Investigation into the Glazing Sector of the Construction Industry in the Cork Region: To Identify the Main Criteria Used in the Window and Glazing Selection Process

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The author hereby declares that, except where duly acknowledged, this thesis is entirely his own work and has not been submitted for any other degree.
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Abstract

The selection of glazing and windows is an important element in the architecture of a building in terms of both aesthetics and practicality. Other related issues include sustainability, and the potential effects of glazing selection on the environment. It is essential that glazing experts contribute to the design process at an early stage in order to maximise the efficiency of the windows while still allowing architects to create their visions and unique buildings. This study focuses on the current systems used in the window selection process for the Cork region, and will propose changes based on the findings of the research.

The findings of this research illustrate that there is a need for the participation of glazing specialists early on in the design stage of building projects, and that without this participation, not all the window selection process criteria will be examined by design teams. The findings of this study show that, currently, there is a lack of knowledge in relation to glazing among those who will have the most influence in the selection of glazing in the Cork region, and more importantly, that there is a tendency to defer the decision on glazing to a point which is too late in the process.

This research therefore, recommends a change the window and glazing selection process in order to provide early access to the knowledge which is currently lacking, by the inclusion of window company representatives earlier in the design process. This paper makes recommendations that further research is carried out to establish the knowledge held by the key personnel in window and glazing companies, that the current study should be repeated in other regions of Ireland.
Chapter 1

Introduction
Chapter 1

Introduction

1:0 Introduction

This research is an examination of the selection process for windows and glazing in the Cork region. It is important to emphasise that a window is a unit made up of a frame and glass installed in the wall of a building, and glazing is the term used to describe glass and frame systems which might, in some cases, form a complete wall of a building. There are two main areas in the glazing industry which are important to this research, the supply and fitting of glazing to new buildings, and the replacement of glazing in existing buildings. The researcher is employed in the industry and is conducting this study in order to improve the existing glazing selection process with the introduction of new systems which will enable design teams to achieve the optimal glazing specification in new buildings, and to establish more accurately what is required in the replacement of windows in existing buildings.

The architectural design of a building will normally include for windows and glazing, however, the architect must include for the practicality as well as aesthetics of the design of the windows and screens. Traditionally, an architect would design a building with little regard to whether or not the design was possible to achieve structurally and would rely on engineers and construction companies to find the best way to achieve the design.

Glazing companies would normally not be included in the initial process and would not be consulted until much later, usually, appointed by the construction company, after the glazing has been specified. Failure to include glazing companies early on in
the design stage of a building can lead to delays in the building program, inappropriate materials being used in the manufacture of the glazing, and potential problems for the occupant after the building is completed. This researcher will examine the existing process that currently exists on the glazing industry, and interview relevant stakeholders in the glazing sector of the construction industry. In preparation for this, an extensive examination was undertaken of the relevant literature that exists on this issue, but this proved to be scant due to the limited research that has been previously done in the study. Relevant stakeholders include architects, engineers, quantity surveyors, construction company representatives, property developers, and customers.

1:1 The Purpose Served By Glazing

Buildings have been designed and built without windows or any other form of glazing, ranging from mud huts to more elaborate edifices. Windows are, therefore, not an essential component in the construction of a building. According to Stone, (1988) glazing does, however, serve a purpose in enhancing the appearance of a building, in the efficiency and economy of running a building, and in the provision of a comfortable environment for the occupants:

_The use of glazing has considerable consequences for the convenience, comfort, appearance and costs of buildings. Most occupiers prefer natural to artificial lighting and like to have a view out; for some processes natural lighting is more valuable than artificial lighting._ (Stone, 1988).
The primary function of glazing is that it allows natural light and heat to enter a building, the amount of which will vary according to many factors including the time of day, the size of the window, the climate, and the orientation of the building. Without windows, artificial light and heat must be provided at a continuous running cost to the occupant. To achieve a balance in the glazing is the challenge for architectural design teams. According to Wigginton and Harris, (2002) the primary functions of glazing have been re-categorised as:

*Daylight adjustment (reflection / protection), glare control (blinds / louvres / fixed), artificial lighting control, heating control, heat recovery (warmth / coolth), cooling control, ventilation control, fabric control (windows / dampers / doors) and insulation (night / solar),* (Wigginton & Harris, 2002).

Glazing is also important in the architectural design of a building from an aesthetic perspective. The inclusion of windows and screens, and the use of light and shade in the design help to distinguish one building from another and provide variety to what could otherwise be dull and boring boxes. According to Treiber, (1995) the work of American architect Frank Lloyd Wright offers examples of the importance of glazing to building design:

*To modulate the stream of light which poured in through the longitudinal window, Wright replaced the plain glazing with subtly patterned glass; later, for the Usonian houses, he added repetitive vertical or horizontal glazing bars, or even, for the clerestories, (high level windows for the purpose of supplying natural light to a building), boards perforated by decorative designs,* (Treiber & Lloyd Wright, 1995).
The most basic property of glass is that it is transparent, and people can see through it. This must be considered in the window selection process. In many cases windows are specified for parts of a building, and subsequently covered up with blinds or painted glass. In dwellings, consideration must be made for privacy, while providing the ability to see out, and alternatively, for some situations such as in a shop for example, the ability to see in should be maximised. This very basic example demonstrates that commercial buildings must be treated differently to domestic or residential buildings. According to Major, (1995) windows are marketed in two major types: the commercial window and the residential window, however, in some situations residential windows can be used in light-duty commercial building, and commercial glazing has seen some use in certain residential applications, (Major: 25).

1:2 The Glazing Selection Process in the Cork Region

The construction industry can be divided into two sectors, the commercial market which covers the construction of office buildings, industrial units, shops, hospitals, schools, and more; and the domestic market which covers the construction of houses, apartments, and house extensions. The glazing industry is similarly divided, offering different products and glazing specifications to each sector. The selection process must be, however, the same for both markets in providing the best possible glazing specification for a building, whether a house in a housing estate, or a multi-storey office block.

