list of websites that in turn provide more links and so it is a huge source of information. The problem with websites is that most of the time, relevant information is hard to find. This is why the websites that are added into the database should be checked to be sure they are relevant to the project. A good idea would be to incorporate a search option to look for websites by subject or relevance to make the search of information much faster and easier.

1.4.3.3: Personal Contacts Database

The purpose of this database is to keep record of the people involved in the manual, experts in the field of sustainability, practitioners and any people that may be directly, indirectly or potentially involved with the Asia Urbs project. This list of people will help people involved in developing the manual because it has vital information such as e-mails, telephone numbers, organisation, area of study or work, address, etc. This will

help people choose from the list potential interviewees and have a good database to invite people to the future Asia Urbs conferences.

The main recommendation for this database would be to find a way to categorise the contacts in a way that would make it easier to create groups of different people, either by profession, expertise, etc.

1.4.3.4:Buildings Database - Recommendation

The WPI team did not implement this database but it is highly recommended that this be done in the future. Its main purpose is to create a list of buildings or development sites that show sustainability and best practices. There could be different ways to categorise the data, for example, by region, climate, or by building type e.g. residential, commercial, etc.

1.5: What the manual is going to be

The manual is going to be a valuable tool that can be used by professionals who are involved in the construction of sustainable developments. As a tool, this manual will let people construct sustainable developments using the best practices possible. It will be used in some nations for improving the building development and other nations for creating the path of building development.

The professionals that this manual will be assisting will include planners, developers, architects, financial institutions, NGO's, politicians, and other people or group of people who are directly involved or interested when a sustainable building is being introduced to an area. The manual will encourage communication between

professionals through the use of a developed communications section. This section should be informative, identifying common problems and barriers that exist in communication channels.

The manual will be a foundation, giving people initial ideas and plans. New lines of communication will be opened, as more people are encouraged to build sustainably. The process will eventually become routine, making it fast, efficient, and affordable, achieving an economy of scale. This economy of scale is the same principal that businesses hope to achieve when they are initiated because it means costs stay low. In the case of sustainability, this means that the incentives are better because there is less cost prohibition.

The manual, if designed correctly, will eventually become basic knowledge to the professionals involved. The idea of sustainability will not be foreign unknown, but rather just another way of life. As life continues to improve through technology, the idea of sustainability should improve as well.

Exactly what the manual should accomplish will not change. However, the specific goals that the manual will be reaching for may change. This report was developed without the India needs assessment. This problem may slightly alter the path set forth by this report. Nonetheless, problems are destined to occur in the implementation of the manual. They should not be viewed as hindrances, but rather ways to improve the manual.

Chapter II: Background

To fully understand the goals of sustainable building design, a context must be set. The ultimate goal of the developmental process of any sustainable site is for said site to be implemented and used in a sustainable way. The initial questions that need to be asked is what is sustainability, what can affect the sustainability of a structure, and how can policies affect sustainable design throughout the entire process.

2.1: Define Sustainability

Key Issues:

- The definition of sustainable development is extremely broad.
- The broadness of this definition leaves the method of which to attain the goals of sustainable development open to interpretation, and does not provide specific policies.

Sustainability and sustainable development has been defined in many different ways. To determine what constitutes “sustainable development,” this manual must first clearly define the concept. This is needed to understand the processes and ideas that are presented in this manual. A rather common definition is from the World Commission on Environment and Development council, who defined sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (1987). This was written in the context of an international community with varying opinions on what environmental issues were actual concerns. This section will discuss the definitions of sustainability, and will then break

sustainability down into the three major factors of sustainability as they apply to the context of this project.

The definition above leaves significant room for future interpretation. The definition can be broken down into two distinct parts. The first part ensures the needs of the present are satisfied, the second encourages future needs to be satisfied. The balance between these two issues revolves around how much change in building design can be influenced in the present, and how much the life styles of the inhabitants can change to accommodate the renovation in building design. There are many ways to accommodate both parts of the definition. The main issue with sustainable development is not whether or not it needs to be met. Rather, the issues are centred on the method of achieving those needs. In other words, in terms of sustainability, it is not the end result that matters, instead it is the path taken to get to that end result that counts. For example, one method of potentially fulfilling the needs of the present and the needs of the future is to continue on our current path, and rely on technology to eventually sort it out. That method will not be discussed here.

In 1992, the Rio de Janeiro Report of the United Nations Conference on Environment and Development expanded and updated the ideas and definitions of sustainable development. The priority remained on the human aspect, guaranteeing that the health and happiness of the inhabitants would be protected. It did not, however, attempt to force sustainability on sovereign powers. The Rio agreement states that it is specifically the right of a sovereign nation to use its territorial resources however they see fit, as long as their actions did not negatively impact the environment and natural resources of another state. Rio did, however, lay down guidelines for global

environmental protection. If all industrial nations were willing to abide by them, Rio predicted a successful move towards sustainability and environmental retention.

Rio (1992) began to narrow down the definition of sustainability, through international agreements, but the focus was still left mostly to interpretation, however, in 1993, further steps towards clarifying sustainability were taken by Hawken, who defined sustainability as:

> Sustainability is an economic state where the demands placed upon the environment by people and commerce can be met without reducing the capacity of the environment to provide for future generations. It can also be expressed in the simple terms of an economic golden rule for the restorative economy: Leave the world better than you found it, take no more than you need, try not to harm life or the environment, make amends if you do.

(http://www.betterworld.com/BWZ/9610/explore.htm)

The primary addition to the original definition of sustainability, brought by Hawken, is the "golden rule." Although highly idealised, this concept may be possible in future generations if the first steps towards global sustainability are taken now. At present, however, it is highly unlikely that the world's current trends can reverse so greatly as to leave the world better than it was found for the immediate future, to do so would be an undertaking too great for a decades time, but could be successful over 50 years, or a century.

Hawken's definition was adopted in The Kyoto Declaration (1997), which is also known as "Rio Plus Five." In Kyoto, the goals established in Rio de Janeiro (1992) under went further development. These goals focused on insuring that unsustainable development would be prevented, balancing the global consumption policies so that depraved states would have access to more materials, and over-consumptive states would have access to less, and promoting sustainable lifestyles through the universities

participating in Kyoto. This again ties back to the human aspect of sustainability, as it emphasises the necessity of community support for sustainability. Without the co-operation of the inhabitants of a sustainable development, (in other words, if the inhabitants do not care enough to life in a sustainable manner) the goals of sustainability can still be prevented.

Kyoto (1997) set forth protocols to effectively reduce global emissions by over five percent by 2012. This reduction will be a massive step towards global sustainability, with the momentum of its potential success carrying emissions reductions further. Kyoto supported this goal by allowing nations that did not meet the goal to trade with nations that met more than the goal. In addition, since large forest areas act as carbon sinks, Kyoto reduces the emissions provided by a nation accordingly, based on the percentage of green space. In addition, Kyoto outlined what each system of a state would have to focus on, where system refers to social, political, production, technological, and economic systems. This outline did not go into detail.

Other definitions for sustainability have been proposed that were not related to the 1987 World Commission definition previously stated. Barbier (1987) stated, "the primary objective of the Sustainable Development is to reduce the absolute poverty of the world's poor through providing lasting and secure livelihoods that minimise resource depletion, environmental degradation, cultural disruption, and social instability." (http://sdnp.delhi.nic.in/) This holistic view on sustainability focuses on the impoverished of the world, which suggests it would apply most readily to third world and developing countries, rather than the industrialised nations that produce the most waste and damage to the environment. It also goes into greater detail as to which aspects need to be focused

upon to make a community, nation, or planet sustainable, but it still leaves gaps as to how this can be accomplished.

So far, sustainable development has been defined in a broad sense. The goals of sustainability are based around meeting present and future needs of a global population. The next major question is how can these goals be brought about? To determine this, the scope of sustainability must be reduced, allowing for closer examination of the issues at hand.

2.1.1: Narrowing the Scope of Sustainability

Key Issues:

- The three major sectors of sustainability are Economics, Society, and Environment.
- Sustainable growth is achieved by protecting all three sectors while advancing one or more of them.
- Advancement that involves the expenditure of non-renewable resources is not sustainable.

Sustainability and what makes a development sustainable has been defined many times. The best method to overcome the differences in definitions for sustainability is to analyse sustainable development and practices. From the previous section, we can infer that sustainability can be broken down into parts: political-economics, environment, and society. Since all three factors are directly or indirectly related, improving one area of a region will naturally improve the other two, in theory. Serious issues arise when one area is advanced at the cost of others. This occurs when radical changes in one sector are initiated, specifically without considering the implications of these changes on the other

two sectors. For example, if a nation were to focus all of its energy on advancing the economy through industrial expansion, massive ecological damage could occur. Especially if this industrial expansion were to receive it's energy from fossil fuel burning power plants. Mining, air pollution, and industrial waste could cause environmental degradation, as well as severe health risks for the inhabitants. This kind of growth is not sustainable for multiple reasons. The first is that fossil fuels are limited resources. The second is the damage caused to the environment can eventually remove even the renewable resources in the area such as clean water and forests, which could bring about an economic depression.

The same problems occur if the environment is considered before the other two sectors. As costs for business and industry increase, unemployment will occur, or lower wages, which decreases society's ability to survive. When people are concerned about survival, they are much less likely to put any thought into the environment. This was the reasoning behind the decision made by President Bush of the United States of America (2001) to not ratify the Kyoto Protocol. (President Bush, http://www.whitehouse.gov/news/releases/2001/03/20010314.html)

On the other hand, if a sector incorporates principles of sustainability, the improvement will begin to assist the other sectors as well. For instance, when the economy is improved, society focuses less on survival instincts and more on culture and ecological preservation. This will make the inhabitants happier and improve productivity, which again stimulates economic growth. A pattern emerges with sustainable growth that is easy to understand; sustainable growth and development leads to more sustainable growth and development. This opposes conventional or rapid

development, which, if not controlled, can exhaust its supply sources, thus limiting future growth. This trend can be slowed, stopped, or even reversed if an international economic depression was to affect the nation in question, however. More examples of this can be found in the local policies of the London Borough of Merton.

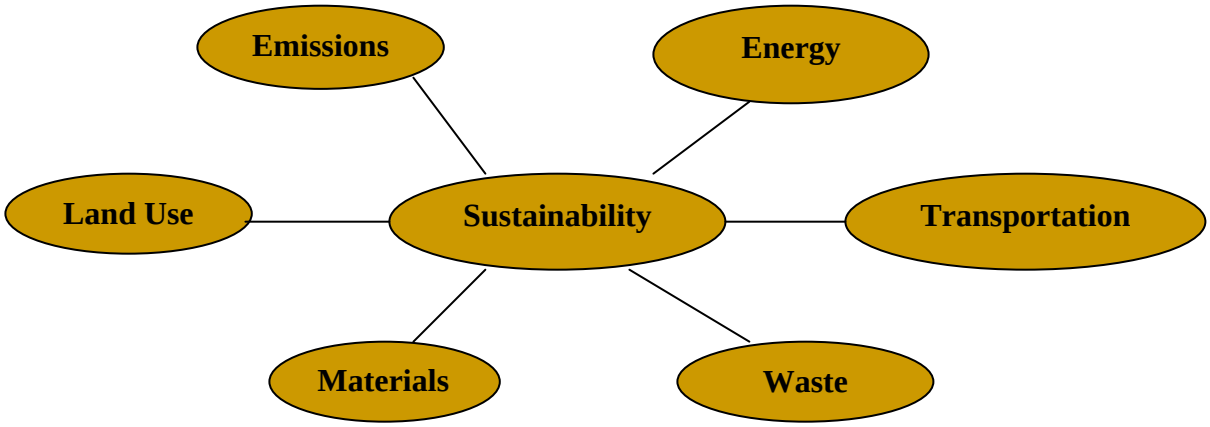


Figure 1: Environmental Sustainability

The above diagram demonstrates many of the factors that directly affect the environmental sustainability of a development.

- Emissions refer to the greenhouse gases given off by buildings and vehicles, the primary greenhouse gas being carbon dioxide.
- Energy is a representation of fuel used by the development, whether by renewable energy sources or fossil fuels.
- Transportation reflects how far the inhabitants need to travel, and how much energy they use per capita, which directly affects how much carbon dioxide they emit.
- Waste refers to black and grey water, as well as garbage and any non-gaseous waste products.
- Materials involve both the use of non-renewable resources and renewable resources in construction, as well as the energy and fuel spent to treat, transport, and construct the material.
- Land use determines population density, and how far or close the development has to be to other developments to be effective in a sustainable sense.

As was stated before, steady advancement in these fields at a moderate rate will improve the environmental aspect of sustainability. Examples of ways these can be improved can be found in the Sustainable Practices and Guidelines chapter.

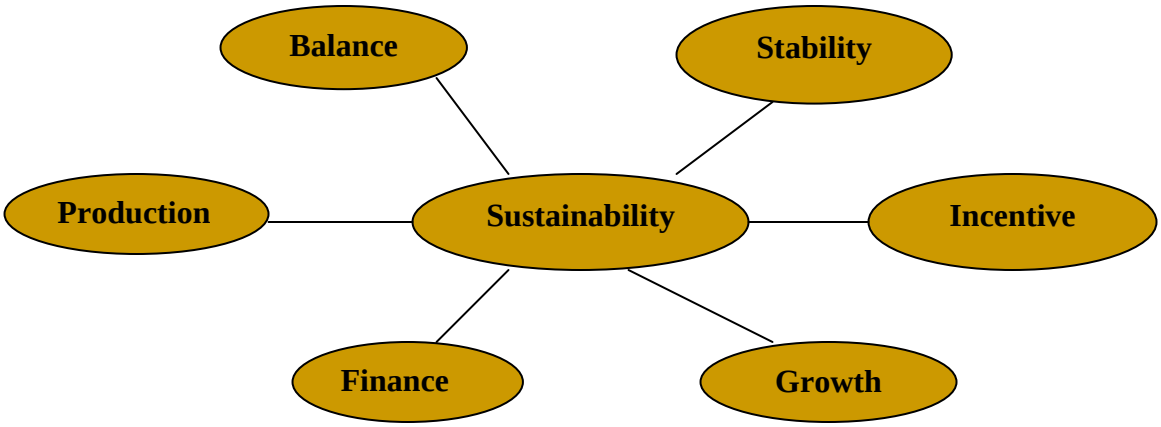


Figure 2: Economic Sustainability

Sustainability in terms of economics has much different implications, as opposed to the environment. To maintain sustainability in any sector, however, it is necessary to nurture all sectors. Factors that help supplement economic sustainability are shown above. Details and examples for specific categories can be found in chapter 2.2, National and Local Policy, as well as Appendix A: Finance and Incentives.

- Balance: balance is the relationship between commercial, industrial, and residential space. Too much commercial space causes more commuters to be employed, which increases fossil fuel use and carbon dioxide emissions from transportation, as opposed to too much residential space, which has the opposite problem. Another issue facing an over abundance of residential sectors is lack of employment opportunities, which is detrimental to economic success and sustainability.
- Stability: Stability relates to the local and global economic markets. Lack of stability causes tension even on local levels, and can affect employment in the area. Sustainability both fosters a strong local and national economy, and is supported by a strong local and national economy.
- Incentives: Economic incentive help persuade corporations and businesses to employ sustainable tactics.
- Growth: Economic growth refers to both positive trade balances, and creation of knew economic areas. Since sustainability is a new technology, it allows for growth

of businesses and companies specialising in sustainable practices, and economic growth feeds back into sustainability by assisting economic stability.

- Finance: Financial concerns are major issues in terms of economic sustainability, but may be a hindrance in the early stages of sustainable development.
- Production: Production is necessary on many levels. First, having products locally available adds to a community's sense of contribution on regional and national levels, as well as increasing the standard of living in the area. In addition, production employs inhabitants, and stimulates the economy, further influencing local sustainability.

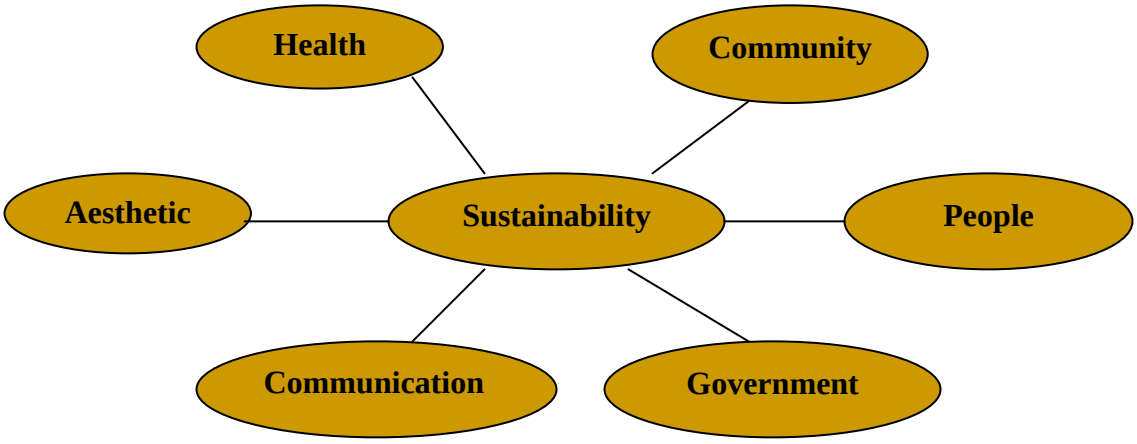


Figure 3: Social Sustainability

The last major issue in terms of sustainability is the society. People are the basis for all sustainability definitions, and this makes social sustainability extremely important. To be fully sustainable, all the aspects of the needs of the inhabitants must be met. In turn, by having all their needs fulfilled, the people can then focus on other concerns, such as the environment and culture. Examples of policies that encourage this can be found in the Local Policies chapter for the London Borough of Merton.

- Community: A strong community can only help sustainability. A strong community involves all the local inhabitants. It acts as a support structure, as well as a forum for discussion and human interaction, as well as a plethora of other advantageous events. Inhabitants will feel comfortable and safe in a community with strong local ties, and will seek to help the community further, as well as desiring to not disrespect the communal areas.

- Health: Maintaining a safe atmosphere in terms of health is also necessary for sustainability. If someone becomes ill from exposure to a building, waste removal situation, etc., the family and community of that person are adversely affected.
- Aesthetics: Aesthetics are also important. If workers and residents are sensually pleased with their environment, they will be happier in general, reducing illness and increasing productivity. In addition, Aesthetics can be both industrial and cultural products, which stimulates economy and culture respectively.
- Government: The local and national governments both play a significant role in maintaining, encouraging, and enforcing sustainability. The most effective method of transferring sustainability to a region is through local and national policies that mandate its advancement. A gradual approach is necessary, however, since rapid environmental reform can significantly damage the economies.
- Communication: Communication is possibly the most important branch of all. Without communication between the different groups (for instance, architects, developers, planners, financial institutions, etc.) sustainability will not be able to grow as quickly as the world may need it to. As it stands, sustainability is revered in architectural societies, is known of by developers who actually built sustainable sites and city planners, but is almost completely out of the minds of financial institutions. Without communication between these respective groups, sustainability will not move quickly into the foreground of new and old developments.

This manual will focus on the sustainability of buildings. A sustainable building (for the purposes of this manual) is a building that attempts to account for the previously mentioned features of environmental sustainability, while serving an economic and/or social benefit to the local community. The reason behind this is that statistics from many different sources (e.g. Greater London Authority, Mayor's Energy Strategy) have determined that buildings use between 60 and 80 percent of all energy produced (and thus is responsible for 60 to 80 percent of the carbon dioxide emitted) by burning fossil fuels. Also, most waste (both of water and garbage) is either produced or disposed of in buildings. The country in reference, as well as the assumptions made determines the difference in statistics. For example, since transportation generally involves departure from and/or arrival to a building, some statistics will account for that cost within the total for buildings, while others will not.

Different methods of affecting sustainability and sustainable designs have been discussed, as well as the implications of implementing some of these methods. The goal of meeting sustainability criteria supports movement toward the definition of sustainability, in that it meets the needs of the present, while taking steps to ensure the needs of the future can be met as well. These concepts are not by any means concrete. However, now that possible methods of reaching sustainability have been found, it can be seen where policies have attempted to assist these goals.

2.2: Sustainable Development Policies

Another major issue when considering the development of sustainable buildings is the law governing construction, material acquisition, land acquisition, and other various law issues that could either assist or hinder the project completion. To account for these variations, we will first examine international policies established at Rio (1992) and Kyoto (1997), the national building policies of the United Kingdom, Spain, and India, and finally the local building policies of London, Barcelona, and Gurgaon.