There are many criteria which influence the selection of glazing, some of which are specific to Ireland and, in particular, to the Cork region. They include the climate,
government regulations, the economy, sustainability, technology and aesthetics. To reach a compromise which satisfies all or as many as is possible of these criteria, provides a real challenge for building design teams and requires input from glazing experts at an early stage in the glazing selection process. According to Rumbarger et al. (2003) the decision relating to light transmission alone for example, requires mathematical calculation and selection from multiple glazing options. The inclusion of a glazing company representative in the design team from the outset of a project would address this and other fenestration issues which might arise:

Building envelope and room design details can be thought of as the light fixture that controls the distribution of daylight in a space. Envelope decisions include the size, shape, and location of the fenestration and the type of glazing and shading system. Room geometry, size, and surface properties also influence achievable daylight levels, (Rumbarger et al., 2003).

In the Cork region the current common practice is that the glazing company is selected by the construction company at the construction stage of a project. The researcher contends that this is too late in the process, and is a flaw in the selection process system.

1:3 The Research Focus of the Study

This research is concerned with an assessment of the glazing selection process currently adopted specifically in the Cork region. The research begins with an examination of criteria currently used by the construction industry for the selection of windows and glazing for commercial and residential buildings. The study examines
and compares the use of these criteria in the Cork region, and assesses the current knowledge of the key decision makers and influencers in building design teams in relation to glazing selection. The study further examines the effect of environmental issues on glazing selection.

This current research focuses on the views of ten people currently involved in the construction industry in the Cork region, either in a professional capacity, or as clients. The group of ten is made up of two architects, two construction company managers, two quantity surveyors, two engineers, one property developer, and one customer of Cork based window company, C & W Windows. The study aims to compare these perceptions with current literature on the subject and contribute to the scant available literature.

This chapter presents the background to the research, and sets the parameters of the study. This chapter also presents the reason for the research and the objectives to be achieved by the study.

Chapter two is a review of literature which is relevant to the research question. This chapter presents the current thinking on the selection of windows and glazing from the perspectives of cost, aesthetics, technology, the environment, climate, efficiency, and sustainability. This chapter develops the hypothesis for comparison with the findings of the research.

Chapter three describes the methodology used in this research study. This chapter presents the reasoning behind the selection of qualitative research methods over quantitative methods, and outlines the steps taken to ensure that the information
collected is relevant to the research question. The chapter describes in detail how the
data was collected and analysed.

Chapter four provides the main findings of the study, in the form of direct quotes from
the interviewees, giving their views on the glazing selection process in the Cork
region. This chapter enables comparison between the current thinking in Cork and the
current literature on the subject.

Chapter five, the final chapter, reviews the main findings of the current study, and
presents conclusions based on the hypothesis developed in chapter two. Chapter five
makes recommendations for improving the glazing selection process in the Cork
region, and also recommends that further detailed research is carried out, focusing on
the knowledge, experience, and systems of Cork based glazing companies.

Chapter two will now present the review of current literature on criteria for the
selection of glazing and windows.
Chapter 2

Literature Review
Chapter 2

Literature Review

2:0 Introduction

This chapter presents the current literature and practices involved in the selection process for windows and glazing. The researcher has identified, from a review of the available literature, a list of criteria and features which are generally considered in the glazing selection process. This literature review forms the hypothesis of the study question. The amount of literature available on the glazing industry is limited, however, the researcher has referenced relevant contributions from eminent authors.

2:1 Glazing Selection and the Construction Industry in Ireland

Long, and Gross (2007) believe that as long as buildings are being erected around the world, there will be a need for windows. Long and Gross (2007) have found that global demand for windows and doors was valued at €51 billion in 1999, and rose to €65 billion by 2004. It is expected to hit €82 billion by the end of 2009. The annual rate of growth is expected to be between 4.5 — 5.0 percent. This is in line with growth in building construction around the world, (Long, and Gross, 2007). Long and Gross (2007) further state that in terms of window applications, (new construction, or remodeling), similar stability prevails. New construction accounts for 57 percent and remodeling (repair and improvement) accounts for 43 percent, a split that is likely to continue in the future.
According to Long and Gross (2007) while the glazing industry is highly fragmented, small firms find it difficult to compete, as raw material and operating costs are on the rise and consolidation is expected to accelerate. Though a mature field, advances continue to be made on an ongoing basis in both door and window design. The market for doors and windows is influenced by raw material costs, legal and regulatory considerations, technological innovations, and pricing patterns, (Long and Gross, 2007).

Kennedy (2008) states that, even though the construction industry in Ireland is slowing down, the residential construction sector will stabilize, and return to full growth. In the shorter term, Kennedy (2008) believes that there may be some relief coming from higher building activity in sectors away from the residential market, such as the commercial construction sector, and the industrial construction sector. Kennedy (2008) notes the current economic difficulties faced in particular by residential developers, but suggests that the market will stabilise and return to growth by the end of 2009. Kennedy (2008) purports that uncertainty in the market is causing a more conservative approach from consumers who are looking for value for money, and increased energy efficiency in residential repair, improvement works and extensions (in Kennedy 2008).

Irish Minister for Finance, Brian Lenihan declared that, “The building boom is coming to a shuddering end . . . despite strong evidence to the contrary. I believe, in time, we will return to a sustainable level of construction-led growth”, (in Hickey and Byrne, 2008: 4.). Director-general of the Construction Industry Federation, (CIF), Tom Parlon stated, however, that a sustainable level of 50,000 new houses per year is achievable, based on his organisations findings, (in Hickey and Byrne, 2008).
Kennedy (2008) states that the introduction of Building Energy Rating makes the energy performance of a home visible to prospective buyers and tenants and gives them a simple way of judging the energy credentials of a home before buying. (in Kennedy, 2008).

Sullivan and Horwitz-Bennett (2008) purport that while the USGBC (United States Green Building Council) reward the use of ample fenestration, (glazing options such as rooflights, windows, and screens), in buildings, and the conservation of energy in new houses, in some European countries it is the law. Sullivan, and Horwitz-Bennett further state that the design and specification of these important building components requires careful attention to such factors as, material selection, fenestration performance, energy efficiency, sustainability, acoustical performance, security, and code (Government regulation standards), compliance, (Sullivan & Horwitz-Bennett, 2008).

Mawhinney, (2002), defines sustainability as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Mawhinney, 2002: 5).

2:2 Government Regulations Covering Glazing in Buildings

The Department of the Environment (2008) state that Government regulations must be adhered to in the window selection process. Technical Guidance Document D — Materials and Workmanship, (2000: 3), states that all glazing materials, design, and workmanship must comply with the legal requirements laid down in the building regulations. Technical Guidance Document K — Stairwells, Ladders, Ramps, and Guards, (2005: 9), directs that glazing used as a guard must be toughened and/or

2:3 Window Selection Criteria.

According to the Department of the Environment (2008), as a result of government regulation compliance, there are other criteria which are considered in the window selection process, such as heat insulation, sound insulation, and light transmission. Other criteria, not directly influenced by regulations include complex fenestration system (CFS), glazing maintenance, the carbon footprint, climate, and the cost of glazing.

2:3.1 Heat Insulation in Window Selection.

The British Research Establishment, (BRE) offers two criteria which influence the selection of windows — (a) heat insulation, and (b) sound insulation, (BRE Digest, 1993). Taylor (2000) states that glass absorbs internal heat, in summer does not allow the sun’s absorbed energy to disperse effectively, and in winter the same property leads to increased heat loss. Taylor further states that ordinary glass has a high conductivity, and has little inherent ability to insulate. Taylor maintains that the main resistance of glazing to heat loss comes from air layers at the glass surface which impede the convected heat flow from the warm interior to the cooler glass surface,
and that the air in the space between the panes in double or triple glazing is the active insulator. Taylor identifies other insulation aids, including inert gases such as argon, which can increase the insulation efficiency by 10 per cent, and coatings which reduce the conductivity of the glass, (low emissivity), (Taylor, 2000).

According to Turner (2004), heat insulation is measured in terms of u-values, (U-value is single number stated in watts per metre squared per degree Kelvin, (W/m2K), measuring heat lost through a surface). The lower the number, the more efficient the insulation properties are. Efficient thermal insulation in the glazing of a building will save significantly in the use of energy to heat the building to comfortable levels. Turner states that the thermal performance of a window system will vary depending on the following characteristics:

- The number of panes.
- The dimension of the space between the panes.
- The type of gas between the panes.
- The emissivity, (level of heat/cold conduction) of the glass.
- The frame in which the glass is installed.
- The type of spacers that separate the panes of glass (Turner, 2004: 239).

Turner purports that different combinations of these specifications, such as the use or non-use of a thermal barrier, (the metal frame is in two parts, separated by a non-conductive material which blocks heat/cold transmission — thermally broken, [TB] windows), in metal frames will achieve significantly different u-values. Assessment of the u-value of a window is based on the ‘Centre-of-glass’ measurement, (Turner, 2004).
According to the Spectus Window Systems Specifiers Guide (2007), U-values are one element of three which make up the Building Energy Ratings (BER):

*Windows are rated by three types of energy flow:*

- Solar heat gain (G-value) — Positive
- Thermal transmittance (U-value) — Negative
- Air leakage (L-value) — Negative

*Each type of energy flow has an affect on the overall energy efficiency of the product.* (Spectus Window Systems Specifiers Guide, 2007: Gen.13)

### 2.3.2 Sound Insulation in Window Selection

According to Adler (1999), the windows are usually the weakest part of the envelope, (the outer walls and roof), of a building where sound insulation is concerned. The mass per unit area of the glazing is generally small compared to the rest of the envelope, (Adler, 1999).

Chudley, and Greeno (2006), suggest four factors which affect the efficiency of sound insulation in double-glazing: airtightness, through good insulation, the weight of glass used, (the heavier the glass the better the sound insulation), the size of the air space between the panes, (the space between the panes should be within the range 50mm to 300mm), and absorbent linings used in the spacer bar which separates the panes, (Chudley, and Greeno, 2006). Sound transmittance is measured in decibel reduction Rw dB, (Rw dB is the rated degree of sound insulation in a window, as determined by one-third octave frequency analysis, presented as a single number in decibels – the higher the number is, the better the sound insulation is) (www.norsonic.com). 30 Rw
dB is an average level of sound insulation in a standard window, with two panes of 4mm clear float glass, separated by a 20mm of air-filled space, (SPECTUS Window Systems Specifier’s Guide, 2007).

According to Cavanaugh, and Wilkes (1998), standard windows, selected without special consideration of acoustic performance in buildings, most often have Sound Transmission Class, (STC) ratings, falling between 28 Rw dB and 32 Rw dB. Changing specifications, such as the addition of laminated glass to common glass configurations will increase the STC rating to a range between 34 Rw dB and 42Rw dB, depending on the glass thickness, airspace thickness in insulating glass, and the number of layers. STC ratings as high as 50 Rw dB can be achieved using an airspace of 100 millimetres or greater, (Cavanaugh and Wilkes, 1998).

2:3.3 Light Transmission in Window Selection

The sun master of our lives far off indifferent

He is a visitor — an overlord he enters our house. . .

Punctual machine turning since time immemorial

Twenty four hours cycle the gradation the nuance

The imperceptible almost providing a rhythm.

Yet brutally he breaks it twice — morning and evening.

Continuity is his but he imposes an alternative — day and night —

These two phases rule our destiny; a sun rises a sun sets

A sun rises anew
Le poème de l'angle droit (1947-1953)


According to Laouadi, and Parekh (2007), the transmittance of light is another important consideration in the selection of windows. The measurement of light transmission is dependent on the source of the light. Light from the sun, which is the source most commonly referred to, is measured in irradiance (W/m² nm), and illuminance (lux), and other light sources are measured using other criteria, (www.lightmeasurement.com).

Teicholz (2001), believes that fenestration, (windows, clerestories, skylights, rooflights, and the like), while allowing exterior view, is, first and foremost, a lighting liability — no different than deciding to use 1,000 watt bulbs. Unless well shielded and/or dimmed or filtered, users will come to hate it. Teicholz (2001), suggests that fenestration should be controlled by limiting fenestration orientation, (positioning of windows in a building), limiting sky view, (use awnings, or louvres for shade), and limiting glazing transmission, (use tints, and glass coatings to diffuse the light), (Teicholz, 2001).