2.2.1: International Agreements

The primary concerns of the Rio and Kyoto conferences focused on lowering carbon emissions, first to slightly below 1990 levels (Rio 1992), then to more than five percent below 1990 levels by 2012 (Kyoto 1997). The implications of these statements, which were agreed upon by a majority of industrialised nations, are that present nations need to lower their emissions, suggesting that new developments need to keep a low emission factor. This is because new facilities are easier to influence in terms of

sustainable design, as opposed to recycling or retrofitting older buildings. These plans become more constricting on development on the national level of policies.

2.2.1.1: Rio 1992

Key Issues:

- The primary goal of Rio de Janeiro (1992) in terms of sustainable design is to reduce global carbon dioxide emissions to under 1990 levels by 2007
- Controversy comes from two directions. The first being that some experts feel that the steps taken by Rio 1992 will not be enough to stop climate change, while many of the nations involved have only made small progress by 2002.

The World Summit in Rio de Janeiro in 1992 was not the first time the environment was discussed on the international level, but it did represent a clear start to international policy in the direction of sustainability. The summit was based on UN Agenda 21, (the list of key environmental issues for discussion at the Rio de Janeiro summit) which stated what needed to happen, resulting in the Rio Declaration. Rio set the stage for a massive environmental push, setting the first emissions goals for the world.

The decisions made in Rio were both controversial and important. The policies and targets set out by Rio are open to a considerable amount of interpretation. The hopes of the conference were to establish concrete targets to bring about global sustainability by approximately 2050. However, this is an idealised goal, and because of that, Rio began with easier to reach targets and broad guidelines, with the hopes that future conferences (Kyoto and Johannesburg) could continue to focus the scope of sustainability. Therefore,

Rio attempted to infringe on sovereignty as little as possible. For example, Rio set forth that individual nations have the right to use their resources however they see fit, as long as it does not adversely affect the resources of other neighbouring countries. This becomes most relevant when considering air and water quality, since neighbouring countries often share both resources.

The controversy is two-fold. The first is from the experts and environmentalists, who claim Rio, did not put enough emphasis on the environment. One such group in the United Kingdom is the Town and Country Planning Association (TCPA), who is currently working on a sustainable strategy for presentation to the United Kingdom in 2003. The target goals of Rio in terms of emissions were simply not high enough for the TCPA to accept. Many feel that if sustainability is not employed faster than what Rio has set for the speed, than the global environment will completely degrade with global warming. This may be true, but asking for more than what Rio had set forth would have resulted in no progress whatsoever. It takes time to persuade some countries to change their ways to such a degree.

One of the problems is statistics that show buildings are responsible for between 60 and 80 percent of the carbon emissions worldwide. This would not be so critical, if it was not for the fact that buildings are the most difficult thing to change. Buildings can last hundreds of years. In fact, in some European cities, buildings can be found that go back one thousand plus years, making it easy to see why sustainable building development is important. Cars, on the other hand, can last the normal consumer about ten to fifteen years, if they are very fortunate. This means that sustainable buildings will

replace conventional buildings at a slow rate, gradually coming into existence as buildings are decommissioned.

The second argument (one that refutes the previous arguments, in a sense) is that industrialised nations have yet to be in a position to meet the Rio goals by 2007. (Kofi A. Annan, http://www.johannesburgsummit.org/html/documents/summit_docs/sg_speech_amnh.doc) This could be because the goals were slightly too lofty for the initial standards, or because it is felt that the UN does not have enough authority to effectively punish those who do not meet the emissions goals. It could be that the next five years would yield the results of national research committees, thus meeting the Rio goals, and setting up to meet the Kyoto Protocol goals due five years later. This will most likely be an issue at Johannesburg 2002.

Rio started the steps towards international agreements to reduce emissions drastically in the future. However, more steps need to be taken on both a national and international level for the goals of sustainability to be reached. This was the driving force behind the initiation of the Kyoto Protocol.

Link:

- For details about the Earth Summit at Rio de Janeiro 1992:
  - http://www.un.org/esa/sustdev/agenda21text.htm

2.2.1.2: Kyoto 1997

Key Issues:

- Kyoto 1997 advances the Rio 1992 plan by a 5% reduction by 2012.
- Kyoto has not yet been ratified by a large enough percentage of the carbon dioxide emitters.

In 1997, the Kyoto Protocol was established with the express purpose of extending the goals of Rio de Janeiro to reduce the global emissions of carbon dioxide by an additional five percent by 2012. It also seeks reductions in other green house gases, such as sulphur dioxide and usage of non-renewable resources. Five years after the conference, the Kyoto Protocol entered the ratification stage. The biggest problem with its ratification is not the lack of support by a majority of countries. Rather, it is the necessity to have 55% of the global carbon dioxide emissions present in those countries. The two biggest carbon dioxide contributors, Russia and the United States of America, have yet to ratify the Kyoto Protocol. Combined, they make up over fifty percent of the global emissions, meaning that to implement Kyoto, one of these countries must ratify it. If the ratification fails, then it is expected that Johannesburg 2002 will serve as an additional push to ratify Kyoto, as well as extending the emission reductions further. (http://unfccc.int/resource/docs/convkp/kpeng.html)

2.2.1.3: Johannesburg 2002 Expectations

Key Issues:

- Johannesburg will attempt to determine a method to reach the goals of the Millennium Summit.
- Johannesburg may be crucial in determining the fate of global sustainability.
- Johannesburg may seek to advance reductions in carbon dioxide emissions.

The next World Summit on Sustainable Development is taking place from 26 August to 4 September 2002, in Johannesburg, South Africa. This meeting will unite different interested people and nations to discuss and act on the need for preserving

natural and energy resources. It will also focus on the improvement of the standard of living, as well as securing the global economy.

(http://www.johannesburgsummit.org/html/basic_info/basicinfo.html)

The results of the Johannesburg summit could be a turning point in the journey towards sustainable development. If no political action is produced from this summit, then sustainable development will be severely hindered. The UN Secretary General, Kofi Annan, states that progress since the Rio summit conference has been very small, but hopes for Johannesburg look promising.

(http://www.johannesburgsummit.org/html/documents/summit_docs/sg_speech_amnh.doc). If this summit at Johannesburg does not expedite this trend, then the concept of sustainable development may be lost.

The Secretary General also outlines the points where he sees this action-taking place. These areas are water and sanitation, energy, agricultural productivity, biodiversity and ecosystem management, and health. He claims that improvements in these areas will achieve the goals of the Millennium Summit. These goals are to combat poverty, as well as promote sustainable living practices through 2015 and beyond.

Link:

- For details about the Millennium Summit goals:
  - http://www.un.org/millennium/sg/report/ch6.pdf

While the UN is trying to promote changes in the areas of water, energy, etc., there are many deliberations and conflicts that delay their efforts of fulfilling the desire of having a truly sustainable planet. The technology exists for these changes, but the

methods that will achieve the desires of the UN are still being argued over. Johannesburg seeks to settle these arguments.

Link:

- Further information about the Johannesburg summit:
  - http://www.johannesburgsummit.org

2.2.1.4: Review

The international community has established many goals to further sustainable development, as well as reducing global poverty, and improving the quality of living for the global population. One of the biggest ways to accomplish this is through the sustainable development of buildings. However, these treaties cannot influence sustainable development on their own. It takes the co-operation of the national governments involved to take the intermediate steps towards sustainable development. Only through national policies and goals will the international treaties become reality.

2.2.2: National Law and Policy

This section describes the national laws and policies that directly affect the development of sustainable sites and what advantages and disadvantages they have specifically in the stated country. According to the international policies that were agreed upon among most industrialised nations, the countries themselves will be held responsible for reaching the emissions targets. The actual implementation of sustainable development can also fall to the local governments, but it is the nation that must guide

and govern these cities to ensure that the standards are met. The United Kingdom, Spain, and India perform this task in the following ways.

2.2.2.1: Case Study: United Kingdom

Key Issues:

- The United Kingdom has set several goals for lowering emissions and switching to renewable forms of energy.
- It has laws, incentives, and taxes to promote a more sustainable business scheme.
- The PPG's do not set in stone what can and cannot be done, rather the PPG informs the local governments of the steps they need to take to reach the UK's goals.

The United Kingdom has set forth a set of four guiding policies within their Public Planning Guideline handbook (PPG), similar to that of Rio and Kyoto. The PPG does this in a very broad way. The PPG gives direction for the local policy makers. Then the local policy makers submit their interpretation back to the national government, for final decision. If the United Kingdom feels that its interests are being met within the local planning guide, then it is accepted.

The first policy states that the United Kingdom will extend their prosperity to others in such a way that future generations will be able to enjoy what was left behind, and the impoverished of the current generation will receive what they need to survive. In addition, the levels of pollution, unemployment, poor housing, and poverty must be lowered in an attempt to improve the general health of the nation (www.sustainable-development.gov.uk/what_is_sd/guiding.html).

After the people are protected, the concerns of the United Kingdom shifts to the second ruling policy that works specifically to protect the environment. Specifically, the goal of this policy is to lower greenhouse emissions and the output of other toxic chemicals, and to protect nature and historic buildings. Once again, protecting human health from devastating events such as climate change is proposed. How this is done within the PPG is very broad. The PPG gives direction for the local policy makers to move in. Then the local policy makers submit their interpretation back to the national government, for final decision.

The third major policy focuses on the use of resources. It indicates that the United Kingdom will attempt to transfer as much as possible of its resource use to those which are renewable, as well as researching new renewable resources to replace the non-renewable resources before it becomes necessary to replace them. Renewable resources must also be used in such a way as to not prevent their future use; for example, water should be kept as pollutant free as possible. This policy embodies the future necessity to rely entirely on renewable resources, or find resources that are not necessarily renewable, but in the least untouched until further renewable resources can be examined. It also directly addresses the future concern of the extinction of non-renewable resources, which is what will fuel the movement towards sustainability.

The last policy focuses on education and national prosperity through implicating the importance of skill training to deliver high economic growth to keep the United Kingdom operating at its full potential. Thus it will need to produce sustainable products that can bolster the economy.

To accomplish these, the United Kingdom developed a set of approaches, some of which are enforced by laws and regulations, while others merely provide guidance the local planners. The most notable in terms of sustainability is the emissions tax, which charges a fee to all businesses based on their level of carbon emissions, gradually increasing over time, and moving to include residences, and the land fill tax, which taxes the dumping of waste materials as opposed to recycling. These are the first in the green law initiative that is being instituted in the United Kingdom, and according to current trends, will not be the last.

(http://www.sustainable-development.gov.uk/what_is_sd/guiding.htm#1)

The United Kingdom has also created statistical goals that must be reached by the entire country by 2010, as well as some goals for 2050. The goals stated were to reduce carbon dioxide emissions by 7.5% by 2010, and 60% by 2050. To reach these goals, certain initiatives have already been put into place. For instance, £50 million has been set-aside for the purposes of granting to hospitals, universities, and other interested organisations to install community heating. The Climate Change Levy taxes energy use based on carbon emissions for commercial and industrial corporations, and taxes between 10 and 20 percent of the total energy bill of affected groups. Exemptions to this are granted based on the amount of energy attained from renewable sources, from CHP plants, and various other carbon neutral sources. Energy reliant industries will be capable of receiving an 80% rebate if they meet agreed CO_2 reduction targets. This money will be allocated for advancing sustainable technology.

Other various policies involve doubling the capacity of Combined Heat and Power throughout the UK, as well as switching at least 10% of their fuel consumption to

renewable sources by 2010, which is expected to save 9.1 million tonnes of CO_2 per year. These policies and goals are the basis for the UK's advancement towards becoming a sustainable nation.

For more information about UK strategies consult the Draft Energy Strategy of the Greater London Authority (GLA)

- http://www.london.gov.uk
  - http://www.un.org/millennium/sg/report/ch6.pdf

2.2.2.2: Review

National policies have set goals for meeting the international treaties, Rio (1992) and Kyoto (1997). These goals are set to meet, and sometimes surpass the original agreements, allowing the governments to engage in carbon trading with others that did not meet the agreement. The national authorities have set the direction for sustainable development to advance within their borders through the PPG's and emissions targets. The responsibility of continuing the goals of sustainable development now falls upon the local planning groups. The planners and policy makers need to determine what physically must happen to achieve the goals of their nation.

2.2.3: Local Planning Policy

Each of the individual cities involved also have their own guidelines and policies to follow which can determine the development of a sustainable or non-sustainable building. These conform to the policies set by their national governments. Some examples of these interpretations are examined here.

2.2.3.1: Case Study: London Borough of Merton, United Kingdom

Key Issues:

- Merton Council addresses the three main factors of sustainability in their UDP, with the goal of an "Urban Renaissance."
- Merton Council followed the GLA checklist for the construction of the UDP
- Although most policies in the UDP support sustainable development, some are capable of hindering it.

In addition to the national legislation set forth by the United Kingdom, there are also guidelines on which to base local policies and practices. The goal is to convince the local boroughs to promote community, public health and happiness, and environmentalism through the expansion of sustainable developments. The local government has four issues that must be addressed per demand of the national government.

- Local governments must acknowledge the needs of the community, as well as their priorities and aspirations. Therefore, the people are allowed to procure what they need to survive in any situation. This statement meets the first part of the definition of sustainability, which is meeting the needs of the present.
- All local groups, whether they are corporate or volunteer, should be organised together to co-ordinate the strategies and ideas used. The importance of this aspect is that it stresses the nature of sustainability in that it extends beyond the responsibility of the government alone. Sustainability cannot be achieved without co-operation from the private sector.
- This new organisation moves in the direction of joint community planning, focusing on the needs, aspirations, and priorities of the community in regards to sustainable development and sustainability. The national government believes that this sort of community involvement will ensure the success of the movement towards sustainability. In addition, all members of the community will feel included in the progress, which will help them understand sustainable development.
- The final step is the summation of all this work towards sustainability, first starting in the community, then expanding outward towards a global perspective. This initiative began in 1996, when Merton developed a sustainability checklist for planning applications. Examples of this checklist can be found in Appendix A. In 1998, a sustainability appraisal was performed on the Unitary Development Plan. Between 1999 and 2000, Merton revised the Unitary Development Plan, focusing on certain

key policies and sustainability statements. All these activities have led to the following:

Planning Guidance in Merton

> The London Borough of Merton has interpreted these objectives as such:
> Policy ST.1a: Sustainable Development: The council will encourage development which is sustainable and resist development proposals which sustainability fail to follow the principles of sustainable development. In applying this policy, the council will apply its sustainability checklist to assess whether development is sustainable. Where large development schemes are proposed, developers should normally submit a sustainable development statement with the planning application (2000)

All the new buildings built within the London Borough of Merton must comply with the sustainability checklist, and in doing so, this aspect provides an advantage towards sustainable developers. Merton established a list of sustainability criteria in the Unitary Development Plan (2000). An excellent example of sustainable policy occurs in the Unitary Development Plan (2000) in Policy HS.4: Sustainable Housing, which states: "the council will promote sustainable housing development within the borough, and will require development to have regard to the principles of sustainable development, and incorporate sustainable development features." This policy directly addresses the concerns of sustainable development, and comes complete with justifications that can be applied to the majority of the United Kingdom. In the justifications, the Borough of Merton outlines specific goals previously established in terms of sustainable development, as well as accounting for increases in population in regards to environmentally safe housing. It goes on to explain which issues are key to sustainability, and how sustainable development is exceptionally applicable for large housing developments, where shared heat and water systems are prevalent.

A critical feature of sustainability that is frequently overlooked in favour of the environmental side is sustainable economics. Examining the economic structure is important to the three major facets of sustainability, environment, economics, and society. By encouraging local businesses to show diversity in production and distribution while achieving environmental sustainability, it is possible to positively impact the social aspects of sustainability through a stable market and workplace. If the market and workplace are stable, the inhabitants will feel secure in their employment while being able to purchase a larger number of locally produced goods that can improve their quality of life. Policies ST.15, ST.16, and ST.17 of the Unitary Development Plan of the London Borough of Merton for the year 2000 does just that. By encouraging and achieving economic prosperity, the community will be able to focus on environmental concerns, rather than focus all their attention on survival concerns. Economic diversity can then contribute to social diversity, bringing about Merton's goal of an "Urban Renaissance."

In a similar fashion, through improvements in the local society, specifically cultural and recreational aspects, it is possible to influence the economic and environmental aspects. Since culture is marketable and employs members of the community, it stimulates the economy. By improving the health of a community's economy and the happiness of the community's inhabitants, the environment will benefit from a more aware society. The Borough of Merton attempts to achieve this with UDP 2000 Policy ST.23, which deals with encouraging cultural and recreational pursuits in a sustainable and environmentally friendly way. By encouraging town centres, Merton is also encouraging a more tightly knit community while reducing the costs and emissions of transportation, all of which lead to a more sustainable community.

To reach sustainability all aspects must be considered. Although considering an individual concern can positively affect the other concerns, it can also damage them. If the environment, economy, or society is pursued without recognising the importance of the other two, then the neglect will result in the immediate degradation of the other two, and the long term degradation of all three. For example, focusing entirely on the environment can stifle the economy of the area by limiting its ability to produce and deliver, which results in fewer jobs, fewer products, and the degradation of the community. These matters force the residents to concern themselves with survival rather than the environment, and the end result is the destruction of what needed to be saved. Likewise, focusing on the economy with no concerns for the community or environment can reduce the quality of life of the people, pollute the environment, and destroy the resources the economic focus relied on.

Merton UDP Information:

- The UDP can be obtained free of charge from Merton Council's local library.
- To order it, the price is £17.50 for residents and £34.50 for non-residents. This is the contact information for Merton council to order a copy:

Gillian Pitcher
Plans and Projects
Planning & Public Protection Division
Environmental Services Department
Merton Civic Centre, London Road
Morden, Surrey SM4 5DX

Telephone: +44 (0) 20 8545 3041
Fax: +44 (0) 20 8545 3326

2.2.3.2: Review

Sustainable design and development began as a concept that was raised before the international community. From that point, it evolved into a set of treaties governing key issues in global development. The international agreements sparked national goals and policies, influencing the planning departments of the cities involved to incorporate and encourage sustainable development. The most important policies adopted were emissions goals, incentive legislation, and sustainable planning policies, as were previously outlined. Now that these policies are in place, the actual work of reducing global emissions comes into focus. The issues governing development have been established, leaving further advancement of sustainability in the hands of architects and developers. Once the government has encouraged sustainable development, the issue changes from goals and policies to implementation.

Chapter III: Creating Sustainable Developments

3.1: Conceptions

Key Issues:

- How can implementation methods reach policy goals, ensuring city approval?
- What are the major differences between renovation and new development?

Now that sustainability has been defined and the policies have been established the way to achieve the goals set out by the policies is via implementation. Implementation can take place as two types of scenarios: either as a new sustainable building or as retrofitting an existing building to make it sustainable.

In order to build up the implementation capacity of the user it is important to elaborate on developmental processes that can be used. These processes can serve either as a direct mean for implementing sustainable buildings, or they can be modified and improved for sustainable building construction. It is important to provide this information because it helps bring ideas to reality.

It is necessary to understand that these processes are not unique. That is, they are not the only method for building a new sustainable structure or retrofitting an old one. There is always variation. In fact, this variation allows for the processes to be applied in different environments where different needs exist.

The development process behind new developments and retrofits is the means by which implementation skills are augmented. By improving these skills, even in just one person, the manual will benefit large areas. This person will be able to create new buildings and

pass on the knowledge that they have learned from the following sections, as well as information that they

3.2: New Development

Key Issues:

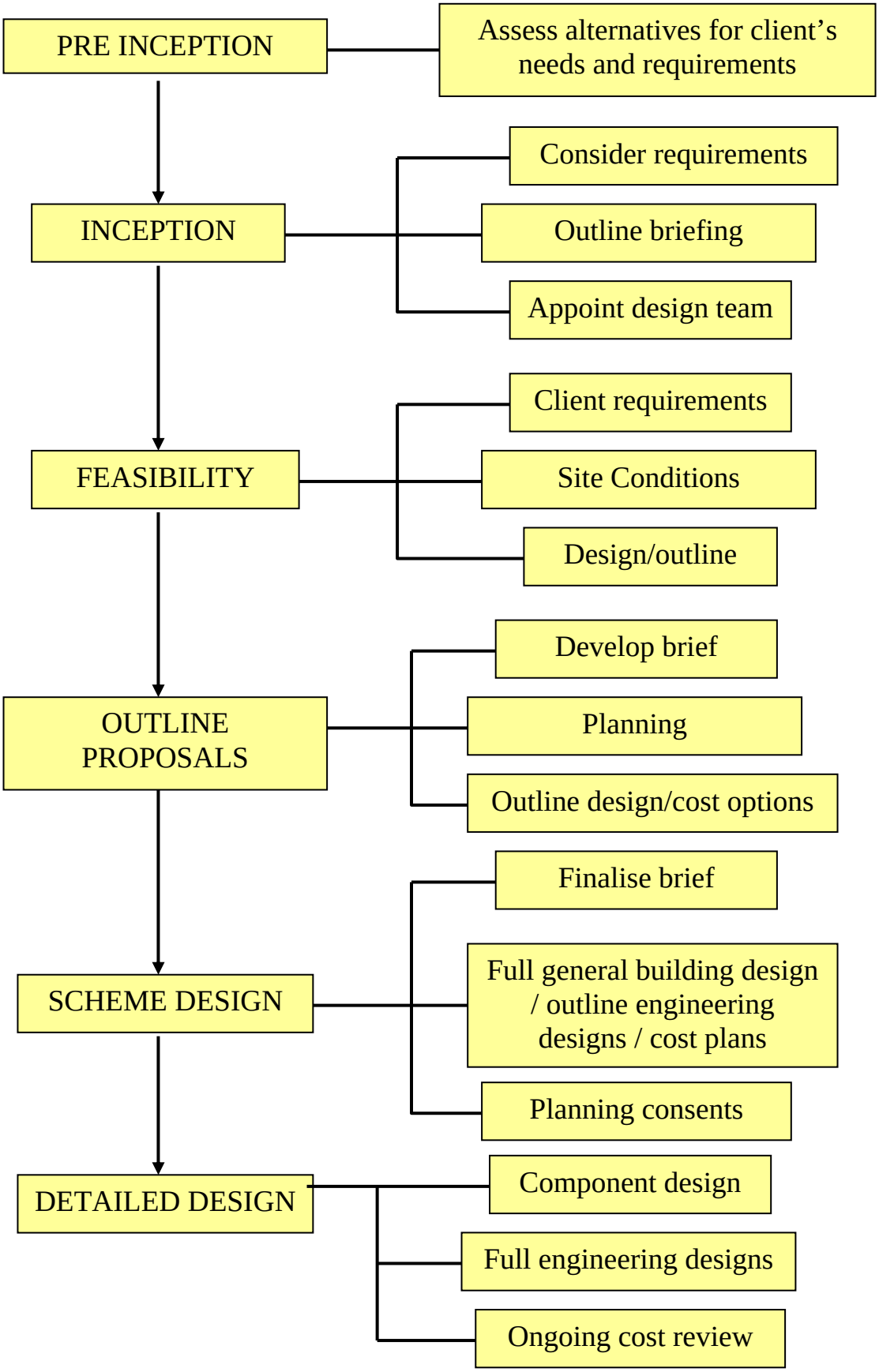
- The major factors of sustainable developments are design, materials, site issues, equipment, and site management.
- The process itself is determined by the client's key architects and developers involved.
- Checklists should be used to ensure the design is going in the right direction.
- The issues that affect the process are determined by several factors, including but not limited to the financial backing of the developer, and the practices that are employed.

3.2.1: Design

The difference in the development of a sustainable building and a conventional one lays in that different considerations and steps are taken into account during the design and construction of the site. Energy efficiency, emissions, green technology, and other aspects of sustainability take on a high priority on the whole building design process.

There are different stages in the development process of the design of a building. Enfield Council created a thorough sustainable construction and design guide that broke down the process into six different stages. These stages are presented in the following page in a flow chart showing each step and their main parts.

Figure 4: Flow chart for the sustainable building project stages



3.2.1.1: Checklists

The guide has checklists for each of the stages, so developers and architects taking on the design process can use them to get a better understanding of the matters they need to consider for the development at each stage. These checklists will also help by giving references, information, and tools.

The following is a summary of those checklists. For more information case studies, and references, consult the "Enfield Council - Sustainable Design and Construction Guide." This can give the reader a better understanding and practical application of all the concepts studied.

Enfield Guide Information:

- To get more information on how to get the guide contact Enfield Council by visiting their homepage: http://www.enfield.gov.uk. Copies are available at £5 each from:

Sustainability Team
Environmental Services
London Borough of Enfield
PO Box 52
Civic Centre
Silver Street
Enfield EN1 3XY

Telephone: +44 (0) 20 8379 3865
e-mail: la21@enfield.gov.uk

The following are summaries of the checklists and are separated by the design stages of a building project. Each of these start with a description and shows the groups of people involved in that stage.

Stage 1: Pre-inception

- At this stage the alternatives for meeting the client's needs and requirements are assessed.

- People Involved:
    - Planning Policy Officers
    - Development Control Officers
    - Client
    - Project Manager

This checklist is mainly about assessing the client's needs, and finding the best options. It starts by going over policy implications of the development, and considering whether to retrofit an existing building, or build a new one. This is followed by the consideration of the options about whether to choose a "brown field" or "green field" site, and finally the issue about reducing parking needs on sites by having a good access to public transport.

The main issues arising from this stage are taking into consideration the client's needs and requirements into the design, while still keeping the aspect of sustainability as a priority. The people involved may have no knowledge about sustainability, and may not even care, so it is very important that they know what it is, and how useful and beneficial it can be to them. This encourages the building development to start with best sustainable practices as a priority, and it will be easier to carry it on throughout the development.

Stage 2: Inception

- Set up client organisation; consider requirements; appoint designing team; outline briefing.
    - People Involved:

- Development Control Officers
- Client
- Asset/premises manager
- Project Manager

The goal of this phase is to make the client aware of the best design to fit their needs, while trying to incorporate best sustainable practices. One concern for the policy makers is how informed the client is about the following aspects, and what has to be done to inform them. The first part is a general perspective about introducing the client to sustainability, and the options of using it in the design.

The next topic covered is energy use. Issues about potential benefits from designing for better efficiency and renewable energy technologies are mentioned.

The proceeding sections go over making the client aware of the potential benefits of designing to be more sustainable in water use, internal environment, pollution, crime prevention, ecology, and landscaping. Building access is also a matter mentioned, and how proper access for disabled and elderly people is important. Access to public transportation is also considered. The last point is about crime prevention, and the benefits of designing to minimise the risk of crime.

The primary goal at this stage is to present the client with the best design alternatives in the context of sustainability, while meeting their needs at the same time. It goes into several areas of the design to make sure the best options are chosen category.

Stage 3: Feasibility

- This stage is aimed at studying the client's requirements, site conditions, design, and outline cost.
    - People Involved:
        - Development Control Officers
        - Project Manager
        - Design Team
        - Quantity Surveyor

This stage focuses on assessing the client's requirements and site conditions. The feasibility stage first goes over general concerns about sustainable design objectives and setting standards and targets for the building project. The second part is focused on energy and different considerations about the site that could improve energy efficiency. The points mentioned are solar energy use, heat recovery, site positioning, and utilising district heating or combined heat and power (CHP).

For water use, the checklist goes over minimising white water consumption, considering reusing grey water, and also treating and disposing wastewater on-site. Communication with the Environment Agency is also mentioned to learn about storage requirements, and to identify a local watercourse.

In regards to materials, Enfield suggests the potential of demolition and construction waste re-used and recycled on-site, and recommends minimising the amount of waste produced during development.

In terms of the internal environment, the main subject is setting the requirements for the building. This refers to levels of lightning, thermal comfort, and internal use of space.

Pollution is examined in terms of the impact the surrounding environment has on the building site. Considerations like noise levels, the level of pollution of the area, and the risk of radon gas emissions into the site from the ground are inspected.

The following sections go over ecology, landscaping, access to the site, and crime prevention. This is asking to see whether the site's ecological features have been established, like flora, wildlife, and water features that could be harmed by the development of a building on that site. It continues by testing if transport and access to the site has been considered. The crime prevention section examines the consideration that has been given to minimising risks of crime on the site.

Stage 4: Outline Proposals

- Brief development; planning; outline design and cost options.
    - People Involved:
        - Building Control Officers
        - Client
        - Project Manager
        - Design Team
        - Quantity Surveyor

This stage of the process focuses on getting an outline of the design, and having cost options for the client. The first general points covered refer to considering

environmental performance measures for the building, such as BREEAM. Then it asks whether the merits of different building types have been assessed. Another important issue raised is whether it has been considered to extend or modify the building in the future, and the impact these modifications may have on light and ventilation.

Further consideration is then placed on materials. Recommendation is placed in considering assessing the benefits of different construction methods. Low-mass construction for walls and roofs is suggested. One of the most important points is minimising the quantities of materials needed, referring to recycled materials and reusing materials from the demolition of existing buildings.

It continues to further energy concerns, first in the context of daylight and passive solar design. This mainly refers to positioning the building so it is within 30 degrees of south where possible, and considering if there is any vegetation or other building that might overshadow the building. The next parts go over insulation, integrated heating and ventilation, and shelter from prevailing winds.

Internal environment consists of considering the risk of Legionellosis from water, and how the impact of the local environment on the site is being minimised. Again, water, ecology and landscape, access, and crime prevention are concerns. Water explains wastewater treatment and minimisation of white water. Ecology and landscape mainly focus on whether the ecological features on the site will be protected. Access refers to transport to the site, and crime prevention determines what design features can be included to minimise crime, such as mixed development.

Stage 5: Scheme Design

- Finalise brief; full general building designs, outline engineering designs, cost plan; submission for planning consents.
    - People Involved:
        - Building Control Officers
        - Client
        - Project Manager
        - Design Team
        - Quantity Surveyor

By this point the brief should be finalised. The same sections are discussed, energy, water, materials, etc., but in this stage these are looked at from a more advanced viewpoint. The questions asked are not considerations, rather, this checklist covers issues about what has already been planned for the building.

The first consideration in terms of energy is if the use of daylight and passive solar design had been incorporated into the design of the building. The details about this deal with window specifications, positioning, layout of rooms, and similar aspects of daylight use. The next set of concerns cover heating and ventilation systems to see whether the system and fuel will meet the projected needs, and have low emissions. Further issues include zoning of the heating system, heat recovery systems, and the use of active solar energy.

The next step details grey water and rainwater reuse, the protection of existing water features, and minimising the need for water mains by the design of landscape

features. The only two points made are whether collection systems and storage facilities for the water have been included.

The next topic is materials, which are key issues in design. The main question is if the materials have been selected for the major elements of the development. Issues covered under this topic are whether the selected materials have low energy intensity, avoid damage to the environment and humans, do they have a long life and low maintenance requirements, etc. The following point refers to provisional storage and recycling of waste materials.

The last sections in this stage are internal environment, pollution, access, and crime prevention. Internal environment deals mainly with minimising health risks by including filters in the ventilation system, and meshes to prevent entry of animal pests. The pollution section refers to incorporating measures to reduce noise levels, mainly sound insulation in floors and walls, and double-glazing for parts exposed to high noise levels.

Access asks if the design has considered the needs of cyclists, young people, the elderly, and the disabled. The main issues are parking spaces, access ramps, wide corridors and doorways, etc. The crime prevention section asks whether the design minimised the risk of crime, by having external passageways and parking areas with good illumination, and using thorny bushes on boundaries to discourage graffiti.

All these issues should be pointing the developers and architects involved in the design of the development in the right direction by this point. The next step will be to finalise all the details of the design, as in engineering and component design, and review costs.

Stage 6: Detailed Design

- Component design, full engineering designs, ongoing cost review.
    - People Involved:
        - Client
        - Project Manager
        - Design Team
        - Quantity Surveyor

In this last stage of the process, the goal is to ensure the options for the development in the design are as sustainable as possible. So the checklist covers the different issues of energy, water, materials, etc. making sure key points were not overlooked.

The first set of questions, which refer to the design in general, discusses ensuring the best environmental practice was followed in outlining the detailed specifications. Secondly, it makes sure the cost takes into account the full life cycle of, not only the building, but its components too, and that the specifications of the design will have low maintenance requirements.

The further energy issues deal with having a heating and ventilation plant of the correct size, and how have the specifications ensured energy use for lighting is reduced. For this point, energy efficient luminaries and occupancy sensors or light level sensors to switch lights off are mentioned. Finally the issue of how the minimisation of heat loss through glazing was ensured comes up, and it is asked whether specifying low-emissivity double-glazing and argon filled double-glazing were considered.

Next comes the issue of water efficiency. For this, aspects like efficient water taps; WCs, showers and urinals are mentioned. Then it is asked if integrating rain or grey water for flushing toilets, irrigating, and water efficient appliances have been considered.

Further consideration into materials goes over assessing the environmental impact of the materials, and components that will be used. It is asked if these materials and components have an A rating in the Green Guide to Specification. The following issue is how construction waste is going to be reduced, for example, by designing to sizes that fit standard dimensions for modules of components and sheet material. A big issue when dealing with materials is their transportation, because it has to be ensured that they are not transported greater distances to the site than necessary, and to instruct contractors to use local suppliers as much as they can.

The internal environment deals with issues such as sick building syndrome, and avoiding synthetic materials and finishes. Also, ensuring there is adequate controlled ventilation to avoid condensation and mould problems. Finally, it asked to ensure that the building occupants are able control the levels of lighting, warmth and ventilation.

The pollution section goes over minimising emissions from the power plants, and materials specified for the development. This refers to specifying a plant that minimises NOX emissions, avoiding materials that use ozone-depleting chemicals, and insulation materials with zero depletion potential.

The Ecology and landscape section asks to ensure that the specification for landscape planting will encourage wildlife development in the area. The last two sections of this checklist are access to the site and crime prevention.

Relevant documents or links:

- BRE - http://www.bre.co.uk/
  - Environmental Design Guide for Naturally Ventilated and Day lit Offices.
  - BR209 - Site Layout Planning for Daylight and Sunlight
  - Avoiding or Minimising the Use of Air-Conditioning
  - Low-water-use wash downs WCs
  - CFCs in buildings

- BRECSU
  - Planning for Passive Solar Design
  - GPG234 Guide to Community Heating and CHP
  - GPG 079 Low Energy Design for Housing
  - GIL 020 Low Energy Domestic Lighting

- RIBA – http://www.architecture.com
  - Safety and Security in Housing Design

- These are some of the suggested documents found in the Enfield Guide, refer to it to find more suggestions.

3.2.2: Building Green Checklist - Development Process Steps

The difference between the development of a sustainable or conventional building lies in the different considerations and steps taken into account during the design and construction of the site. Energy efficiency, emissions, green technology, and other aspects of sustainability take on a high priority on the whole building design process.

These development process steps were adapted from "Building Green – Checklist for environmentally responsible design and construction" (http://www.buildinggreen.com). More information on the main aspects in the development of a sustainable building is available. They are divided as:

- Design

- Site issues
- Materials
- Equipment use
- Management

3.2.2.1: Design

Design is one of the most important steps in the process. During this phase, all the possible best practices that are going to be used in the building have to be considered and evaluated to see which ones will be used.

- Optimise space: The resource use should be kept to a minimum. The design should look at optimising the interior space and keep the overall building size to a minimum.
- Energy Efficiency: Employ tight construction, good insulation and other energy efficient tools, such as high-performance windows. All these help increase energy efficiency by reducing heat loss during the winter, or heat gain during the summer, which significantly reduces electricity or gas bills.
- Renewable energy use: Incorporate daylighting, natural cooling and passive solar heating. All these are aimed to conserve energy by using natural radiation from the sun to light, cool (during summer months), and heat (during winter months). This reduces the necessity of heating and air conditioning. Another aspect to consider is solar water heating and photovoltaic cells.
- Material use: Minimise waste by having standard building dimensions, avoiding structural over-design, and simplify building geometry.
- Landscaping: Design water-efficient, low-maintenance landscaping given that conventional lawns create a high ecological impact from water and pesticide use.
- Graywater: Look into graywater (water from sinks, showers, washing machines, etc.) to see if it can be recycled for irrigation.
- Durability: The materials used in building should be strong enough to make up for the energy used in harvesting and transportation with longevity.
- Health hazards: Try to minimise radon entry into buildings, and make it easier for future alleviation. Avoid moisture problems, which may cause mould and mildew growth. Finally, design insect resistant detailing to reduce pesticide use.

3.2.2.2: Site Issues

This aspect relates to the community, the surrounding areas of the building, and resources.

- Community: To create a good community and neighbourhood, development patterns have to be consistent and cohesive.
- Automobiles: Locate the building where access to public transportation, bicycle and walking paths are available. This is to reduce the dependence on automobiles.
- Resources: Evaluate the site for solar access, type of soil, vegetation, water resources, etc. Guide the design according to the availability of these resources.
- Environmental impact: Locate the building near other units to preserve open space and wildlife habitats. Avoid wetlands, and keep pristine areas untouched.
- In-fill and mixed-use development: Instead of building on greenfield or undeveloped areas, encourage in-fill development that increases density in developed areas. Also, try to mix residential with commercial areas (mixed-use) to reduce automobile dependency.
- On-site water-management: Design to have rainwater runoff absorbed rather than carrying it to off-site sewers. Design for rooftop water collection for irrigation in arid areas.
- Building position: Having trees to the east and west sides of the building can help keep away cold winds in the winter and help cool summer breezes towards building. Also, east and west-facing windows usually cause excessive heat gains in the summer and heat losses in the winter. So vertical shading can be used, or trees and shrubs can be placed to shade the windows.

3.2.2.3: Materials

Ozone protection: Avoid ozone-depleting chemicals in equipment and insulation. HCFCs, which have replaced the banned CFCs, damage the ozone layer and should be avoided.

- Low-maintenance building materials: Maintenance can be painting, waterproofing, etc. The less maintenance a building needs the greater the energy conservation. This also reduces environmental impact.
- Materials with low embodied energy: When processed or manufactured products and materials are made, the process is generally energy-intensive. So as long as the durability and performance of these is not sacrificed, low embodied energy materials (those that do not take as much energy in their production) should be used.
- Distance in transportation: Buying locally produced building material is very important, because this means that less energy is lost, and less pollution created, in the transportation of those materials.

- Recycled products: Using materials or products made from reprocessed or recycled materials reduce waste problems, and cuts energy consumption.
- Salvaged building materials: A way to reduce waste, save natural resources, and cut manufacturing energy consumption is by using salvaged materials. These can be timber, hardware, plumbing fixtures, etc. Avoid using old windows and toilets that will reduce energy and water efficiency.
- Certified timber: Timber should be obtained from places where deforestation is not a problem. These are independent certified forests that produce timber for construction purposes. Avoid buying tropical hardwoods unless it is certified.
- Gas pollutants: Adhesives, carpeting, solvents, and other products may emit gas pollutants such as formaldehyde and VOCs (volatile organic compounds). These can cause health problems for the workers and occupants of the building and pollute the environment.

3.2.2.4: Equipment

This is a crucial part of the design. If a very sustainable building is planned, but still poor or inefficient equipment is used, then one of the most important aspects of environmental sustainability will be neglected, energy conservation.

- Install high efficiency heating and cooling equipment: Having efficient water heaters, furnaces, and air conditioners will save occupants money (by wasting less energy), and they will also have reduced emissions and pollution during operation.
- Lights and appliances: High-efficiency in these is also very important. The start up cost of these appliances (as is with most efficient equipment) is generally high, but it saves on energy bills in the long run, and it also has environmental advantages.
- Water efficient equipment: Use toilets, showerheads, and faucets that are water conserving. They reduce water use, and the need of sewage treatment plants and septic systems.
- Mechanical ventilation: This is used to keep indoor air in closed buildings healthy. In cold climates heat recovery ventilators should be considered.

3.2.2.5: Management

Once a building is finished, it cannot be expected to be completely sustainable if the people who inhabit it treat it as a regular building. There are some things that have to change in order to make the site as sustainable as possible. These are some of those ways:

- Avoid the use of pesticides or chemicals that may damage the groundwater. Try to find less toxic alternatives.
- Sort out waste. The waste on the site should be sorted into different containers. To do this, marked bins should be kept for different types of waste. Find what materials can be recycled, and where to take them to do so. Have the people in the building learn about this.
- Recycling: Make recycling easy by placing bins near kitchens, photocopiers, and other high traffic areas.
- Make the building as environmentally responsible as possible. Use energy efficient vehicles, have the people in the buildings arrange carpools to the site, to minimise unnecessary driving when doing errands. Use recycled paper and supplies. Use coffee mugs rather than disposable ones, and recycle as much as you can.
- Try to educate as many people in the building (staff, clients, etc), about environmental impacts of buildings and how to reduce them.