Hagan (2001) disagrees, arguing that the use of complex fenestration systems was not so straight forward, leading to:


Hagan asserts that one can’t afford to dismiss low technology methods using renewable energy. This should not imply a repudiation of modern technology, but
does suggest its redirection, in the use of complex fenestration systems, (CFS), in the pursuit of internal environment quality, (Hagan, 2001).

2:3:4 Complex Fenestration Systems in Window Selection.

Laouadi, and Parekh (2007), contend that Complex Fenestration Systems, (CFS) which control light transmission, can affect the indoor environment quality, (IEQ) positively or negatively, on one hand by reducing glare, and on the other hand by causing an increase in the use of heating energy for the building. A balance must be achieved which allows comfort, and energy efficiency. Laouadi and Parekh further state that CFS which allow for this in the design, thereby improving IEQ, can expect improving accelerated market penetration. Any detrimental effect on the IEQ can have severe effects, not only on product commercialisation and market acceptance, but also on the energy performance of the installed product in buildings, (Laouadi, and Parekh, 2007).

Hagan (2001), points out that there are three main strategies being adopted in the pursuit of IEQ in buildings returning to a position where the building’s structure, configuration, and orientation do all the mediating through passive environmental design; developing an ‘ecological high tech’ approach; or, opting for a hybrid ‘both/and’ strategy which uses both passive and active systems to control the internal environment, (Hagan, 2001).
2:3.5 Maintenance and Window Selection — ‘Nano Cleaning’.

According to (Sanderson, 2004), the use of ‘Nano Cleaning’ (self-cleaning), glass is a criterion which must be considered in the window selection process, particularly in high-rise buildings, such as offices, or apartment blocks:

*Pilkington Activ (glass)* is based on titanium dioxide, which is used in foodstuffs, toothpastes, and sun cream, but usually it is a white powder which is not ideal for glass because you can’t see though it. So we used it in a thin film form - 15 nanometres thick - so that it appears as close to normal glass as it can. Although not strictly nanotechnology, (technology where dimensions, range from 0.1 nanometres — 100 nanometres), the special coating and the chemical reactions happen at the nano-scale (one thousand millionth of a metre). The titanium dioxide coating on the glass had two properties that made it special, it absorbs sunlight - ultraviolet radiation - which causes what is called a photocatalytic effect. Through this process, the coating reacts with light which then breaks down organic dirt. Secondly, the coating makes the surface of the glass hydrophilic. This means that when water hits the surface of the coated glass the water droplets attract each other forming a sheet, rather than individual droplets. It destroys the organic dirt, and destroys it naturally, as well as reducing the 'glue' that other dirt can stick to on the surface. With the photocatalytic effect of the coating constantly working in the background, the glass dries cleanly, (in, Twist, 2004).
Chynoweth & Baker (2006), concur and further state that a recent innovation by Pilkington was a self-cleaning glass. The product has a transparent, microscopically thin coating of titanium dioxide. The coating, which has several distinct chemical layers, is hydrophilic and photocatalytic. According to Chynoweth and Baker, this means that water is attracted to the surface of the glass as a sheet rather than droplets, allowing rain to wash loose particles of dust and dirt from the surface. Chynoweth and Baker further state that the process is helped along by ultra-violet radiation causing the coating to react chemically with deposits of organic dirt, oxidising them, and breaking their adherence to the surface of the glass. According to Chynoweth and Baker, the coating is permanently bonded to the surface of the glass and provides continuous chemical activity, so that even heavy soiling will eventually be broken down sufficiently enough to wash off the glass during rain showers. (Chynoweth & Baker, 2006).

2:3.6 Economic cost of Window Selection.

Binggeli (2003), suggests that the cost of window replacement weighed against the long-term savings in energy conservation, and the lifespan of the window are important criteria in the window selection process:

*The proper amount of fenestration is determined by architectural considerations, the ability to control thermal conditions, the first cost of construction versus the long-term energy and life-cycle costs, and the human psychological and physical needs for windows,* (Binggeli, 2003: 143).

Sullivan and Horwitz-Bennet (2008) support Binggeli (2003), and further state that durability, maintenance, and efficiency, are all factors to be considered in the window
selection process. According to Sullivan and Horwitz-Bennet (2008), selection of wooden windows requires a commitment to maintenance not required with other materials, making the accumulated cost, and inconvenience of the maintenance, over a period of years, not an economical option for some. Sullivan and Horwitz-Bennet (2008), further assert that powder-coated aluminium, with paint guarantees of twenty to twenty-five years, is, initially, more expensive, but, is maintenance free for much longer. According to Sullivan and Horwitz-Bennet (2008), galvanised, and powder-coated, steel windows, are similarly expensive, and enduring, while µP.V.C. windows, even though they are the least expensive at the point of purchase, are less durable, requiring earlier replacement. Aluminium/wood composite windows are expensive to buy, but require moderate maintenance, after between seven, and ten years. Sullivan and Horwitz-Bennet (2008), contend that each of the materials, combined with CFS will contribute to low energy usage in a building, and that all frame materials, using double or triple-glazed units, will save against single-glazed, non-thermally broken windows. In new-builds, however, each frame material will compete against each other. Sullivan and Horwitz-Bennet (2008) state that in terms of cost-effectiveness, aluminium is the most popular choice, followed by vinyl (µ.P.V.C.), wood, then fibre-glass. Sullivan and Horwitz-Bennet (2008) argue that the total life-span cost of a window can be a deciding factor, however, the initial outlay for the most cost-effective window may be a negative influence in the selection process. The design will also alter the cost-effectiveness of a window – a fixed pane aluminium window is more cost-effective than a fixed pane µ.P.V.C. window. This can change when opening sashes are added to the design, as it is more expensive to add opening sashes to aluminium windows than it is for µ.P.V.C. windows, and also due to the greater fluctuation in the energy rating of the aluminium window, over the µ.P.V.C. window, (Sullivan & Horwitz-Bennett, 2008).
Koones (2004) suggests that added to the savings accrued in enhanced heat insulation is the extension of the life-span of carpeting, furniture, and decoration due to reduced fading. Koones (2004) further states that ‘Switchable glazing’ is a new technology in which the glass will adapt to changes in lighting, and heating – either in a passive, or active way. Koones (2004) identifies the three passive technologies as thermotropic, thermoehromic, and thermoscattering glass treatments. These technologies use no electricity, and will automatically work when the sun shines, leaving the building occupant with no control over passive technology fenestration. Koones (2004) further identifies the three active technologies as; electrochromic, suspended particle device, (SPD), and liquid crystal glass treatments — which allow the consumers to either control the glare and heat entering the house, or, to obscure the view with a small amount of electric current. Koones (2004) purports that some of these technologies will help block UV (Ultra-violet) rays and will reduce the harmful effects of the sun’s energy in the fading of furniture, carpets, and artwork, leading to a longer life-span of soft furnishings for the home owner, (Koones, 2004).