3.2.3: Tall Buildings

Key Issues

- The developmental process behind tall buildings would be useful in helping people construct them. Knowing this information may provide additional assistance in their construction.
- Incentives make the building more attractive to buyers, and may improve the 'acceptability' of sustainable structures to the community.
- Community needs to understand value of the building and the benefits it will produce. This will make the building more attractive.
- In tall buildings, there are many areas that can be improved to lower energy requirements. The availability of options means that more can potentially be done to benefit the environment.
- The barriers can sometimes be removed, but other times are part of the construction process. Getting rid of as many as possible can significantly ease development.

The following information was gathered from the **"**Tall Buildings and Sustainability Report", 2002 (for information on how to get a copy of this report see the information box at the end of the section). While some page numbers are provided, it is recommended that the document be referenced for more complete details.

3.2.3.1: Financial Considerations

- High density, low land use
- Economy of scale
- More materials can mean efficient production and less costs
- More available land on the plot not used by structure (p. 26, 2002)
- New practices may improve worker productivity raising profits

3.2.3.2: Community Benefits and Marketing

- Extra land area on plot may be used for parks, benches, or shops (p. 26, 2002).
- Improvement of worker productivity can interest buyers of the building.
- The Commerzbank Headquarters in Frankfurt saw that the surrounding area was restored to preserve the natural culture in the area. Many of the perimeter buildings exist in unison with the office and include parking, an auditorium, and shops.
- In the Flower Tower, the addition of trees and sports field in the building plan means that the structure doesn't take away as much from the city.

3.2.3.3: Transport

- Clustering of tall buildings together can lower need for private transportation provided a good public transport system exists.

3.2.3.4: Technology Incorporated

Emissions

- This information was not covered in the report.

Energy

- Buildings in London use approximately 72% of the total energy consumed
- Many modern tall buildings are usually built with aluminium, steel, and glass. However, according to the report, these three materials have the highest 'embodied energy'. (p. 22, 2002)
- Alternative materials can include concrete. Different forms of concrete can be used to build buildings up to about 70 stories. The difference between concrete and the other materials in terms of embodied energy is very large.
- Many options are available for material composition. While cement requires 4000 to 7500 MJ of energy per tonne, pulverised fuel ash requires only 150 to 400 MJ per tonne and ground blast furnace slag 700 to 1000 MJ per tonne. All three can be used to make concrete.
- Lloyds Register of Shipping Building was given 31 out of 36 points in the BREEAM rating system. However the building is air-conditioned. A change of grading system may be necessary.
- Natural sunlight can work in conjunction with thermal masses to minimise energy needs.

- Wind turbines can be used on roofs or other locations to produce clean energy.
- The façade of the building can be used to keep hot or cool air inside depending on needs of the inhabitants. Different levels of glazing or a double skin can be used to achieve these effects.
- Potential power sources for a building include combined heat and power (CHP), photovoltaics (PV), fuel cell, and wind power. CHP and fuel cells are very efficient and produce small emissions. PV cells, if used in large amounts, can power entire buildings. Their ideal orientation for London is facing south with a 30-degree inclination.

Water

- Rainwater collection can lower pumping requirements.
- Grey-water recycling and low flow urinals, toilets, and sinks can reduce water consumption for the building.

Other

- Fire prevention and safety are key issues for tall buildings. Smoke dampers permanent fire brigades, and sprinkler systems can all be used for emergency situations.
- Certain designs exist that can remove some barriers of building. The Commerzbank Headquarters reduced the shade impact in design where the Swiss Reinsurance design can remove the wind problem. Alternatively, the Flower Tower uses the wind constructively for power.

3.2.3.5: Barriers

- The safety of workers is important at greater heights. Tall building developments may have to pay more to ensure this safety.
- Workers who work at those heights generally require higher labour costs because of their skills.
- Foundations for a tall building have to be dug deeper, meaning more costs, and can sometimes be illegal, such as in London where some methods of driving piles are illegal because of the noise and environmental impact
- More lifts and stairs are needed for a tall building than a conventional one.
- Wind at the ground level can become much stronger, which is uncomfortable for people walking, and at higher floors wind can create distracting noises and cold drafts
- The shade the building creates is another issue. Companies of other buildings in the shade may sue for natural sunlight theft. This is more critical if the building being shaded is also sustainable, and requires sunlight to perform optimally.

Recommendation:
This site contains the exact same information as the paper report. It is recommended to speak with Will Pank regarding the developmental process of constructing a tall building. If he does not have that information, he may be able to provide other valuable contact information to fill in the gaps.

Contact:

- Will Pank:
  - Email: will.pank@fabermaunsell.com
  - Telephone: +44 (0) 20 8639 3802

- To get more information on how to get the "Tall Buildings and Sustainability Report" from Fabre Maunsell, contact the Corporation of London:

Economic Development Office
Corporation of London
PO Box 270
Guildhall
London
EC2P 2EJ

Tel: +44 (0) 20 7332 3614
Fax: +44 (0) 20 7332 3616
E-mail: econ.dev@corpoflondon.gov.uk

Link:

- To get an electronic copy of the report go to:
  - http://www.cityoflondon.gov.uk/business_city/research_statistics/reports/29.htm

3.2.4: Further information

The following information can also be found in the electronic database developed for the manual.

3.2.4.1: Tools

- **BREEAM (Building Research Establishment Environmental Assessment Model)**
  - Link: http://products.bre.co.uk/breeam/breeam1.html
  - Environmental Assessment tool and accreditation scheme
  - Scheme: Certificate awarded to individual buildings according to a set of performance criterion.
- **SAP (Standard Assessments Procedure)**
  - Link: http://www.gravesham.gov.uk/People/BuildControl/SAP.htm
  - Means of estimating energy use for space and water heating in new and existing buildings.
  - The scale is from 1-100 the greater numbers being the best rating.
  - Based on the Building Establishment Domestic Energy Model (BREDEM).

3.2.4.2: Green Builders, Architects and useful organisations

- The Association for Environment Conscious Building
  - http://www.aecb.net/
- The Green Register of Construction Professionals
  - http://www.greenregister.org/
- The Royal Institute of British Architects (RIBA)
  - http://www.architecture.com/
- Combined Heat and Power Association
  - http://www.chpa.co.uk/
- Royal Town Planning Institute
  - http://www.rtpi.org.uk/
- CIRIA – Construction, Industry Research and Information Association
  - http://www.ciria.org.uk

3.3: Retrofitting

Key Issues:

- The long life expectancy of buildings makes the idea of retrofitting important.
- People need to choose between planning the project themselves, hiring energy consulting firms, or hiring an energy service company to do the work for them.
- Globalisation of these guidelines is necessary to improve buildings on an international level.

3.3.1: Introduction

The following is a guide to retrofitting a commercial or apartment building in the United States. It is necessary to focus on retrofitting existing buildings with sustainable practices, because of the long lasting qualities of buildings. To achieve the goals of Kyoto, many of the changes will need to be made to existing buildings.

Much of the information in this section is common sense, and can be applied to other regions around the world as well. Other information is site specific, and would require an appropriate person or group of people to review the information to determine a suitable alternative in a different region or different style of building, such as a personal residence.

There are three different guides that are mentioned on the web site, "Road Maps to Energy Efficiency." The first guide details how the management of the building should carry out renovation. The second outlines the procedure for hiring an energy-consulting firm. The last guide offers the procedure for retrofitting a building with the assistance of an energy service company (http://energyroadmaps.org/road/index.shtml).

3.3.2: Private Retrofitting

Retrofitting a building with no outside assistance requires more attention, and generally more capital from the building owner and occupants. This claim may sound inaccurate, but consultation companies can often save the owner money based on their knowledge of the process. However, all the benefits of the work are returned to the building owner and occupants.

1. Benefits: Understand the outcome of retrofitting their building. People need to know what benefits are in store for them so they can feel comfortable about making the right decision.
2. Evaluation: The building must have a preliminary evaluation to make sure that it can be retrofitted with sustainable designs. A utilities company can usually perform this analysis, as they are aware of average energy consumption in the area. The company can also provide information about what target energy efficiency can be reached by the building.
3. Decision on changes: The owner of the building needs to decide whether to make the suggested changes to the building. He or she must evaluate the costs and the benefits, taking into account the long term as well as any implicit costs or benefits.
4. Labour: Determine if current labour experts already employed by the owner are capable of making the needed changes to the building. If so, then the retrofit can proceed. Otherwise, the owner must look externally, possibly receiving assistance from the utilities companies or other sources.
5. Thorough Evaluation: A more complete evaluation of the building is needed to determine exactly what can be retrofitted. This process also determines the expected costs and savings, as well as other valuable information regarding the building and procedure, such as goals of the retrofit.
6. Improvement Decision: The owner needs to decide which improvements to use and which will not be used. This decision cannot be made beforehand because of the lack of information. Building occupants should also be able to voice their opinion.
7. Financial analysis: This is more a corporate procedure but it evaluates the renovation in terms of its initial costs and expected returns. For apartment buildings and other tenant-based buildings, this analysis should evaluate how the benefits are split between owner and tenants. The owner must also be aware of other hidden benefits that sustainable buildings offer.
8. Payment: Determine method for paying capital for the building. For example, one option is for the landlord to pay all costs and receive all benefits. Another example is for tenants to pay the costs and receive the benefits. The latter is more problematic, because the savings in sustainability are generally long term. This means that tenants are more unlikely to see their costs repaid by the benefits. A solution to this problem

is to combine these two methods. The landlord or owner initially pays for a fixed amount of the costs to the tenants. If the tenants' cost is less than this amount, the owner pockets the savings of the retrofitting. If the tenants' cost is more than this amount, the tenants share in the savings of the retrofit. To simplify this process, the Environmental Protection Agency in the US has developed a tool called the QuikScope. It makes the process of determining exactly who gets what much easier. For more information on QuikScope, visit (http://yosemite.epa.gov/Estar/business.nsf/content/CRE_Tools_QS.htm).

9. Upgrade Plan: Here the methods for implementing the steps of retrofitting should be evaluated to determine what process is more efficient and cost effective. It should also determine how to evaluate the end results against the expected goals from the evaluation step.
10. Funding the Retrofit: This can either be done out of pocket, or with assistance from a financial institution or public funds.
11. Implementation: Implement the procedure using outside assistance if needed. Care needs to be taken to ensure that the procedure for retrofitting is adhered to.
12. Education: Inform and train staff or tenants with regards to the new designs, and how they might be made more effective. Some groups in the US are able to train employees with this new information. Their help can expedite the training process.
13. Maintain and Evaluate: The exact return on investment and energy savings should be documented, and the changes should be maintained for optimal performance.

3.3.3: Retrofitting Using an Energy-Consulting Firm

The process for retrofitting a structure with the aid of an energy-consulting firm is very similar to the private process. Step 4 is replaced by a step to select the energy consultant. This should be done based on the experience and success the consulting firm has had with similar projects. The firm needs to understand what the goals of the project are, and should not desire a different goal.

Another addition is in between steps 12 and 13. Here the building must be re-commissioned. This ensures that the building works the same way as was intended, and can be done by the energy-consulting firm. The other steps are the same as above in the same order.

3.3.4: Retrofitting Using an Energy Service Company

The last process describes the retrofitting procedure for hiring an Energy Service Company (ESCO). The procedure here has a few similar steps to private renovation, but also has additional procedures, as well. For this reason, the process will be described in depth where necessary.

1. Benefits
2. Evaluation
3. Contract Proposal: The contract states that the energy savings of the retrofit will pay the ESCO. The ESCO adheres to the International Performance Measurement and Verification Protocol (IPMVP) to ensure cost savings.
4. Thorough Evaluation
5. Payment
6. Finance: The savings gained from an ESCO are required to meet or exceed costs. If they don't, the ESCO pays the difference. If the savings are higher, then the owner and the ESCO share the savings. Another alternative is for the owner to pay a percentage of the savings to the ESCO for a certain timeframe.
7. Agreement: The signing of the project agreement between the building owner and the ESCO takes place.
8. Securing Finance: The ESCO secures money for the project.
9. Implementation
10. Education
11. Re-Commission: This ensures that the building works the same way as was intended.
12. Maintain & evaluate
13. Exchange: The project exchanges control from the ESCO to the owner.

The processes that people have developed for creating sustainable buildings, from a new design or an existing building, have been developed. Now the methods in which people have used these processes in creating sustainable buildings will be shown. These examples were chosen for their ability to exemplify best practices of sustainability in three categories of structure: residential, commercial, and industrial.

Link:

- http://energyroadmaps.org/road/index.shtml
- This link covers all the above description in detail and with flow charts.

3.3.5: Retrofitting Case Study – Recommendation

We were able to identify a process for retrofitting buildings but could not obtain any case studies. However, we still feel that this information is very valuable to the manual, given that it is one of the two ways identified to implement sustainability in buildings. For this reason we recommend searching for retrofitting case studies to be included in the manual.

3.4: Case Studies of Sustainable Buildings in the UK

3.4.1: Residential/Commercial Mix: BedZED

Introduction:

Bill Dunster Architects (BDA) designed BedZED. The goal of BedZED is to incorporate all of the sustainable practices that BDA had previously employed in separate designs to result in a Zero Emissions Development. BedZED can be found on Hackbridge Rd. in Beddington, in the London Borough of Sutton. BDA's partners in this project are BioRegional (found the site, helped gain green specifications), Peabody Trust (performed marketing and sales), Gardiner and Theobald (justified green upgrades and hired subcontractors), Ellis and Moore, and ARUPS (engineered the design).

Key Issues

- The major difference between BedZED and other sustainable developments came in the reputation of Bill Dunster. He already had the contacts, experience, and esteem of his colleagues. This gave the BedZED team advantages in recruiting clients and gaining funding. The question is, how do architects and developers who do not have these advantages work around them?
- Even still, the financial figures (1300 sterling versus 1000 sterling per square meter) can be daunting to clients. How were these prices justified to the clients (Peabody Trust, etc.)
- Acquiring land from the city can be easier in some ways, and harder in others. Only with the co-operation of the city planners can the development team can the success of the project be assured. In addition, with the city planners working in conjunction with the development team, they can even overcome price differences with privately owned land. How are these features accomplished?

3.4.1.1: Developmental Process:

1. Dunster conceptualised BedZED from sustainable practices used in his other developments. BedZED was an attempt to incorporate all at once.
2. Met with liaison at BioRegional (Client), who became part of the core of BedZED.
3. BioRegional liased with Peabody Trust, and brought them on board as well.

4. Dunster brought in Gardiner and Theobald, Ellis and Moore, and ARUPS. Gardiner and Theobald proved the economic value of the site and justified the "green upgrades." Ellis and Moore and ARUPS are engineering firms.
5. BioRegional found site in Beddington. They chose the site for two reasons. The first was that BioRegional was based in Sutton, which is the borough Beddington resides in. Second, Sutton is known for its sustainable policies and guidance.
6. Three parts, all of which occurred simultaneously.
    a. The group of partners worked together to get their bid successfully registered. This was with regards to getting WWF sponsorship, and the planners of Sutton justifying the fact that they weren't maximising the profits for the city by using this scheme.
    b. Dunster, the architects, and the engineers worked out a scheme to fit BedZED on the site. Determined how many units could be implemented, etc.
    c. Gardiner and Theobald promoted their construction management wing; found subcontractors based on their bids, and hired the subcontractors.
7. After bid was registered, Peabody pushed for construction, and construction began, while Peabody negotiated with quantity surveyors.
8. Process transferred to Gardiner and Theobald.

3.4.1.2: Financial Considerations

- Problems arose in the fact that BedZED costs approximately £1300 per square meter, as opposed to the price of conventional designs, which was around £1000 per square meter. This problem is mainly in attracting clients, (Peabody Trust and BioRegional).
- There are plenty of policies that assist sustainable developments, but the research involved in finding them all is quite extensive.
- It took slightly longer and cost slightly more than was expected, capping out at approximately £10 million.

3.4.1.3: Community Benefits and Marketing

- BedZED offers a unique scheme, incorporating business, leisure, and homes into a compact design.
- The facilities at BedZED (such as an onsite nursery) are open to the rest of the community as well, in addition to the leisure and sports facilities.
- Marketing is performed by Peabody Trust, which implements interviews to see if the potential residents could live a ZED lifestyle.
- BedZED also gives opportunity for low-income families to reside there, as well, since Peabody Trust is a firm believer in giving low-income families residency.

3.4.1.4: Transport

- BedZED has an electric car park incorporated into the design scheme, allowing residents to buy electric cars, and charge them by the photo voltaic cells mounted on the buildings.
- This car park may advance to a car pool if enough residents participate.
- BedZED residents are encouraged to use a bike, and BedZED gives all residents information on bike purchasing and repair, as well as giving them space to store their bikes.
- However, since business space is incorporated into the design, it may be possible for residents to walk to work.
- BedZED also gives residents information on grocery delivery, reducing individual residents needs to find transportation to a supermarket.

3.4.1.5: Technology Incorporated

The technology used in BedZED is quite extensive. The following is examples of those ways. For more information, visit http://www.zedfactory.com.

Energy

- Energy is generated through the use of photovoltaic cells on the structures, and a wood chip burner for additional power, during peek hours.
- Energy is spent heating the homes during the winter, providing electricity, and powering the electric cars.
- Using passive heating and cooling, as well as a much larger amount of insulation saves energy in BedZED.

Emissions

- Emissions are reduced through several methods. The purpose of BedZED is to make zero emissions.
- The power structures are designed to utilise entirely renewable energy, giving off no emissions.
- For the small amount of emissions generated, the amount of green space can act as a carbon sink, removing a portion of the carbon dioxide from the air.

Materials

- BedZED attempts to use only materials from the surrounding area, thus reducing the embodied energy caused by transportation of materials.
- BedZED also utilises as much recycled material as possible, as long as it is still in sound working order. This is particularly useful for steel and aluminium, since production costs for these materials are very high.

Water

- Grey water is managed onsite, restoring the water back to the network.

Other

- BedZED utilises several other techniques to reach its goal of Zero Emissions Development, while maintaining an aesthetically appeasing nature.
- These include sky gardens; walk ways, and various other technological aspects that can be witnessed at the BedZED site itself.

3.4.1.6: Barriers

- The biggest problem faced by the BedZED team was procuring the land. To do this, they had to achieve ecological objectives, and receive sponsorship by the World Wildlife Foundation (WWF). They needed the sponsorship because local planning policy in the London Borough of Sutton deemed that if the city owned the land, it must maximise the money gained by the city for the property (Section 123 of the Local Governments Act of 1972, as amended). By receiving the WWF sponsorship, they allowed the city to bypass the law, accepting the BedZED bid, which was much lower than the conventional developers bid. In the end, the solution to this problem was getting the sponsorship and time.
- It was difficult to explain the appearance of BedZED to the neighbouring community. The architecture is significantly different, and some people were afraid it could lower their land value. The BedZED team had to explain "We are not building spaceships in your back yard" (Leigh Bowen, Bill Dunster Architects, 2002).

Links:

- Bill Dunster Architects - http://www.zedfactory.com
- Bioregional - http://www.bioregional.com/
- Peabody Trust - http://www.peabody.org.uk
- Gardiner & Theobald - http://www.gardiner.com/

3.4.1.7: Conclusions

After applying the template for analysis, the question of how sustainability and the developmental process interact for this case can be answered. BedZED addressed many of the key issues of sustainability and its development. In terms of the environment, it successfully achieved post construction zero emissions. In addition, being a mixed-use residential and commercial site lowered travel costs for both working and shopping. However, these are not the topics that raise further issues.

BedZED had some advantages that were not completely unique to them, but are not common throughout the architectural world. One of the biggest issues from the BedZED case study revolves around the contacts and reputation of the architects involved. How can architects with less experience still manage to produce sustainable developments? How can they justify the value of the project, and how can they earn the respect of the city and its planners?

Beyond the high price of each unit (30% greater than conventional developments), there were no significant financial concerns for BedZED. What financial issues might architects and developers without the reputation of Bill Dunster Architects encounter? How would this have been handled if it were privately owned land? In future case studies, these issues should be addressed.

3.4.2: Industrial Case Study – Recommendation

We were unable to obtain a best practice case study on an industrial site. However, we still feel that this information is very valuable to the manual, especially for developing areas that may exist in Asian countries or other locations. For this reason we recommend the following list of options to obtain a case study.

The first option is to contact BRE again. Their website claims that they evaluated industrial sites. However in phone calls they stated that they had no information about any sites. A follow up phone call stating the fact on their web page may provide more information. Another option is to keep searching online. Although we have tried this ourselves, it is only a matter of time before someone places a case online for public viewing. Lastly, the final option is to continue attending conferences and talking with people whom may be better informed than we are. We feel that these options can provide the information required to fill this section.