2:3.7 The carbon footprint and Window Selection.

Wiedmann and Minx (2007) define the carbon footprint as:

A measure of the exclusive total amount of carbon dioxide emissions that is directly and indirectly caused by an activity or is accumulated over the life stages of a product/service, (Wiedmann and Minx, 2007: 4).

According to Wiedmann and Minx (2007), the carbon footprint must include the activities of individuals, companies, organisations, processes, and industry sectors. Wiedmann and Minx further assert that in any case, all direct, (on-site, internal), and
indirect emissions, (off-site, external, embodied, upstream, downstream) must be taken into account, when calculating the carbon footprint, (Wiedmann & Minx, 2007). Papaefthimiou et al., (2006), concur and suggest that the carbon footprint must be considered in the window selection process and must consider:

- The reduction in energy usage contributed to by the heat insulation qualities of the window.
- The materials used in the fabrication of the window.
- The overall usage of energy associated with the fabrication, transportation, and fitting of the window, (2006: 1455).

Papaefthimiou et al., (2006), further state that the selection of passive and active glazing technology, such as electrochromatic glass will contribute to a reduction in carbon dioxide emissions. According to Koones (2004), advances in technology have produced electrochromatic evacuated glazing. Electrochromatic technology consists of a glass substrate that has been coated with electro-optical thin films that can control visual light, and completely shut down the transmission of solar heat. Koones (2006), states that the glare of the sun is blocked with the flick of a switch, causing the glass in the window to change from transparent to shaded with an electrical signal, using DC, (direct current), power, and is transparent in its non-energised state (Koones, 2004).

Papaefthimiou et al., (2006), purport that electrochromatic glass can produce mid-pane U-values of 0.86W/m2K. By reducing heating requirements in the winter, cooling requirements in the summer, and, due to the allowance of greater areas of fenestration in a building reducing artificial light requirements, leads to a reduction in:
The energy demand for the building, and therefore, a contribution to the reduction of carbon dioxide emissions. (Papaefthimiou et al., 2006: 1467).

2:3.8 Climate and Building Orientation in Window Selection.

Rappaport, and Hammond Creighton, (2007), note that developments in fenestration have led to more complications in the selection process for windows and doors. Rappaport and Hammond Creighton further state that building design teams are discovering that there are more glass product options in today’s market, and that windows and doors now incorporate varying levels of the key measures, and properties to match application needs and desired performance:

We are disappointed when we see a building full of floor-to-ceiling windows that always have their shades pulled to avoid the glare, (Rappaport & Hammond Creighton, 2007, :148).

Sullivan and Horwitz-Bennett (2008) concur, and further state that glass manufacturers are producing glasses for different climates, and weather conditions. It is now common for different glasses to be used on different walls of a building, based on the measurement of solar heat gain, and light transmission on each side of the building. Sullivan and Horwitz-Bennett (2008) purport that building design teams have differing priorities. Green-minded teams, for example, will steer away from materials which they believe require significant energy usage in manufacture, and generate considerable amounts of toxic waste, while other teams will opt for the most cost effective materials, (Sullivan and Horwitz-Bennett, 2008). Smith (2001), agrees,
and further argues that the size of the windows, and the specification of glazing used, are dependent on the orientation of the walls into which they are being installed:

*Glazing on the outer side of the thermal wall is used to provide some insulation against heat loss, and help retain the solar gain by making use of the greenhouse effect,* (Smith, 2001, :50).

### 2.4 Summary

There has been much more written regarding windows than was anticipated at the commencement of this research. The literature on the selection process for glazing covers a wide range of selection criteria. The literature has found that in some cases, the data to be conflicting. To achieve the desirable amount of light transmission into a building, for example, will, in some cases, conflict with the necessity to insulate the building against cold, and noise. The literature reveals that there are many types of glass to choose from, which will provide the solutions to situations where the glass may, in solving one problem, create a new one. The regulations regarding window and glazing selection laid down by governments have also been discussed. These regulations set minimum standards of quality, efficiency, and safety, which must be achieved in the manufacture of windows and doors, and in the provision of glazing generally.

The internal environmental quality of a building has been identified as an important factor in the selection process, mainly focusing on the comfort of the occupant, but also, considering the protection of furniture, and decorations from solar damage. Complex fenestration systems, such as awnings, blinds, louvres, and brise soliel, (a
horizontal louvre system fixed to the outside of a building, above windows, providing shade), are widely used to maintain a balanced internal environmental quality.

Self-cleaning glass, passive technologies, and active technologies, which are commonly seen as gimmicks, are widely discussed in the existing literature. The high cost of these glasses prohibits distribution to the masses, however, they have been used, successfully, in high-end building projects.

The ‘carbon footprint’ is an issue which is currently receiving much publicity globally. This literature review has shown that saving energy in the selection of glazing is important in a number of ways which have not been previously considered. The saving of energy in the home for purely economic reasons is joined by the saving of energy for future generations, and most recently, the attempt to calculate the cost in terms of energy, of the production and delivery of the energy saving glazing.

An examination of the literature review has enabled the researcher to set a direction for the inquiry. A list of relevant questions was compiled for the interview guide which when answered, will a new perspective on the glazing industry in the Cork region, or establish fresh ideas in this area. Chapter three outlines the methodology used in the pursuit of this current research study into the selection process for windows and glazing in the Cork region.
Chapter 3

Research Methodology
Chapter 3

Research Methodology

3:0 Introduction

The purpose of this chapter is to describe, and assess the research methodology used in the compilation, and analysis, of this study. According to Kumar (2005), to undertake a research study to find answers to a question implies that the process is being undertaken within a framework of a set of philosophies, uses procedures, and techniques that have been tested for their reliability, and is designed to be unbiased, and objective. The researcher has endeavoured to emulate this definition during the course of the study. The researcher has identified the problem to be solved, or highlighted, raised the question which is to be answered, and set objectives which are to be achieved by this study.

3:1 The Research Problem

According to Maxwell (2005), research questions are not the same as research hypotheses. Maxwell (2005), further states that research hypotheses are a statement of your tentative answers to research questions, what you think is going on; these answers are normally implications of your theory, or experience.

Glazing, and windows are an important feature in any building, whether residential, or a commercial office building. There are many criteria which dictate the use, type, and amount of glazing in a building, ranging from light transmission, solar gain, heat insulation, and sound insulation, to maintenance, cost, aesthetics, and climate. Throughout the world, the criteria for window selection differ in importance,
depending on the climate, culture, or style predominant in a region, and, in many cases, are not followed by those who specify the glazing. The Cork region is similar in this respect. There are examples of under, and over glazing, aesthetics dominating over practicality, and a general lack of balance in the design of the glass element of buildings. The design team for most buildings is made up of the developer, (customer), the architect, the quantity surveyor, the engineer, and the builder. How the building will be designed will be decided by the more dominant in the team, or will be a compromise between the design team members. Either way, the building design will not be optimised.

3:2 The Research Question

Alford (1998), states that the major purpose of a research question is to “unfreeze” the traditional train of thought, and introduce new theories. Alford (1998), further states that the techniques for answering the research question should flow from the research question, and not vice versa. The research question and title for this study is:

*Investigation Into The Glazing Sector Of The Construction Industry In The Cork Region: To Identify The Main Criteria Used In The Window Selection Process*

The research question above is more suited to qualitative research methodology, than to quantitative research methodology. Qualitative research uses a direct approach in the collection of the information and allows the researcher to interview selected individuals who are interested in the subject of the study. Qualitative research calls for opinions to be analysed, rather than data to be counted, and is better suited to
focusing on a specific issue. The researcher is employed in the glazing sector, and will benefit from the knowledge learned in answering this question. The issue the study will focus on is that glazing specialists are rarely consulted at the design stage of buildings. Qualitative research can be used to explore this issue in more depth than quantitative research.

3:3 The Research Objectives

Kumar (2005), states that, irrespective of the type of research, the objectives should be expressed in such a way that the wording clearly, completely, and specifically communicates to the reader the intention. For this research study, the researcher has set main objectives, and sub-objectives. The main objectives of the study are to highlight a gap in the process for window, and glazing selection in the Cork region, to identify the people, or group of people in building design teams, who have most knowledge regarding the window selection process, and to justify the inclusion of glazing company representatives in building design teams. Sub-objectives of this research study include the assessment of the impact of sustainability, the carbon footprint, and energy saving legislation on the window selection process in the Cork region, and the identification of the deciders, and main influencers in building design teams.

3:4 The Research Design

According to Creswell (2003), three elements of inquiry — knowledge claims, strategies, and methods — combine to form different approaches to research. Creswell (2003), further states that using these three elements, the researcher can identify either quantitative, qualitative, or mixed methods approach to inquiry. The subject of this
study calls for opinions, and facts, based on the experience of interested individuals. For this reason, the researcher decided to opt for qualitative research methodology, rather than quantitative research methodology, or the mixed methods approach. Using this method, the longer answers provide information specific to the issue rather than the generalised information collected by quantitative methods. This research study follows a logical path to answer the question stated in 3.2, based on already held assumptions, (Knowledge claims). The researcher referenced literature on glazing and the construction industry in order to compare the hypothesis with the findings of the research. As part of the research process, the researcher compiled an interview guide consisting of a list of ten questions, in order to interview ten individuals with an interest in the window selection process. Interested parties in the window selection process are architects, quantity surveyors, property developers, (customers), engineers, and construction companies / builders. The researcher decided, for the purpose of the study to interview two representatives from each category.

3:5 The Research Strategy

According to Mason (2002) research strategy is the way in which to go about the research. Mason (2002) further states that proposed methods and techniques need to be justified by comparison with other possible methods of research. The research strategy adopted by the researcher was, firstly, to examine the existing literature on the topic in order to identify gaps in the existing literature. The literature review was compiled in order to have a starting point which would be either supported, or discounted by the primary research. Having opted for qualitative research, the researcher, then, devised an interview guide based on the contents of the literature review, organised, and carried out structured interviews with relevant parties. A test
interview was conducted and this revealed that it was necessary to add one extra question. In order to maintain consistency in the interviews, this question remained in the interview guide for subsequent interviews.

The researcher used colour coding to mark similar opinions, and comments to extract reasonable, and rational findings from the interview contents in order to analyse and compare the contents with the hypothesis, to frame the answer to the research question, and present a conclusion which either supports existing views, or introduces new knowledge.

3.6 Data Collection

The researcher used the CIT library, referring to books, journals, and academic periodicals. The researcher further used the on-line databases, provided by the CIT, and the internet, so as to gather information for the literature review. The researcher interviewed ten relevant individuals to the study. These interviews were organised by phone, and in most cases, were held during normal working hours. The researcher, in all cases, travelled to the most convenient venue for the interviewee. On arrival the researcher thanked the interviewee for participating in the study, and asked for permission to record the interview. Each interviewee was asked, in advance, to elaborate on their answers, if possible, and to present their own opinions, and views. The method of recording each interview was by placing a digital dictaphone on the table or desk, and reading the questions from the pre-prepared interview guide.
3:7 Interviews

In preparation for the interviews, and in order to maintain the integrity of the interviews, the researcher compiled a list of ten questions, directly related to the hypothesis, and which specifically arose from the literature review. In the first test interview, however, it was found that an extra question was required. This question was added, making the number of question for each interview eleven. The average length of the interviews was between fifteen, and twenty minutes, or approximately two thousand words of transcribed text. Each interview was then uploaded into a computer, transcribed to Microsoft Word, and printed. The advantages of holding interviews outweighed the disadvantages. By using the method of face to face interviews, the researcher was able to collect more opinions, and gather more data, due to the unlimited choice of interpretation the interviewee had when answering the questions. There was much less chance of getting simple ‘Yes’ or ‘No’ answers in an interview. Disadvantages of holding interviews included the amount of time required to organise, and hold the ten interviews, and subsequent transcribing of same — a long, and arduous task, not helped when, in some cases, the interviewee deviated from the subject area. The researcher quickly refocused the interview when this occurred.