3.5: Other Recommended Case Studies

3.5.1: Hannover Kronsberg, Germany:

Based on the reviewed materials, Kronsberg attempts to address the three primary aspects of sustainability, economics, society, and the environment. It nearly reaches zero emissions in post development. It stands at approximately 20% emissions, reducing further to 5% with the implementation of photovoltaic cells. In terms of society, it has planned for a completely integrated community, complete with schooling, religion, cultural venues, and leisure facilities. Lastly, on the economic front, it employs mixed-use facilities, combining both residential and commercial. Investigating the developmental process may yield much different results from BedZED. Major issues revolving around Kronsberg are who developed the designs and the plan? What part did the city play in its conception and construction (the city owned the land)? How was the project financed? The scheme is complete, and extensive monitoring is underway to assess the benefits of sustainable living.

Contact Info:

Kronsberg Environmental Liaison Agency (KUKA)
Feldbuschwende 2
30539 Hannover
Tel: +49 (0)511 950 7983
Fax: +49 (0)511 950 79850
e-mail: kukagmbh@compuserve.com

3.5.2: Viikki, Helsinki Finland:

The development calls for a university science park, and has a mixed-use residential commercial plan involved. However, the majority of the site is for the university itself. The development process included learning by doing, and the development is on land owned by the city. The scheme is complete, and extensive monitoring is underway to assess the benefits of sustainable living.

Contact Info:

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Aleksanterinkatu 22-24, FIN-00170 Helsinki
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Fax: +358-9-179-149
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3.5.3: Review

It has been shown that sustainable building practices are already in use around the world. However, the impact that these practices have on society is very minuscule. Many people are not even aware of what sustainability is; let alone what good practices are. To combat this problem, analysis of technology and technique transfer needs to be addressed. People involved in sustainability need to understand how they can globalise their design process so that other uninformed people can start building sustainable developments in different locations, using different materials, having different laws of governance.

Chapter IV: Barriers and Issues

4.1: Policy

Policies that support sustainable developments have become more prevalent over the last ten years. However, not all policies help sustainable growth. Some quite ably hinder it, in fact. Although many exist that could fit this description, in the United Kingdom, there are two pieces of policy that can produce the biggest problems. In many cases, these two issues will not be a concern, but developers and planners both will need to investigate the role historic building sites and city owned land will play in the development.

4.1.1: Section 123: Local Government Act 1972, as amended (Section 123)

Section 123 is a widely debated topic in the sustainable community. The reason why it is so important is because it states what the local governments must do when the sale of some of its property is at hand. Section 123 states that the city must receive the best price attainable in terms of revenue from the sale of city owned property. This makes Section 123 an issue whenever city owned land comes into play in sustainable development. This means that if the intended site is city owned, and two contractors bid on that land, the local government must accept the highest bid for the land.

The developer can circumvent Section 123 if the planning committee for the site wants the development. One method of doing this has already been discussed in the case study on BedZED. The basic method to bypass Section 123 is to appeal to the Secretary of State with the reasoning behind the decision, and organisations backing the claim. The

Secretary of State can allow the local government to ignore Section 123 in its deliberations.

4.1.2 Historical Building Policy

Key Issues:

- In the case of historic buildings, many policies are employed that could deter sustainable renovation.
- Handling the problems that arise from this will be extremely difficult, and this manual has no suggestions.
- Working on developing a sustainable historic building may prove to be a lesson in "picking their battles" for developers.

Historic buildings are a large part of the London landscape. Many of these buildings are well known tourist attractions while others are old architecture that needs to be preserved. Whatever the case, historic buildings add to the character of their surroundings, and play an important role in how a community is defined.

When it comes to the application of sustainable practices, the regulations governing historic buildings tend to become an obstacle for improvement. There are many rules set forth by the Planning Policy Guidance 15, an UK policy book on developments. These regulations need to be adhered to so that a building can retain its effect on the community, and so the local atmosphere does not change. The Planning Policy Guidance 15, or PPG 15, states that public opinions for historic buildings are becoming stronger (p.10). This means that any retrofitting ideas have to be critically evaluated while keeping public opinion in mind.

The PPG 15 book states that architects have to identify the prominent features of the building that they will be working on. (p.6) These features have to remain unchanged if sustainable practices are put into place. These rules and regulations hinder the effectiveness of the sustainable practice, but to change them would mean changing, and possibly even losing, part of the culture in the area.

Architects also have to understand that the outside of the building is important too. They can't decide to simply remove the historic building and create a sustainable building in its place, nor can they make additions to the size, shape, colour, style, etc. of the historic building. This is because the building is widely recognised, and the opinion about a physical alteration would be very negative, regardless of how helpful that alteration might be (p. 28).

There are also different levels of care, thought, and consideration that need to be assessed for a historic building. In London, a grading system is used to classify how important a building is to the culture of the city (p.48). This grading system implicitly defines how limited a designer is when considering retrofitting sustainable practices for the building. For example, in a Grade I building, it may be that no renovations can be made. If this is the case, then the developers, architects, and planners will have to discuss a compromise. In some cases, it may be necessary to change the policies involved.

Another potential problem arises from developing sustainable sites around historic buildings. A historic building should be part of the landscape. If one were to build modernised, sustainable buildings nearby, then the historical building would look very out of place. The designer may want to consider a potential compromise working on

improving the interior of the buildings, and making sure that the external view remains the same.

The process of renovating and retrofitting a historical building with sustainable practices is a very difficult procedure. The seemingly endless restrictions and limited solutions will likely deter any consideration or thought being put into potential improvements. However, avoiding these restrictions when possible should be considered. A good idea might be to determine when the best time would be for implementation of sustainable practices into a building. For example, suppose the building needs repairs. Some of these repairs, while being necessary, may also alter the building's physical appearance. In this case, it may be possible to convince the government to apply sustainable practices within these repairs. This way the retrofitting is not the primary cause of the alterations.

Both the environment and conservation of historic sites need to be considered when a change is being made to a historic building. The site is likely a place that is important for tourists, so the alterations that are made to the building should focus on public satisfaction, as well the incorporation of sustainable practices. As stated in PPG 15, a compromise should be made between local government and the developers for the sustainable renovations for a historic site. (p. 19) This compromise may be the only solution to solve the problem of the numerous restrictions and limitations.

4.2: Communication

Key Issues:

- Communication is a key issue for business and projects.
- Already exists now, but needs to be improved much more.
- It can be a barrier or a solution depending on its use.
- No specifics on how to communicate effectively, but a case study may help.

The task of communicating ideas is very important in the business world. It is used to convince others about why a certain idea or project is good or bad. It can be used for getting funding, and it is vital for any politician seeking office. It is easy to see why communications are a significant part of sustainable developments.

Already, people involved with sustainable developments are holding conferences and meetings. The UN has had world summits on the matter, communicating their ideas on what they would like to see in the future of sustainability. Conferences have been held throughout Europe during the summer of 2002 that have produced valuable discussion on the matters of sustainability. Sustainable buildings have been developed, and exist in completion for study use. A lot of material is online as well, available for public access.

However, how to communicate the ideas to the right people, and in the right way is not commonly known. Sometimes, no matter how great an idea is people are cautious of it, simply because of misconceptions and misinformation. For sustainability, the idea is to extend the future of human comfort. However, one of the biggest problems is that many people are simply unaware of what the term sustainability means. Even if they know that, they may not be aware of the movement being made to implement the

practices into developments. This kind of information has to be advertised and must be done in such a way as to make it attractive.

Communication is probably the biggest barrier facing this project. It involves the movement that needs to be taken to inform the public about the benefits of sustainable developments. Like mentioned in the BedZED case study, nearby residents were afraid that the development would drop their land prices. They were also afraid of how the building would physically look. The development and planning network had to work out how to quell these fears while letting the project finish.

Communication also involves trying to bring together the different groups that are involved with a sustainable development. Architects, financial institutions, construction firms, developers, and other interested organisations all need to be brought together so that a sustainable building goes up the way it was planned at the expected price. The only way to unite these people is through the use of communications. There are many different areas where communication skills have to be utilised.

Communications, if used properly, is a tool that can be used to remove barriers to sustainability. However, if it is not used correctly, it can lead to new barriers. There is no single process of how to communicate effectively. The only way to illustrate effective communication is through case studies. In order to understand this problem better, following the Merton MorZED project or the RENUE project may prove beneficial. Witnessing how communications have helped them break through barriers in some areas, and how it has created new ones in other areas, will provide valuable information for future developers.

4.3: Review

Throughout the chapters we have identified the need for sustainable development, identified how one might go about constructing sustainable buildings or retrofitting old ones, and have given examples of some best practices. However it is important to understand that sustainability is a very broad topic. In the following section, we will restate what we have already identified as the primary foundation. We will also evaluate what may be the way forward for the Merton Council and ultimately the EU in terms of the final manual and this foundation.

Chapter V: Summary and Recommendations

5.1: Introduction

So far, many key issues in sustainability and sustainable development have been addressed. The primary purpose of phase one developing the manual was to find and raise the key issues inherent in sustainable development. The major topics of interested were briefly noted in chapter two, defining sustainability. Some of these topics have been addressed, while others have not. This chapter will summarise what has been done, what could be further addressed, and what else can be researched that has not yet been. These issues are those found to be of interest in the three key sectors of sustainability, environment, political-economics, and society.

5.2: Environmental Sustainability

The environmental aspects of sustainability are possibly the least researched issues to date. However, the key environmental issues are some of the most widely researched and written concerns in other publications. The key issues of environmental concern are listed below.

- Emissions: Carbon dioxide emissions are the primary cause of global warming. Since emissions covers both the release of greenhouse gases themselves and the use of fossil fuel energy, it is a very important topic. Policies regarding emissions have been well researched. Results from the ratification of the Kyoto Protocol (1997) and the coming Johannesburg World Summit will enforce and promote more policies regarding emissions to be included. The technical details of emissions and their reduction have significant room for further research. The

BedZED case study includes some details on low emission development, and more can be found by researching BedZED further (http://www.zedfactory.com).

- Energy: The topic of energy has not been widely covered. Several methods to reduce dependency on non-renewable energy were utilised in the development of BedZED, but these topics were not widely researched here. Wind power, photovoltaic cells, and other renewable energy schemes should be researched for this manual as well. Policies dealing with energy are present in the Greater London Authority document.
- Transportation: This topic was also not widely researched, and relates back to emissions, energy, and land use. The best plan for continued research in transportation (in regards to this manual) would be to research high-density developments that encourage walking, bike riding, or the use of public transportation as a method of travel. Minimisation of motor vehicle transportation may be the best research topic in regards to transportation.
- Waste: Physical waste removal and grey water were also not widely covered. Some research topics of interest in these fields are recycling policies, land fill gas utilisation as an energy source, rubbish incineration as an energy source, and on-site grey water treatment. Researching BedZED further may yield results in grey water treatment.
- Materials: Information on some materials has been included as Appendix A: Technical Features and Issues. In light of more recently researched data, more information on reusing materials should be found. The reuse of materials is economically and environmentally sound. The findings so far have been that

wood is the most renewable material, while concrete is the best for use in tall buildings, since it has a low embodied energy. In addition, glass, although it has a higher embodied energy, is necessary for passive solar heating and lighting, as well as applications in photovoltaic cells. Steel has a very high embodied energy, although it can be used to make much taller buildings. Aluminium is the worst to use, since it has a high-embodied energy and virtually no capacity for insulation. Other important materials for use in developments involve insulation. Further research on different types of insulations, and the amount of insulation to use will be very beneficial.

- Land Use: High-density urban structures are the most efficient in terms of transportation and energy use. More research could be committed to this subject. The GLA document also recommends high-density developments for their shared heating properties.

Other environmental concerns may exist. Some that have not been adequately covered include carbon sinks (green space), the use of ceramics in buildings and burner technologies, and the use of hydrogen fuel cells instead of fossil fuels. These topics may be of interest, but do not necessarily relate directly to buildings themselves. In addition, some of these technologies have not been implemented, and in some cases, the research has not been completed. However, they may eventually become key players in the pursuit of sustainability.

5.3: Political-Economics

The political-economic scheme in sustainability is sometimes just as vital as the environmental scheme. How to develop a sustainable local or national economy is not as well documented in the environmental sustainability community. The important features of political-economic sustainability are detailed below.

- Balance: The links between residential, commercial, and industrial space have not been researched in this document. This is a vital feature for the planners, and relates directly to land use and urban density. Valuable information for planners to have on this subject would be average workers needed and provided for a given amount of space and density level. The residential capacity for a city should approximate the total commercial and industrial capacity of the city. Outsourcing residential or commercial zones to other cities or regions increases transportation costs, and lowers urban density. In an ideal situation, all of the residents of a city would be employed within a certain distance from their homes. Finding this distance could also help planners.
- Stability: This feature of economics has been covered lightly in the Unitary Development Plan (2000) of the London Borough of Merton. In it was stated that businesses should be based on real products and services, and should provide as wide of a variety as possible of products and services. More could be done on this topic in general. Many documents on local and non-local economy development exist, however none have yet been explicitly covered.
- Incentive: Incentives are covered lightly in Chapter 2: Policies. More information on incentives can be found in Appendix B: Finance and Incentives.

The information on incentives is abstract. The policies granting specific incentives to businesses have not been, but could be applied to case studies detailing how they were employed. Further research into BedZED may yield data on exactly what incentives were used, and how they discovered them.

- Growth: Growth relates back to balance and stability. The goal of sustainable economic growth is to develop at a rate where all aspects of economic, social, and environmental concerns are addressed. How to do this may become a very important feature for the development of Gurgaon, India. Researching this topic could be valuable on a global level, and it may be possible to come to conclusions based on researching the other major and minor aspects of sustainability.
- Finance: Some methods of financing sustainable developments have been covered in practice (BedZED case study) and theory (Triodos Bank case study). The theoretical information on finance in general can be found in Appendix B: Finance and Incentives. Further research on venture capitalism may be useful. Also, interviewing a developer on the topic of financing sustainable projects (perhaps Peabody Trust or other BedZED partners) may yield positive results.
- Production: This topic has been mentioned briefly in Chapter Two: Policies. The London Borough of Merton's UDP (2000) provides some information on production planning. Since production generates actual solvency, it is a key feature in the development of a stable economy. The UDP (2000) mentions widening the scope of products for the purposes of encouraging an "Urban Renaissance." More products will also improve the quality of living in the area by adding variety.

The political-economic field of sustainability could benefit strongly from the input of economists or economic documents. More fields of interest may emerge upon the examination and evaluation of the recommended research.

5.4: Social Sustainability

The concept of social sustainability spans a very broad list of topics. Like the previously examined points of interest to sustainability as a whole, this subject has areas that need further research. The role of society in sustainable development is critical to the success of sustainability. The following issues of social sustainability may be very important in developing sustainability.

- People: people are at the very core of sustainable development. All of the primary definitions of sustainable development revolve around meeting the needs of people. This topic is not really researchable, but all research and planning that is done needs to keep this issue in the forefront.
- Community: The two issues revolving around the community are also important to the goals of sustainability. First, one major barrier in sustainable development is the communities understanding of it. If the community does not understand why sustainable developments look different or are necessary, then it will be much more difficult to succeed. Communication ties into community in the sense that there needs to be communication between the developers, planners, and the citizens themselves. The second major issue is one that could be researched further. The questions are how can a sense of community and security be promoted in a sustainable development? How can the development work to

- Health: This subject has not been covered at all. The Unitary Development Plan (2000) for the London Borough of Merton has policies involving health and safety. These could be further researched, as could health related issues and techniques in sustainable development. For instance, the circulation of fresh air through a building would positively affect the health of the inhabitants. Foregoing the use of materials such as asbestos will reduce the chances of residents receiving cancer from the building itself. These topics are plentiful, and could be included in the manual.
- Aesthetic: This feature of sustainability is based around the concept of improving the quality of life of the residents. This has not been covered in this document, and could probably be left to the architects designing the buildings. Although the role of aesthetics is an important one, it does not need to be featured in this manual.
- Communication: Possibly the biggest barrier in the development of sustainable sites is communication. Communications have been included into the case studies and Chapter Three: Creating Sustainable Developments. These sections have included a significant amount of data on planner/developer interactions, as well as architect/developer interactions. It does not, however, provide as much information on finance/developer interactions, or interactions with other interested groups, mostly in the private sector and voluntary sector. These groups can often

play a major role in the creation of new developments, and information on how this communication can work would probably be very valuable.

- Government: Chapter Two: Background contains a large amount of data on the international government structure, as well as the national and local structures of the United Kingdom. This information sets the context for beginning the development of sustainable sites. Without these policies, there would be no grounds to start developing sustainably. More research can be done on the Greater London Authority guide for energy, as well as the national and local policies of Barcelona, Spain, and Gurgaon, India. With all of these policies listed, it will be possible to determine how to transfer sustainable techniques from one region to the next.

Issues such as communication and government will need to be further addressed for the final development processes to fall into place. Other topics that have not been as widely researched, but still deal with society, are also important, such as culture. In terms of culture, little research needs to be done as to what kinds of culture should exist. However, determining how much space, if any, should be set aside specifically for cultural venues could be valuable information.

Appendices

Appendix A – Technical Features and Issues

A.1: Sustainability Features

A.1.1: Waste

People in the U.S throw out about 180 million tons of trash annually. (http://www.leeric.lsu.edu/energy/energy_answers/) Reducing waste is a major goal of sustainability. By reducing waste, the environment for both human and wildlife living is improved. Sustainable practices that reduce waste have an important place in building design.

The process of reducing the waste output of buildings is commonly referred to as the green building process (http://www.pprc.org/pprc/pubs/newslets/news0799.html). The goals of the green building process are minimisation of energy usage, maintenance of the surrounding environment, and assurance of health and comfort of the user (http://www.buildinggreen.com/about/whatsgb.html). These goals are the same as the goals of sustainability. This means that a planner who wants to create a green building can do so by using sustainable building practices.

Most commonly used is the practice of recycling. Most communities have recycling programs in place that reduce the needs of new materials. However other practices exist which reuse waste as building material. Implementation of these practices into building design would create a more sustainable building.

A.1.2: Transport

Transportation, in the context of sustainability, includes the transportation of materials and labour to the site of construction. It also involves the transportation associated with the building after construction. In both cases, transportation usually involves the use of cars, trucks, ships, etc. These means of transportation are associated with some sort of environmental impact. The environmental impact of transportation could be the air pollution from the vehicle exhaust, or the resources consumed when burning petrol.

The cost of transportation and time for transport also play a role in the building sustainability. If the use of a certain material would enhance the sustainability of a building, but the material is not available in the region, cost and time of transportation need to be considered. The cost of the material may outweigh the benefits of using this material. Also, the time necessary for transportation may pose a problem in the building process. These factors need to be considered when evaluating the sustainability of a building.

In the case of Gurgaon, India, certain materials, such as lumber, are not readily available. In order to use a material that is not abundant in the region, it will be necessary to transport it in from another location. The cost and effects of the transportation process will need to be addressed when considering whether or not to use this material. If lumber is cheap to import, and can be transported in a manner that does not negatively affect the environment, then it may be plausible to use this material in buildings. However, if the importation of lumber is expensive, time consuming and harmful to the environment,

then a different material will have to be used. Thus transportation factors also need to be considered in the process of determining sustainability.

A.1.3: Energy

Conservation of energy is a goal for sustainable building practices. Energy conservation can be improved in many ways. If a contractor analysed a building in regards to the climate, insulation, and heat characteristics of the building, information could be gathered to help design an energy efficient building. This knowledge would allow for certain designs to be incorporated into a building. For example, the building could be designed to allow for natural lighting. This would reduce energy spent on electric lighting.

Climate affects people differently depending on location. People living in a mountainous region have to deal with cold air, and people who live in deserts face extreme temperatures during the day. Some sustainable building practices address this issue. An example of a climate based sustainable practice was done in Jodhpur, India, an area with a hot and arid climate. Researchers determined the predominant direction of the cool winds. They then used this information to have contractors create a structure known as a wind tower. The wind tower had an opening located well above the house. It allowed cool air to circulate through the house while preventing the entrance of additional sunlight into the residence (http://sdnp.delhi.nic.in/node/spa/case.html). This case study exemplifies how a sustainable practice could be applied to a specific location.

Another example is illustrated in a case study developed by researchers at the University of Oregon. The study details the use of certain materials for reducing energy

costs. Placing certain types of flooring materials near a window so that the flooring would be exposed to the sunlight created a heat storage unit. The floor absorbs heat during the day, and releases the heat at night.