3:8 Data Analysis

According to Hardy and Bryman (2004):

*It is the instrumentality of measurement — measure as an organising tool that relates observation to concept to theory — that is the common thread of all analysis*, (Hardy & Bryman, 2004: p2).
After printing the transcripts of the interviews, similar relevant points were colour coded for easy recognition, and patterns of thinking, and exceptions, were highlighted. Links were developed between the data which had been collected, the interviewees who provided it, and the hypothesis, and literature review. Conclusions on the findings were reached on both what was said, and also by what was omitted.

3:9 Limitations of the Study

The researcher found that trying to accommodate the study between work, and family was difficult, and that the most striking limitation was lack of time. The transcription of interviews, the re-reading, coding, and comparison of the points took a long time to do. The organisation, and holding of interviews was also time-consuming, as it was stretched out over weeks. Most of the interviews held by the researcher were arranged for times which fell within working hours, and some had to be postponed, and re-scheduled, due to last minute work commitments for either party. Property developers were hard to reach for appointments, and rigid with time allocated to the interview.

3:10 Conclusion

This chapter outlines the type of methodology used in this current research. A logical, and controlled methodology was used in the compilation of the data, the analysis of that data, and the presentation of the findings. Each of the interviews was carried out systematically, with each interview receiving the same treatment. It has shown that the hypothesis was researched, and presented in a way that the findings can be measured. Chapter four will present and outline the findings of this current research study, and an analysis of same will be presented.
Chapter 4
Research Findings and Analysis
Chapter 4

Research Findings and Analysis

4:0 Introduction

In this chapter the researcher analyses the answers received during the course of the interviews held as part of the research process. The answers have been colour coded so that similar and opposing opinions can be matched, and so that diverse opinions can be highlighted. Using this method, a structure can be formed enabling the researcher to compare the answers to the hypothesis. The conclusions and recommendations will be presented in chapter five.

4:1 The Carbon Footprint and the Window Selection Process

The findings from this study reveal that the carbon footprint is not given weight in the window selection process in the Cork region. The study further indicates that a narrow definition of the carbon footprint is widely held among those interviewed. Eighty percent of the interviewees do not consider the carbon footprint as being important in the selection of glazing. Twenty percent stated that, with the recent publicity on the subject, they had considered the carbon footprint, and the effects of building on the environment. One property developer, stated that he has considered the possible effects of the carbon footprint in construction, but pointed out that he was not fully aware of what the carbon footprint is about. The architects interviewed in this study showed some knowledge of the carbon footprint:
We are also doing work where we are pursuing LEED, (Leadership in Energy and Environmental Design) certification. I'm not sure if you are aware of the LEED process. It's an American certification process, and it's absolutely imperative in America to have considered the specification, and the impact on the carbon footprint in the building specification, so yes, we are conscious of it

(Nicolaas Bester, Architect).

The representatives of construction companies commented in this study that, as window selection is decided before they become involved, they can have little influence regarding the effect of window selection on the carbon footprint, however, they consider the effects on the environment of their own projects:

If we were developing a site ourselves, we would do, but normally when we get an inquiry from a client, or a quantity surveyor, the type of material will have already been selected, so we don't have an input into that

(Bob Deane, O'Shea Construction).

Quantity surveyors responding in this study stated that their brief is to get the best value possible for their clients. One quantity surveyor stated that he was not well-informed regarding the carbon footprint, and another surveyor pointed out that he was not interested in it at all:

From my point of view, I would not have any consideration whatsoever of the carbon footprint. From a quantity surveyor point of view, the key is to get the best value for our client, and the carbon footprint really wouldn't be a factor
in considering what the best value would be. It would be the product that would be available, regardless of where it would come from, and at the best value for my client

(Pat Murphy, Quantity Surveyor).

The engineers interviewed for this study also expressed no interest in the consideration of the environment. They regard energy efficiency and structural soundness as the most important factors to be considered from their point of view. One engineer stated that:

_We're keen on providing a good window selection for clients, or advise them on windows, and in that respect, we generally talk to them in terms of the energy rating of the building, and the effect the windows would have on it. We're looking at it in terms of sizing, and 'U' values. This tends to be the information we're giving to clients, as opposed to the carbon footprint_

(Brian O'Kennedy, Engineer).

This research found that current customers of C & W Windows who were interviewed also expressed no interest in the carbon footprint. These clients put aesthetics, comfort, energy conservation, and economy as their prime considerations. These clients of C & W Windows stated that they had little knowledge of what the carbon footprint is:

_To be totally honest, from a private residential point of view, in considering it, I had known about triple-glazing and double-glazing, but a lot of engineers who specialise in energy ratings say that double-glazing is sufficient and that_
you don’t need triple-glazing. To be totally honest with you, that’s as far as I’ve ever gone into it

(Philip Fahy, Property Developer).

This current research has found that the carbon footprint is not considered by the majority of the interviewees, and is not fully understood by some of those who do consider it. All of those who were interviewed in this study are linked in some way to the construction industry, and all are affected by the carbon footprint. Each choice made in the selection process for glazing makes a difference, in a positive or negative way to the environment. Some interviewees have stated that they intend to consider it in the future, and give more importance to it, and other respondents believe that saving energy in the building and the carbon footprint are one and the same thing.

4:2 Heat Insulation and the Window Selection Process

This current research has found that all the respondents believe that there is value in the use of energy rating, and in the reduction of u-values in windows in the construction of buildings in the Cork region, however, one interviewee stated that the value in relation to the climate is not cost effective:

From what I have been told by the energy rating people, I understand that the saving in the difference between triple-glazing and double-glazing is not worth the extra cost for the triple-glazing. That’s what I’ve been told by people who are in the energy rating business

(Philip Fahy, Property Developer).
Another interviewee concurs and further states:

*With the climate of Cork, we don’t have the major problem with solar gain that would be in other parts of the world.*

(Nicolaas Bester, Architect).