(http://darkwing.uoregon.edu/~esbl/Environment5.html)

Energy concerns will be different depending on the geographical region. Since Gurgaon is located in a hot climate zone, natural cooling would help reduce energy use. The materials and design of a sustainable structure would be chosen so that heat was kept outside of the building during the day. This same structure would also need to let in the cooler night air.

The air-cooling tower mentioned earlier could be drafted into use with some minor modifications. If it is feasible to construct miniature wind towers above houses to produce power, then the tower could have a dual purpose. This creates a sustainable structure because the building uses a renewable energy source that is not based on fossil fuels.

A.1.4: Emissions

Emission reduction is a key goal of sustainability. They produce a negative impact on both human living as well as natural wildlife. The potential impact that emissions have on the environment could be extremely severe. This is why sustainable practices include emissions reductions in the construction of buildings

Gasses such as sulphur dioxide and carbon dioxide that are produced from power plants, motor vehicles, and industrial smokestacks contribute to the greenhouse effect. These gasses produce a higher average global temperature and leads to changing of

weather patterns and increase in water temperature. While these changes may seem small, it could dramatically affect marine and coastal life. The gasses are also not healthy for humans. It's easy to see that this serious global impact is why sustainable developments are aiming to reduce harmful gas emissions.

Noise pollution is also another harmful emission. Although humans have learned to tune out everyday noises in the environment, some noises are more disturbing. Some of these disturbing noises are associated with construction vehicles and tools used at building sites. Since tools and construction vehicles are needed for a sustainable building site, their noise should be considered. This is because the loud noises disturb local animal habits such as breeding or hunting and also people working in the area. However, not only should construction noises be looked at but also noises from the building should be considered after construction. Best sustainable practices take into consideration comfort levels for both human and animal lifestyles. Minimising noise during and after construction are beneficial steps that should be sustainable practices that are applied to more sites.

Light pollution has some similarities to noise but there are also some large differences. It has the same effects on animals, disturbing their habits around buildings. However, light pollution is not as big a problem for most humans. This is because if all light pollution were eliminated, then crime would tend to increase in the area. The amount of light and the presence of crime are inversely related. A compromise has to be made between these two levels where the practice is implemented.

While there are other types of harmful emissions that could be named, the principles are still the same when it comes to sustainable practices. The reduction or elimination of these emissions usually leads to a better life for both humans and wildlife.

A.1.5: Land Use

Efficient land use is becoming more of an issue as human population continues to grow in size. Research needs to be done in regions that are feeling the impact of this growth in order to find ways to fit more people into a certain space. However, efficient land use is not just limited to the efficient use of available area for living. It is also improving the use of land for crops and forests. These improvements will allow for future generations to continue enjoying the same quality of life.

One process that exemplifies how land use is part of sustainable development is an irrigation process that some farmers use in Colorado. By understanding how much water was being used on crops and finding areas where water use could be significantly reduced, researchers developed new methods that allow the farmers to maintain their yields while using considerably less water. The improvements were remarkable, with the efficiency of water usage increasing from 68% to 93%.

(http://sustainablecolorado.org/Best_Practices/Irrigators/irrigators.html)

Conservation of water is a sustainable practice because the natural water supplies on the planet are currently limited. Unless technology is improved to take advantage of water that lies in salt-water bodies, only a small percentage will be usable for human consumption. So conserving it now means that there will be water left in the future when, potentially, technology will have improved to allow for a greater supply of

drinkable water. On a more local focus, such practices could prove very useful for hot and dry communities where water is a scarce resource.

Sustainability, in terms of land use, is a worldwide concern due to the increasing need for housing. Gurgaon is no exception. Its urbanisation is diminishing the land available to build new structures. This is seen in the booming real estate market. (http://www.hindustantimes.com/nonfram/070501/htp04.asp) This increase of new building implies that the available land left for construction is dropping. If this is the case, then minimising further land use is a key issue for developers in Gurgaon. An alternative general solution is to demolish ageing buildings and replace them with modern sustainable structures.

Minimising land usage lowers the visible human impact on the environment as well. If a sustainable community were built with minimal land usage, it would affect the surrounding environment less. For Gurgaon, where seasonal rains are a problem, this means that more plant life would remain. In an area like Gurgaon where there are few trees, mudslides may occur. A practice for preventing mudslides is to plant trees, shrubs, grass, or any other kind of plant life with roots. (http://www.insurance.ca.gov/EXECUTIVE/CatSeries/Mudslide/Mudslides.htm#WHAT%20YOU%20CAN%20DO) Encouraging practices such as the planting of trees, as well as informing builders of these risks, can avoid future disasters. In this case, there is the added bonus of an aesthetically improved landscape.

A.1.6: Resources

The topic of resources refers to things like trees, water, and construction material. Resources are the basic building blocks required in creating a sustainable building. However, natural resources can also be affected by a building. If a chemical factory dumped its waste into a nearby river, then they are ruining a valuable resource, and damaging the local ecosystems. The river may also be a source of food and water for the city where the factory is located. The factory negatively affects both the environment and the community, endangering the owners, workers, and future generations of the area.

An example of practices that affect resources positively is a buying procedure used by Home Depot. In 1999, Home Depot changed its timber buying policies, stating that it would buy only certified wood. Buying certified wood means buying wood that did not originate from delicate ecological forests. Sustainable practices like this allow for older forests to exist for many generations because wood is taken from certified forests, or tree farms, instead.

(http://www.enn.com/enn-news-archive/1999/08/083099/nowood_5332.asp

Resources use greatly affects sustainability. Minimizing the use of non-renewable resources, and maximizing use of renewable alternatives, reduces the impact on the globe. However, these practices need to be implemented soon. According to reports compiled by the World Resources Institute and the Energy Information Administration, the energy consumption worldwide is steadily increasing. (http://www.geocities.com/combusem/ENERGY1.HTM) This means that resources such as coal and oil are being consumed at a faster rate. Unless renewable practices are employed, current trends will ultimately mean the disappearance of certain materials.

A.1.7: Purchasing and Procurement

Even though a structure might be built with a number of sustainable themes in mind, it is possible that the goal of sustainability was not met. If, for example, all the materials are manufactured new and ordered from a far off site for a certain building with a set of sustainable practices, then this building would be less sustainable than another, which had the same set of practices, but minimised the purchase of non-recycled materials, and used more materials purchased locally.

The goal for sustainable practices focusing on purchasing and procurement is minimising the effect that purchasing has on the environment. (http://www.merton.gov.uk/eap/visions.pdf) Purchasing affects the environment because the purchased materials generally use up natural resources as well as fossil fuel energy during their construction. So, sustainable purchasing practices aim to reduce energy consumption and resource consumption.

Sustainability, in terms of procurement, is reducing the need of transportation of goods or improving the sustainability of the goods themselves. (http://www.merton.gov.uk/eap/visions.pdf). Ideally, a building would be constructed with local materials that were produced by using renewable energy, or some other sustainable practice.

The application of these sustainable practices to a building begin the instant planning begins. This is because materials will be needed even for planning the sustainable structure. However, their application does not end here. It continues through construction of the building, and only ends when the building is demolished.

A.2: Material Science

A.2.1: Introduction

The materials used in the manufacturing of buildings relate heavily to sustainability. To minimise the ecological footprint left on the area, it is important to research the kinds of materials to be used for many factors. Materials have a direct affect on energy used by the building, how long the building will remain standing, and how much energy was used in the creation of the building. After these characteristics are assessed, an important aspect to consider is the similarities between materials, which will allow for ease of replacement due to material availability. Different geographical locations have different materials that are locally available. Therefore, by finding out which materials are similar, it will become easier to transfer sustainable practices that are based on the materials involved. In addition to transferring pre-existing sustainable building practices, the information available in this section will assist in developing new sustainable building practices. Important characteristics in materials with regards to sustainability are thermodynamic properties, durability, reusability, and availability.

Thermodynamic properties include insulation and heat absorption. These properties are critical for energy conservation. Ideally, the building materials would absorb energy during the day, thus cooling the building, and then release the energy stored at night, warming the building and reducing heating costs. During colder seasons, it becomes important to ensure that heat will remain in the building, putting further stress on insulation systems.

Durability is defined as the material's ability to resist rust, corrosion, fracture, and any other form of degradation, and is necessary to ensure longevity in the life of the

building. It ties in closely with reusability. If durability is high, the structure will not need to be repaired, and thus will not further tax the natural resources of the region. Reusability is defined as an abundance of the material to such a degree that it will not run out, or cause an impact on the local and global ecosystems. Reusability allows for a similar end result, in that natural resources are not removed from the region's supply. (American Heritage Dictionary 2000)

Availability of the building materials is vital for any building project. Since every inhabited region of the world has building materials available in one form or another, it becomes important to assess many types of materials to decide what would work best for the region. Also, some materials may be transported from remote locations, in the event that it was necessary for the building's design. These materials will be compared based on a set of properties that are well documented and researched.

A.2.2: Stone

Stone is a naturally abundant building material for a significant portion of the world. Since there are many kinds of stone available, the key characteristics of concern will be elasticity (how brittle the stone is), thermal conductivity (how much heat it will retain), and hardness, (resistance to permanent deformation).

The elasticity of a material is a measure of how well it can return to its original state after a stress is applied to it. An example of a material with a large modulus of elasticity is steel, where as a material having a low modulus of elasticity are ceramic or a polymer, like clay or rubber. Stones fall under the category of ceramics, and range from

inelastic to quasi-elastic. For comparison purposes, the focus will remain on similarities between stones (Winkler 43).

Non-elastic stones consist of shale, some forms of sandstone and some forms of limestone. The applicability of limestone and sandstone must be determined on a case-by-case basis, since they are two of the least uniform types of stone available (Winkler 43).

Semi-elastic stone types consist of granite, syenite, micro granite, dolomite, and basalt, as well as some forms of limestone and sandstone. Quasi-elastic (the classifications of materials between elastic and non-elastic) stone types consist of gabbro, diorite, and some forms of basalt (Winkler 43).

Thermo-conductivity of stones is a measurement of how well they retain heat. This feature relates to energy conservation, since it reflects the capacity of insulation within the stone. In regards to sustainability, the higher the thermo-conductivity in the building material, the smaller the ecological footprint, this is due to less use of fuels for heating. An example of sustainability based on this principle is as follows: in a well-lit room, granite can be used to absorb the radiation from the sun during the day, cooling off the room. When it becomes night, the granite will radiate the energy it absorbed back into the room, thus heating it, and saving on the energy used to heat the building. Stones with similar thermo-conductivities to granite are basalt, sandstone, and limestone. Gneiss and marble have slightly lower thermo-conductivities, in general, but are still effective in most cases. The thermo-conductivity of air, as a comparison, is significantly lower, signifying that it heats up and cools off faster (Winkler 45).

The last property that will be examined for stone is hardness. Hardness is a measure of a material's ability to resist permanent deformation and fracture. This is important to sustainability because it measures how tough and durable the material is. If it is a hard material, then it will need to be replaced less, and the energy cost will be lower. There are several ways to measure the hardness of a material. The method that will be used here is an impact toughness test. An impact toughness test involves dropping a two-kilogram weight on a material, and determining what height is necessary to cause the material to fracture. Under this method of testing, granites, syenites, and gabbros yield the highest hardness ratings. The next hardest materials are basalts, sandstones, and shales. The least hard material is limestone, which fractures easily (Winkler, 37).

According to geological surveys, the following stone materials are found in India: granite (western region) and limestone (everywhere). Stone is generally quite costly to harvest from a quarry, manufacture into building materials, and then transport to the site. (http://www.gsi.gov.in/ 3-26-02)

A.2.3: Clay, Brick, and Tile

Clay, brick, and tile are often used as substitutes for stone, for many reasons such as cost, and availability. These materials have been used in masonry for thousands of years, and can last hundreds of years. The properties for these materials are based on the same principles as those for stone. Where clay is available, brick becomes a highly sustainable resource, because it is easy and energy efficient to make, easy to transport, and easy to build with. Bricks are also highly durable and reusable.

There are many forms of clay that are available. The elasticity of clay ranges from two to six million pounds per square inch, which is considerably lower than most other materials. The thermo-conductivity for clay is lower than that for brick, and the hardness of clay is low. In general, clay is not used for masonry purposes, although it is present in adobe structures. The problems with using structural clay lie in the fact that it is not as stable as a harder material, such as brick (Plummer 89-95).

Bricks vary according to their manufacturer. They generally consist of straw and fired clay, and are commonly used for masonry applications. They tend to have a higher thermo-conductivity than clay, a higher hardness rating, and a higher modulus of elasticity. However, in regards to thermo-conductivity, clay tends to absorb more heat than brick during the day, due to the abundance of water within the structure. In this case, it acts similarly to granite for utilisation of passive solar energy (Plummer 112-160).

Clay and brick are readily available in India, and are found in the region of Haryana. The harvesting and manufacturing of clay brick into a workable building material costs approximately one third of a ton of coal equivalent energy per ton of brick (http://www.gsi.gov.in/ 3-26-02), (Haygreen 50).

A.2.4: Cement and Concrete

Cement and concrete as used for building applications have many different forms. They usually consist of a binder and an aggregate, as well as another substance used to give the composite strength. These can take the form of particles, fibres, or other various forms of additives.

The thermo-conductivity of cement varies slightly depending on the composite form, and the additive used. The majority of concretes act similarly to stone and brick, being two to four times more conductive than brick, and slightly less conductive than stone. If the additive is fibrous and metal, the thermo-conductivity will increase, absorbing more heat than in a particulate concrete matrix. However, this method of building takes more energy, since it must be done in a factory setting rather then on site, and then the concrete must be transported. This kind of concrete is also more expensive (Plummer 138), (Brandt 13-18), (Haygreen 48).

Concrete and cement are generally slightly less durable than bricks, unless they utilise fibres rather than particulates. The tensile strength, which is a direct indicator of the hardness, is 2.85 mega-Pascal's for concrete with a limestone aggregate, and 2.69 mega-Pascal's for concrete with a basalt aggregate. Fibre-reinforced concrete has a much higher tensile strength of 4.05 mega-Pascal's. This suggests that the distinguishing factor when choosing between particulate and fibrous concrete is the stresses that the structure will have to endure, and how long the structure needs to last (Brandt 153).

Cement and concrete are abundant resources, and take slightly less energy than brick to manufacture (approximately one third of a ton of coal equivalent per ton of cement). It is more transportable than stone (unless it is fibrous), but parts of the ingredients come from stone that is turned into dust. It is then mixed with a bonding agent (usually activated by the addition of water), followed by an aggregate. Concrete and cement are not widely used in Haryana, since the local conditions do not provide for ease in its production (Haygreen 50), (Brandt 13-18), (http://www.gsi.gov.in/ 3-26-02).

A.2.5: Lumber

Lumber is an abundant and reusable natural resource in many parts of the world, which can make it a highly sustainable resource; however, its use can make a large ecological footprint if the right measures are not taken to replace it. Lumber is used for the frames of buildings and occasionally for walls if sheet rock is not available. Lumber has a maximum limit on how tall the building in question can be. It is most practical in residential buildings, but can be used in commercial buildings, if precautions are taken to put low amounts of stress on the supports.

Since lumber is an organic material, it is not as thermally conductive as stone, brick, and cement. This phenomenon occurs because the irregularities within the structure of lumber impeded heat transfer, as opposed to steal or stone, where the structures are much more uniform. It is approximately four times less conductive than brick, and can be as many as ten times less conductive. It is usually used with plasterboard and fibreglass insulation, in addition to a siding of some kind. In general, these materials will not absorb as much energy from the environment as the previously mentioned materials, but it also won't let as much heat escape. This makes it fairly ideal for colder climates, since cement, stone, and brick will release the heat from the inside of the building more readily unless insulated, and thus energy will need to be consumed to heat the structure in any situation (Brandt 138), (Haygreen 48).

Lumber is also not as durable as stone, brick, or cement. It is fibrous, which makes it easier to harvest, but also reduces the amount of stress that can be applied to the structure. For softwood, the tensile strength lies between 100,000 and 120,000 kilopascals parallel to the grain, but only 3500 kilopascals tangent to the grain. This

means that lumber is more then twenty five times stronger end to end then it is across the width. Compared to other materials, parallel to the grain is slightly lower, but tangent to the grain is considerably lower. In addition, other factors must be considered when the life of the material is in question, such as rotting and warping. This limits the life of the lumber, but under good maintenance, the lumber can last several hundred years (Haygreen 73).

Lumber is extremely energy efficient in its harvesting and manufacturing, (which includes treatment). The energy required to produce lumber is only one fourth of a ton of coal equivalent per ton of lumber. This would be particularly useful in a region with a high percentage of forest. However, in regards to Haryana, India, only 3.5% of India is forest, and thus it would be very difficult to produce lumber efficiently, since the fuel spent transporting it would be quite high (Haygreen 50) (http://www.gsi.gov.in/ 3-26-02).

A.2.6: Steel and Glass

Steel and glass are the basis for most modern buildings. The reasons for this are that a steel frame is highly durable, and well-insulated glass cuts down significantly on energy use in a building. Glass windows help utilise passive solar energy, which furthers the sustainability of the structure.

The thermo conductivity of steel is approximately twenty to thirty times greater then that of concrete, due to the conductive properties of metals. It does, however, cool off considerably faster, which means it will absorb heat during the day, and release it back into the environment during the night, but the amount of time it spends releasing the energy will be considerably less. Glass has a thermo-conductivity ranging from slightly

less than brick to slightly more than brick. The thermal benefits of glass deal more with radiation from the sun. Glass does not absorb a significant portion of radiation, allowing the radiation to enter the building. This energy can then be collected by a stone or tile floor, which will cool the room until night, where it will release the energy back into the environment (Haygreen 48).

Steel is an extremely durable material, capable of returning to its original state under severe amounts of stress (tensile strength is approximately four thousand mega-Pascal's). In addition, the effects of creep due to constant loading stop after the strength has dropped about sixty percent, which means that steel, will not suffer from spontaneous fracture, making it extremely safe for tall buildings and bridges. The strength of glass is not significant, and glass is easily breakable. Glass should be used in conjunction with a frame of another material that can handle axial loading (Brandt 11), (Amstock 127).

Although steel is an extremely durable and long lasting material, capable of lasting centuries under good maintenance, the energy used to produce it is extremely high (approximately two tons of coal equivalent fuel per ton of steel). Steel is much denser than the other materials that have been examined. This means that a ton of steel does not goes as far as other materials in buildings, so even more energy is used per building. In addition, the transportation of steel is quite costly. Gurgaon is an industrial city, and because of this, steel will probably be available, but the cost of steel in a monetary and fossil fuel sense does not justify its application as a structural tool, except in high population density areas, where efficient waste removal can counter act the energy expensive of steel. The cost of glass, in terms of energy, is low, and the benefits of glass (in terms of utilisation of passive solar energy and natural light) are high. This makes

glass very useful in terms of sustainability. Glass is available for construction in Haryana (Haygreen 50), (http://www.gsi.gov.in/ 3-26-02).

Appendix B – Finance and Incentives

After a design has been established, and a developer found, the next major step is to secure the funding necessary to build the sustainable development. There are many challenges to this process. Sustainability in building design is starting to become a mainstream idea in terms of architecture, and it is even entering into the political landscapes through city planners. Unfortunately, financial institutions traditionally do not move into new fields as quickly as architects, developers, and city planners do. This section first examines the general process for conventional banking, and then gives examples and descriptions of sustainable, or socially conscious, banking.

The first step in acquiring the financial backing necessary to advance a project is to identify what sources the income could be generated from. Most sources will not provide one hundred percent of the funds necessary, however; so more than one source may be necessary. The three major sources of fund generation are banks, venture capital, and government grants, loans, and tax breaks.

Key Issues

- Financial Institutions, such as banks, are very conservative, and may be wary in regards to using new or untried technology.
- To overcome this, confidence, competency, and control must be shown over the plan. All the details should be worked out before approaching the bank.

B.1: Banking and Sustainability

Financial institutions, such as banks and credit unions, are based around the concept of solvency. The banks borrow money from investors, which makes up the

majority of their funds. These investors are completely protected from insecurities with their money except in the event of bankruptcy in the institution. The investors receive an interest rate on their funds that do not change very frequently. The bank makes money by loaning out the investor's money to organisations and people, and charging a higher interest rate to these people than they give to the investors.

These facts explain why banking institutions do not invest in new or unproven ideas. Regardless of the possible long-term gain, the bank needs to protect its assets, and loaning out money to unproven industries is a risk that can prove quite damaging. If a bank were to invest all of its money into an unproven industry, and it failed, the bank may be forced into bankruptcy. People who invest in banks are guaranteed to get their money back, unless the bank declares bankruptcy, at which point the investors are only protected to the extent which national laws provide.

This can become a serious hurdle for sustainable developments, which is currently considered unproven by banking standards. In this particular instance, a conventional building development would have big advantages over a sustainable development, especially if the conventional development was asking for less money than the sustainable development.

The way to overcome this obstacle requires thought on the developer and architects part.

- First, the bank wants to give out loans. Any money that is not working for them is working against them. Therefore, the parties involved need to prove that this design is going to produce profit for the developers, and cover the loans delivered by the bank.

- To gain the trust of the bank, the architect, developer, and other interested parties must first determine exactly how much money is needed.
- After that has been defined, the involved parties must decide exactly how much money these facilities will be sold or let out for. These prices should be compared to other developments of a similar nature (for instance, a three bedroom flat should only be compared with other three bedroom flats).
- If the determined price is higher than a conventional design, then a market for these facilities needs to be established. Having a list of parties interested in purchasing or letting out these facilities would greatly improve the chance of receiving financial backing from the institution.
- If the design will save the buyers money in the long run (through less energy and heat use, for instance) then that marketable trait needs to be described to both the buyer and the institution.
- With all of these features installed, the patron of the project needs to demonstrate some form of capital, or collateral, that can in some way account for the money being loaned to them. This allows the financial institution to back their liquid assets with a physical item, and protects them if the project fails to produce profits.
- Once the previous items are established, the bank will want to know all about the project it is backing. They will be specifically interested in the marketing campaign or backing organisation that will inevitably fill the building or buildings.

- Another major feature is the conviction present in the people selling the idea to the bank. These people need to be confident that this project will work. If there is even the slightest possibility shown on behalf of the project that it might fail, the bank may reduce the amount of the loan, or even back off completely.
- The last feature of the project the bank will be interested in is the social, economical, and environmental concerns of the building. Most banks will not be particularly concerned with these, except in the event that the project is going to negatively affect their reputation if they fund it.

B.1.1: Financing From the Institutions Perspective

Case Study: Triodos Bank

- Triodos Bank is an example of a socially conscious institution. This means they support projects that assist the environment and society.
- Triodos Bank's method of accepting loan applications differs from conventional banking in favour of sustainable designs.
- Triodos Bank is still governed by the primary driving force of a conventional bank, which is security in solvency.

There are, however, some banks that will show preferential treatment to convincing designs that support sustainability and environmentalism. One such example is Triodos Bank. Triodos Bank was founded in 1980. Triodos Bank falls under the

category of ethical banks, meaning it focuses on investments that protect and help people and the environment. Triodos has seven basic steps to loaning out money.

The fist two steps of Triodos banks policy are close in relation to the last step of a conventional bank. Triodos first asks its borrowers what it wants to do. Then it decides whether or not it can back the project based on its principles. For Triodos, not particularly effecting the environment or other social concerns will not be enough. The project must describe strong positive movements for these categories.

After determining whether it can back the project based on ethics, the organisation then requires the developers to send their business plan, and discuss it over the phone as step three. The business plan must encompass all aspects of the project, including total cost, selling price, and marketing strategy.

If Triodos finds it necessary, they will arrange a meeting at the developer's place of business to discuss the application. After this has been completed, Triodos determines whether or not it accepts the loan, then it makes an offer with any terms and conditions attached. Step six is whether or not the developers and other interested parties accept the offer, and step seven is loan security and advancing the loan.

Triodos allows investors to choose categories for which kind of projects their money gets invested in. The downside is that a portion of the interest they would have collected is smaller, but it also lowers the rate that the organisation backing the project has to pay. This will be exceptionally helpful for sustainable designs.

Triodos has had considerable success, almost doubling their balance sheet totals since 1997, according to their 2001 Annual Review. With more money in their

possession, they will have more money to back sustainable and social projects, which is an excellent trend for other institutions to follow.

Link:

- More can be learned about Triodos Bank by visiting their website at:
  - http://www.triodos.co.uk

B.2: Venture Capital

This section describes venture capitalists, what they are looking for in terms of investments, and why most would not be interested in sustainable developments, unless they were "socially conscious" investors.

B.3: Federal grants, loans, tax breaks, etc.

This section describes what monetary tools are available to sustainable developers from national governments.

B.4: Incentives For Sustainability

This section describes what other incentives for sustainable designs there are, citing specific policies for the United Kingdom. Both grants given and penalties administered are included, as well as where to look for these policies on the books in other regions. Finally, it expresses what can be done to increase the number of these incentives or penalties through new policy additions.

B.4.1: Case Study: United Kingdom

Key Issues

- There are many incentives to encourage sustainable development and living within the United Kingdom.
- Incentives can be put into practice by other organisations.
- Incentives can assist everyone from the developers down to the residents that will eventually inhabit the site.

Incentives are defined as policies that give organisations and individuals a reason to meet certain standards. Incentives can take many forms, from land grants, funding, rebates, tax breaks, granting of permission, to penalties such as the UK carbon tax. They can come from a variety of sources, but usually arise from the government, or large corporations. In terms of sustainable development, incentives are usually most useful for the developers and initial owners, but can also be extended to the homebuyers or other interested parties. Many forms of incentives exist that would appeal any of these groups.

One incentive that the United Kingdom national government offers is the non-fossil fuel obligation (NFFO). This obligation reduces the price of electricity generated by a renewable source. Another incentive from the government is a VAT back rebate, where the VAT rate, normally 17.5% is lowered to 5% if one buys photovoltaic cells for new developments, or photovoltaic arrays to be added to old developments (Tall Buildings and Sustainability report, March 2002). The same VAT reduction is available for wind turbines, thus making renewable forms of power more attractive (Renewable Energy Assessment and Target for London Vol. 1, December 2001)

The government is also working to disseminate information such as the fact that photovoltaics have a service life of at least 25 years, and reduce energy bills during peak

hours (Development of a Renewable Energy Assessment & Targets for London, Dec. 2001). The goal of this proliferation of information is to convince people about the benefits of switching to renewable energy sources. Ultimately, with this hurdle cleared, people may begin applying other sustainable practices.

Other steps taken by the UK has been to put forth £50 million in grants in the Community Energy programme. This programme seeks to reduce CO_2 emissions, reduce dependence on fuel, and reduce fuel costs (Assembly and Functional Bodies Consultation Draft, March 2002). The government has also passed legislation that taxes unsustainable forms of energy production. These taxes encourage the production of renewable energy. If a company fails to do this, they have the option of limiting their CO_2 emission to a government set limit (see UK policies).

The PowerShift programme gives grants to people who buy vehicles that use alternatively fuels. These grants are from 30% to 75% of the additional cost relative to a petrol vehicle. Some people debate whether the saved fuel costs are worth the additional price of a non-petrol vehicle. This grant influences those people to buying the more environmentally friendly vehicle.

B.4.2: Corporate Incentives

Key Issues

- Corporate incentives spread much farther than is listed here.
- Corporate incentives can be initiated by a group of corporations.

One possible incentive that could stem from the United Kingdom policy is corporate carbon trading. Since the United Kingdom imposes a tax on the carbon emissions of businesses and industry, it would be quite possible to allow businesses to sell their carbon to one another. This takes after the proposal of national carbon trading in the Kyoto Protocol (1997). This system can be applied to any region, and could be capable of generating a huge economic boost if it is employed in the correct way. In the event that the Kyoto Protocol (1997) is ratified, then this scheme would be a definite benefit to high carbon emitting countries.

Appendix C – Technology Transfer

Policies regarding sustainable development have been established; sustainable developments have been designed and built. Now the need shifts to focus on what is left. Sustainable designs have proven successful in the United Kingdom, as well as Spain. How do the development schemes and design features established in these regions enter into Gurgaon, India? This question will need to be answered before India can begin implementing the manual.

Technology transfer is a very big issue in the Asia URBS project as a whole. It encompasses the communication schemes between organisations, while assisting in the relocation of the developmental processes, and re-evaluation of the technological features incorporated. This section describes some of those methods. As India produces its needs assessment, and all the organisations involved start meeting, this section will become increasingly more important. More issues will arise, as will more methods of transferring the different types of information.

Key Issues

- Adapting technology from one location to another.
- Problems with culture, geography and economy differences.
- Finding the most appropriate transfer method.

C.1: Technology Transfer

Technology Transfer is the application of technology from one use or setting to a new use or setting. There are some issues that arise from this transfer of technology. The

target location and region have to be researched to find out if the technology found is applicable and if it is easy to transfer.

The problems with transferring new technology to other countries are not limited to only geographical issues; those are just part of it. One way of looking at this might be as Ghemawat (2001) states that there are four main types of distance that separate countries and these are cultural, administrative, geographic and economic differences. This is in the context of expanding world markets and not specifically technology but it serves as a template to develop ideas about the problems that might be encountered.

In the context of cultural differences problems may arise over religious differences and language. Countries with similar cultural backgrounds will encounter fewer difficulties with the actual transfer of ideas, but other issues may come up. It cannot be expected that people will immediately adopt new technology, as changing life styles is not easy or readily accepted. When transferring technology, it is very important to expect it not to fit correctly in the new environment, it usually has to de adapted to the existing customs, and conform ideas to fit to local culture.

Other issues that arise in the area of technology transfer are economic and political differences. These are mainly legal and monetary differences between countries or regions of the world. In the case of sustainable building practices, any type of practice suggested for implementation in India has to be adapted to comply with local policies and economic constraints. Certain practices may not be applicable because of existing building codes or regulations in Gurgaon. Attention also has to be paid to monetary conversions from the UK to India. Materials or designs, which may be economical for

areas in the UK, may not be so economical in India. Part of technology transfer is to make sure suggested practices do not conflict with existing policies.

To illustrate the problems and constraints that people face when attempting to transfer technology or markets, consider Burger King. Imagine someone wanting to open a franchise in India. They would run into cultural problems because cows are considered sacred animals in the Hindu religion, but hamburgers are made of beef. A new product would have to be developed to comply with local customs. Economic problems might arise if the prices are too high for the people in that area. If the franchise were to be opened in Canada, these problems would not exist. Cultural and economic similarities between the United States and Canada make the transfer much easier.

One main issue, in the area of technology transfer, for the sustainable buildings project manual, is how to adapt practices so that they can be applicable to the culture, geography, and economy of Haryana, or more specifically, Gurgaon. Research into cultural, geographical, and economic differences between western civilizations and India is necessary to determine the best approach for technology transfer. There are numerous database formats that can be used for technology transfer; however, certain methods may not be suitable for the users in Gurgaon.

C.1.1: Database Formats

C.1.1.1: Paper Manual

A paper manual is a common method for sharing information. Although a reliable way of handling information, paper manuals are limited by several factors. One of the main problems with this format is that it is not convenient to move hard copies

from one location to another. Looking for information in the manual is also much harder than in an electronic database. Positive qualities include the comfort level people have with using paper manuals. Although computers are readily available and utilized in Western cultures, paper manuals are still the main method of information transport in many places.

C.1.1.2: Website

For people with Internet access, a website provides a fast and easily accessible method of transferring information. The number of Internet users in India has increased steadily over the last several years. As stated by IDC an internet consulting firm in India "The India Internet landscape has changed drastically from a few thousand subscribers in 1994 to more than two million paid Internet subscribers in 2001." (http://www.idcindia.com/internet_default.htm). Given that websites are a good format option it is an option that has to be assessed.

The positive qualities of a website include the fact that the information is always available, the website can be accessed from anywhere in the world. Websites are also excellent methods of information transfer because they are easily updateable. This factor can also be a downside in that people returning to a website that has been updated may not be able to find information that has been changed or removed from the website. A website also needs constant attention, in that people have to check to make sure links are working properly and handle feedback from email inquiries.

A major downfall of website use is that many people in the world do not have access to computers, let alone the Internet. The region where the information is being

transferred to must have Internet access if a website is going to be the sole method of technology transfer. Another issue with websites is that they can crash, making them unreliable. If a website going to be used, it is necessary to have a backup of all information and safety measures, such as firewall and anti-virus software, to protect against information loss.

C.1.1.3: CD-ROM

The CD-ROM format is versatile and potentially useful for the SBP manual. The fact that it is an electronic media allows for an index, which can be easily used to find information. The most important aspect of the CD-ROM is that it can be simply converted into other formats. Information can be printed out to create paper manuals or it can be uploaded to the Internet to make a website. The only downfall of a CD-ROM is that, like a website, it requires the user to have access to a computer of the same calibre that was used in creating the CD-ROM. This may pose a problem for certain locations where a sustainable building practice manual may be desired.

C.1.1.4: Periodical Journal

Periodical journals are excellent for publishing and documenting the findings of a research project. Journals are globally available, making for easily accessible information. Unlike paper manuals, journals update information and research papers, which allows for error correction and addition of newly implemented material. As the information is updated continuation of research is stimulated. The main problem with periodical journals is that there is no easy way to search for something specific. Many

volumes and publications often have to be looked at, which is a tedious and time-consuming process.

C.1.2: Application to Sustainable Building Practices

Transfer of technology is a much broader issue than simply selecting a type of media to carry out the transfer. It involves studying geographic, social, cultural and economic aspects of countries and making sure that the technology chosen can be transferred and adapted efficiently wherever it is going. Furthermore, in this case, it also involves taking into account matters of sustainability and energy conservation in order for the process to be successful.

Besides understanding and successfully carrying out technology transfer, there is also the task of selecting the best format of transfer. This task is difficult because many requirements have to be met by these formats to be able to successfully make a transfer from one place to another. One format may possess certain aspects that are beneficial, but lack qualities that another format has. It may be necessary to incorporate more than one format for the final transfer of information.

C.1.3: Cross-cultural SBP

The idea of sustainability is applicable throughout the world. However, the way it is used will almost never be identical. The idea that things such as climate and technology affect sustainability has already been discussed. However, the idea that people's cultures affect sustainable development and the practices behind it is also true. People who are used to living in adobe houses may not be as willing to live in a house

made of lumber and brick. Not only would the environment be different, but also the elimination of the adobe houses means that the sustainable development is altering the culture. This is not what sustainability is about. Sustainability is about the preservation of the natural "environment." This includes plants and animals, but also people.

The process by which sustainability changes is one that is difficult to define. The change depends on many variables like climate, technology, available resources, and other limiting factors. Ideally, the best method for producing a specific sustainable structure would be to gather as much information as possible globally, and then filter it according to the site specifications. This filtering process is part of what technology transfer is all about. As explained before, technology transfer is how to convert available information so that it is useful for a certain place.

The process of understanding cross-cultural sustainable practices is very complicated. Even though a few variables were mentioned above, there are many more that are unknown and unnamed. These variables are concerns that have to be addressed if one wants to create a more sustainable structure for a region.

C.1.4: Technology Transfer User Interface Concept

We will design the user interface for the final database to be convenient and easy to use. The interface will make the manual easier to navigate, and the processes described will be capable of greatly assisting the user. It will also produce a variety of information, which can be narrowed down into what the user specifically wants. The process consists of three basic steps:

1) We will start by asking the user basic questions about zoning and spatial concerns (which will include floor area). The interface will be a pull-down menu for each category.
2) Upon choosing the zoning area and spatial concerns, the web page links the user to a list of buildings that fall under their specifications. At this point, the user is allowed to browse through the list of buildings, or specify the search further by limiting results to a specific geography, climate, topology, and material type.
3) If the user chooses to browse the cases, then the case will be displayed. At the end, there will be a similar interface as before, but this time it will ask the user what the climate, geography, topology, and space of the region in which the building is to be transferred to. The program will link the user to a page with a list of tips for transferring the building from its current location to its future location.

This process makes the site "searchable," but removes the messiness involved with an "in-text" search engine, since it does not search by text; rather it searches by case coding. We will assign the different climates, geographies, etc. a numerical value and turn it into a string. The computer can then look for things that match or come close to matching the string, and it will display these matches. If a perfect match cannot be found, then a closest match scenario would be presented to the user. This scenario would be practices that require minor alterations before they can be applied to the desired location.

The final product will be based upon the results garnered from the buildings and case studies we are going to analyse. As already explained earlier, the qualitative and quantitative analysis of data analysis that we will carry out after the surveys, interviews,

and research will yield the most appropriate building practices that will be incorporated into the project.

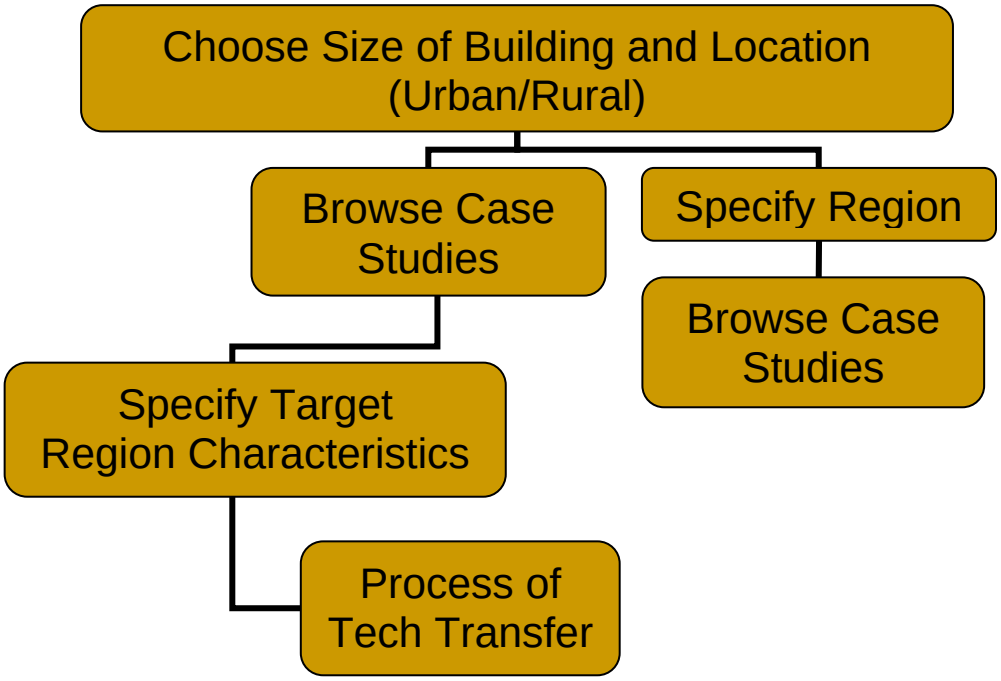

Figure C - 1. User Interface Concept Flowchart

Appendix D – Background on Gurgaon, India

D.1: Geography, and Culture of Haryana

The state of Haryana is located approximately thirty kilometres south of New Delhi, the country's capital. Haryana was founded on November 1, 1966 and is 2,105 square kilometres in area. The state is composed of nineteen districts, Gurgaon being one of the southern districts. The city of Gurgaon is located in the northern-most part of the district. The following maps show the location of the state of Haryana in India, the district of Gurgaon within Haryana, and the city of Gurgaon within the district, respectively (www.haryana-online.com).

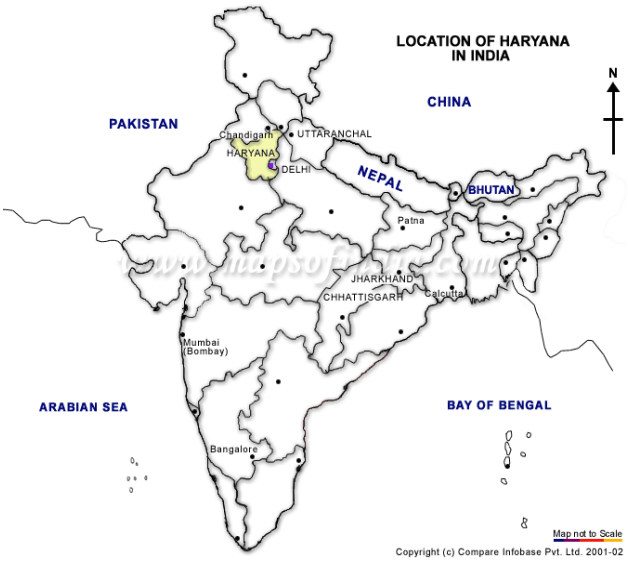

Figure D - 1. Map of India

Figure D - 2. Map of Haryana

Both maps from (http://www.mapsofindia.com)

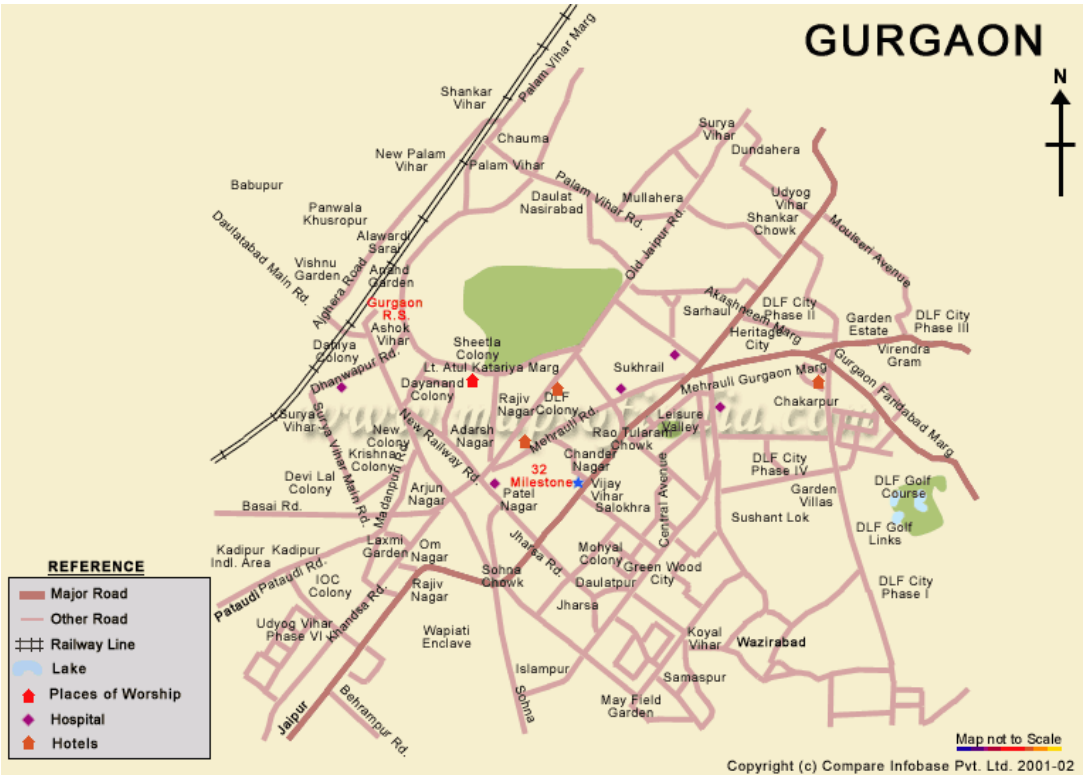

Figure D - 3. City map of Gurgaon

(http://www.mapsofindia.com)

D.1.1: Physical Geography

There are four main types of geography in the state of Haryana. The Shivalik Hills contain rivers, which provide the region's water. The Ghaggar Yamuna Plain is made up of sand, clay,and kankar, which are hard balls of gravel. There is a semi-desert sandy plain, and dry Aravali hills (www.haryana-online.com). This region of India is largely an agricultural region. Haryana is known as the 'Green Land of India' because of its fertility (http://www.1uptravel.com/states/haryana/). Cotton, sugarcane, wheat, corn, barley, oilseed, and rice are all major products of Haryana. Only 3.5% of the area is forest. The trees are all dry deciduous. Types of trees found include Kikar, Pipal, Mango, Neem, Java Plum, Imli, Indian Rosewook, Barh, Sagwan, Mulberry, Pine, Poplar, Eucalyptus, Lasura, Amla, and Dnak (www.haryana-online.come). Natural resources are scarce in the region. Haryana has a small amount of coal, limestone, iron ore, quartz, sulphur, dolomite, feldspar, and kaolin. Location of non-metallic minerals can be seen on the following map.

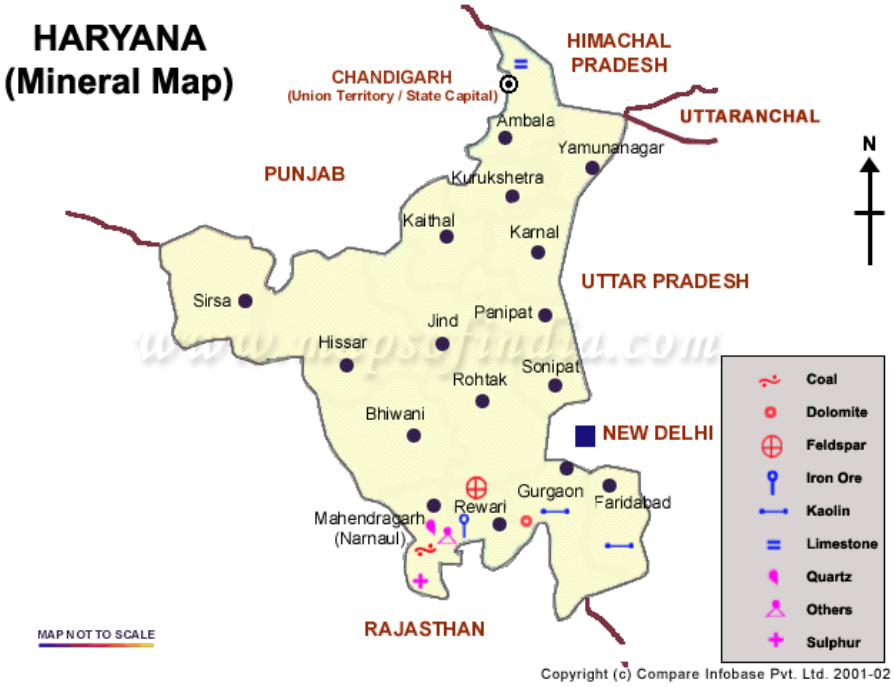

Figure D - 4. Mineral map of Haryana

(http://www.mapsofindia.com)

D.1.2: Climate

The weather conditions of Haryana vary greatly with the seasons. In general the weather of the area can be categorized as tropical. The months of December and January are usually very cold, with temperatures as low as 4°C. March through June the region experiences extremely hot and dry weather, changing to hot and humid toward the end of June and through July. Temperatures peak around 110°F. The monsoon season brings an average of twenty-six inches of rain between July and September. Local flooding is a common problem. During the monsoon season, ocean air travels up from the east/southeast. The remainder of the year, continental air moves from the west/northwest to the east/southeast (www.rrindia.com/climate.html).

D.1.3: Culture

Haryana is a region full of history. It was originally home of the Bharata dynasty, which gave the name Bharat to what is now India. Haryana played an important role in Indian history until the rise of the Muslims and the emergence of the city of Delhi as the capital of the country. The region remained in the sidelines until 1875 when they joined in the first war of Independence against the British Government.
(http://www.1uptravel.com/states/haryana/).

Haryana is also the birthplace of the Hindi religion. Ninety percent of today's population of Haryana is Hindi. In the north and northwest districts people of the Sikh religion reside, and Muslims live in the southeast.
(http://www.mapsofindia.com/stateprofiles/haryana/index.html)

The main language of the region is Punjabi. People also speak Hindi, of which the most important dialect is Bangaru, Urdu, and English (http://travel.indiamart.com/haryana/).

Religion and social traditions are very important to the people of Haryana. They have many festivals of celebration and are known for their love of cattle (http://www.mapsofindia.com/stateprofiles/haryana/index.html). Dance is the most important form of celebration, and folkdances are numerous. Weddings, births, festivals, and harvest time all include folk dances. The people love bright colours and their dresses for dancing are elaborately decorated (http://www.haryana-online.com/culture.html). Folk theatre is also common in the region. The Saang Theater has all male performers. Performances are given in open theatres where the audience sits on all three sides of the stage (www.indiaprofile.com/relgion-culture/haryana-culture.htm).

D.1.4: Economy

Haryana is mainly an agricultural state, with 75% of the population being rural. Industry, however, is growing in the cities. Gurgaon is the main industrial centre of Haryana. Maruti Undyog Limited, the largest car manufacturers in India, has its manufacturing plant located in Gurgaon. IT industry and software development are also located within the city (www.haryana-online.com). Major industries of the region include cotton, wool, scientific instruments, glass, cement, paper, sugar, tires, bicycles and electronic equipment.

(http://www.mapsofindia.com/stateprofiles/haryana/index.html)

In keeping with cultural traditions, different artisan castes also exist in Haryana. The goldsmiths make up the Sunars cast, the blacksmiths the Lohars, oil traders are part of the Telis cast, the barbers the Nais cast, and the Dhobis cast is comprised of the launders. The people of Haryana are generally taller, stronger, and healthier than people from other areas of India because of their hard work in the agricultural fields and high amounts of dairy products in their diet (http://www.haryana-online.com/culture.html).

In 1979 the Haryana Urban Development Authority composed the Haryana Urban Development Authority (Erection of Buildings) Regulations. Main concerns of the state include health and safety, land preservation, and street appearance. The following shows the regulations for Industrial, Residential, and Public Buildings.

(http://chd.nic.in/huda/reg.htm).

INDUSTRIAL

Maximum permissible coverage on ground	Maximum permissible floor area ratio	Maximum height of the industrial building
60 percent of area of the site	125 per cent	21 meters

INSTITUTIONS AND OTHER PUBLIC BUILDINGS

Area of Plot	Maximum permissible coverage on ground floor	Maximum permissible F.A.R
Up to 10,000 Sq. metres.	33% of the area of the plot	100%
Above 10,000 Sq. metres.	25% of such additional plot	100%

RESIDENTIAL

(a) Permissible Maximum Coverage

Area of Site	Maximum permissible coverage on ground (including ancillary and residential zone)	Maximum permissible coverage on the 1st floor
1. For the first 225 sq. metres. of the total area of the site	60% of the such portion of the site	55%
2. For the next 225 sq. metres. i.e. portion of the area between 225 and 450 sq. metres.	40% of such portion of the site	35%
3. For the remaining portion of the site. i.e., for the portion of the area exceeding 450 sq. meters.	35% of such portion of the site	25%

As can be seen from the above tables, industrial buildings cannot cover more than sixty percent of the ground site, and cannot be more than twenty-one meters tall. Other public buildings are limited to a plot of ten thousand square meters, of which the building can cover thirty-three percent. For residential buildings, the building can cover sixty percent of the first two hundred and twenty-five square meters of ground. The building can cover Forty percent of the next two hundred and twenty-five square meters, and the building can cover thirty-five percent of the remaining portion of the site. These regulations will have to be taken into consideration when suggesting possible sustainable building practices for Gurgaon.

D.2: Technology and Buildings of Haryana

The technology available in Gurgaon and the region of Haryana is a crucial part of the Sustainable Building Practices (SBP) manual. Existing buildings and past building practices give a sense of what is needed and what is already present in Gurgaon. The technology and practices being researched for this city are not necessarily the most advanced or new, but are the most applicable and suited for this region.

D.2.1: Buildings in Haryana

The first settlement in Delhi was supposed to have been a city called "Indrapratha". No remains exist, but the city is mentioned in the epic Mahabharata. It was built about 1400 BC.

The area of Haryana has been influenced not only by Indian architecture, but also by British architecture. The decision to make Delhi the new capital in 1991 resulted in a struggle over what architectural style should be used to shape the city. Both the English Imperialist style and current Indian styles were considered for the city (Metcalf, 1989).

The following pictures are of historic buildings located in cities near the region of Haryana, all of them within 400km:

Agra

The Public Works Department of British India (PWD) was responsible for the communications system and all official buildings of the British Raj in every provincial and district town in India (Tillotson, 1989). Procedures for construction of buildings such

as the bungalow in Figure D-5 were standardised by the military engineers in charge of the PWD.

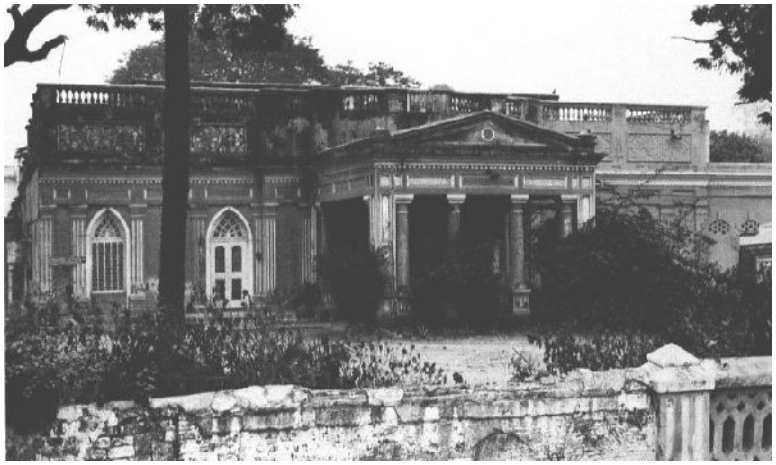

Figure D - 5. Agra – Bungalow in mixed style (Tillotson, 1989)

Jaipur – Albert Hall Museum

The Albert Hall Museum (Figure D-6) was built under the supervision of Samuel Swinton Jacob between 1883 and 1887. It had some ancient Indian forms such as the pyramid of pavilions, but in general shows more western influence. The decorative carvings and decorations of the museum (some can be seen in figure D-7) are the work of local craftsmen.

Figure D - 6. Jaipur – Albert Hall (Tillotson, 1989)

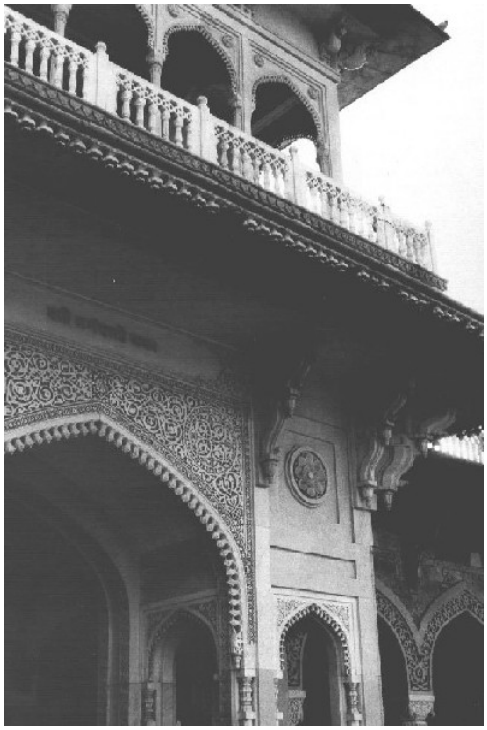

Figure D - 7. Jaipur – Detail of entrance to Albert Hall (Tillotson, 1989)

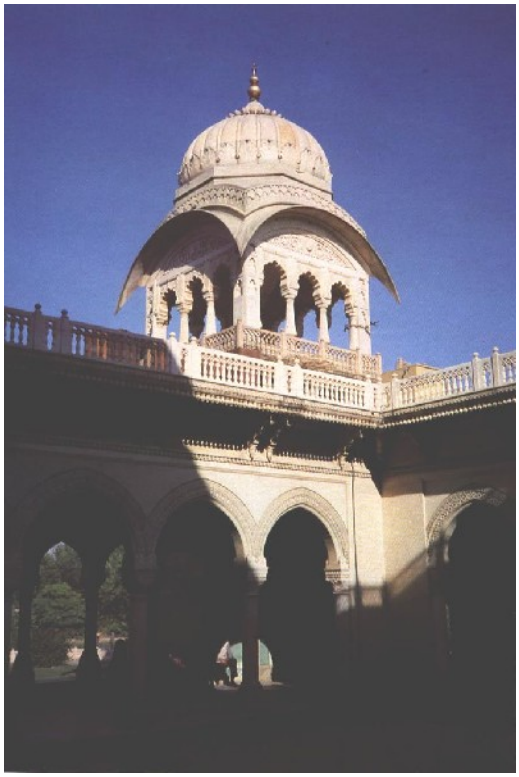

Figure D - 8. Jaipur – Albert Hall (Tillotson, 1989)

Ajmer – Mayo College

Mayo College (Figure D-9) was built under the style called Indo-Saracenic, which emerged from the British Imperial overlords. This style was considered to have both Indian and Imperial influence, which made it easy for the Maharajas to adopt. The buildings are considered culturally traditional but also progressive at the same time. Mayo College was built by Major Charles Mant of the Bombay Engineers (Tillotson, 1989). Figure D - 10 shows the design for Mayo College by Major C. Mant.

Figure D - 9. Ajmer – Mayo College (Tillotson, 1989)

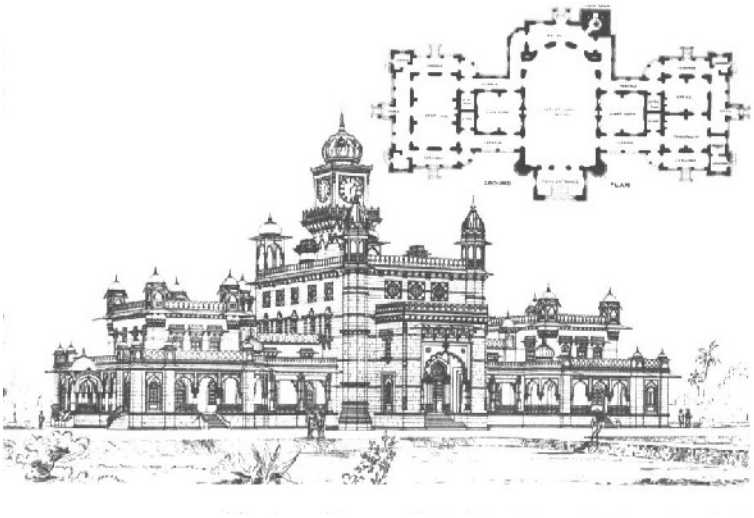

Figure D - 10. - Mayo College design (Metcalf, 1989)

New Delhi

As the new capital was being made there was a struggle over what architectural style should be used to shape the city. Some buildings show influences of both British and Indian styles.

House owners (Figure D-12) have grown tired of having all houses look so similar and as a result, there has been growth in a new style of house, known as Punjabi Baroque.

It is a modern style that combines different existing styles such as Spanish arcades with Swiss chalet eaves and classical porticoes (Tillotson, 1989).

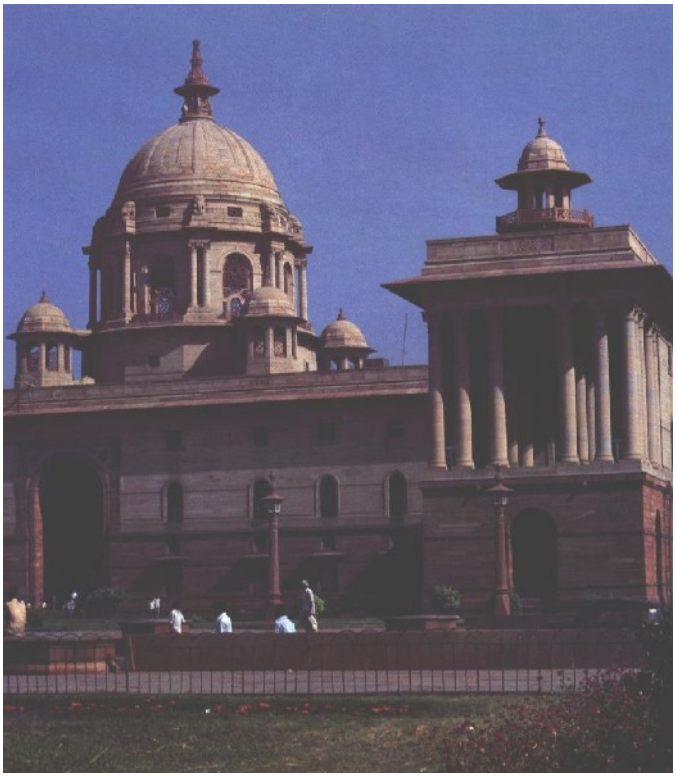

Figure D - 11. Secretariat in New Delhi (Metcalf, 1989)

Figure D - 12. A modern private house in Delhi (Tillotson, 1989)

Having looked at historic buildings, following are modern building situated in Gurgaon:

Figure D - 13. A modern building in Gurgaon

This building shows the modern traits that are being used presently in Gurgaon.

(**http://www.worldcityphotos.org/I/IND-Gurgaon-SDasgupta1.jpg**)

Figure D - 14. The Bristol Hotel near Gurgaon

(http://www.123hotelinfo.com/gurgaonhotels/)

Figure D - 15. The Gateway Tower Offices
This building again shows the modern style being used in Gurgaon.

(http://www.reiworld.com/gallery/Gateway.asp**)**

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