This study has found that the value of energy ratings to construction companies is not in the saving of energy for the occupant of a building. According to this study, construction companies highlight the energy rating of their buildings as a marketing tool to make them more attractive to buyers. This research shows construction companies view energy ratings as an imposition on them. They have now turned energy ratings to their advantage:

*Even in the falling market, the majority of clients would ask what the British Energy Rating is. They’d look at their living room, and say, “This is good. I’m happy with it”. When it boils down to it, however, a fill of oil is eight hundred and fifty euros, and they don’t want to have three fills of oil in the year when two can do. They will look at it and decide to spend the extra money now.*

(Colm Mc Carthy, Murphy Construction).

This study has found that the majority of the respondents are not aware of the difference between u-values and energy rating. Glazing can have a high u-value, (high rate of heat loss) and still have a high energy rating. This is due to the effects of solar gain, cancelling the effects of heat loss. In the Cork region, due to the mild climate, the importance of energy ratings is lower than in regions where the climate is
more varied — ranging from very hot in summer to very cold in winter. This current study shows that the majority of the respondents have not considered this factor.

4:3 Acoustic Insulation and the Window Selection Process

This study has found that acoustic insulation is considered by the respondents only when confronted with excessive noise levels. The majority of the respondents in this research stated that formulating the glazing specification on a project was not in their remit, but that they still needed to be cognitive of the impact of poor sound insulation on passing inspections by the Department of the Environment:

_When an architect presents the drawings of the windows, we would ask the question, “Will these windows pass whatever certificate is required by Department of the Environment guidelines?” It’s important, but, from our point of view, we’re passing the buck a little bit back to the specifier, who would then talk to the window supplier. We would look for a piece of paper — a letter of comfort to say that the architect is happy with the window supplier._

_Once it’s done on this basis, it’ll pass_

(Michael O’Driscoll, Engineer).

Another interviewee stated that the specification of acoustic insulation in windows was an economic decision for his company. If a house is close to a main road, in order for a property developer to sell that house the decibel level must be reduced to ensure the comfort of the occupants:
Obviously, if they're not selling their units, it's going to effect cash-flow coming to my construction company, and I'm going to sit down in meetings and say, "Lads are you addressing this noise factor? Are you addressing it with your windows?" I'll raise the point, because I know that if they've got a housing estate of twenty houses, and ten of them can't be sold because they are backing out onto a main trunk road, I'm going to pay the price at the end of the day. If they're not selling, I'm not getting my money

(Colm Mc Carthy, Murphy Construction).

This research found that acoustic insulation was not considered by architects unless directed to by An Bord Pleanála, or to meet regulation requirements:

*It has become a major concern when it has become a planning requirement in terms of residential amenity, adjacent to busy road networks. On a previous project that we were involved in — in the U.K., we were working very close to elevated railway lines, so the acoustic properties of the glass, in that instance, were, very much, a key factor, and consideration, in the drawing fore-thought*

(Paul Butler, Architect).

According to two interviewees in this research, the specification for acoustic insulation is normally for internal glazed screens. On external glazing it is not common to specify for acoustic insulation:

*If there is a specific requirement for acoustic insulation, it's internal. In certain instances, we have an atrium with internal glazing between the atrium*
and offices. In a hotel situation you would need acoustic properties to the glazing

(Nicolaas Bester, Architect).

This study has found that acoustic insulation is not considered in the window selection process by any of the respondents. During the interviews, some respondents cited common examples which they had not previously considered, other than sites adjacent to busy main roads, where they now believe acoustic insulation should be considered. They offered examples such as in the city, (Peter Gough, C & W Windows customer and Bob Deane, O'Shea Construction), in office blocks, (Philip Fahy, Property Developer), and between adjoining buildings to reduce the sound transmission from neighbours, (Michael O'Driscoll, Engineer).

4.4 Light Transmission and the Window Selection Process

The study has found that there is not enough consideration of light transmission in the design of buildings, and in the selection process for glazing. The majority of the respondents stated that buildings are designed more for aesthetics than for the comfort of the occupant:

I would see a lot of houses come through the office here, mostly for pricing for contractors, and I would see a lot of repetitive stuff with the same type of design churned out over and over. I'd say little or no thought goes into the whole design, or the light coming into the house

(Karl Slyne, Quantity Surveyor).
In relation to commercial construction, the majority of respondents believe that there is consideration given to the transmission of light through the windows. In relation to house building the majority of those interviewed believe that not enough consideration is given to the transmission of light through the windows. The majority of the respondents stated that the responsibility to consider light transmission in building design lies with the architects, and that most architects get this aspect of the design wrong:

*Architects will come along and they’ll have light for the show factor, but I’ve seen buildings designed like Cost Cutters across the road. This building was designed by an excellent architect, and is a lovely looking building, but when you walk into the middle of the apartment block there is no light. There is a glazed door at the front and a messy kind of velux (roof-light), that’s throwing down light through a large tunnel over four metres long to get some bit of light into the kitchen area. From my personal point of view, and from the construction company point of view, I cannot see how they took light into consideration*

(Colm Mc Carthy, Murphy Construction).

An interesting finding emerging from this study is that architects accept that they should consider light transmission in their building designs, and that, unfortunately, in the past standardised glazing has been used:

*Traditionally, you would have seen many buildings with similar façade treatments on north, south, east, and west facing elevations*

(Paul Butler, Architect).
One interviewee stated that government regulations, and conditions imposed by An Bord Pleanála influence the amount of light transmission which can be achieved in the design of windows in housing estates. For example:

*In houses in Ireland, up till now, the planning restrictions are so tight that it's very difficult to give, or achieve the amount of light that you want to get into a building, and also the tradition is for smaller windows. We do very few house designs in this office, but when we do, we most definitely, try to use larger openings, and specify glass with a high light transmission value, rather than with a high shading coefficient*

(Nicolaas Bester, Architect).

Another interviewee in this study concurs, and further states:

*I believe An Bord Pleanála have a hugely detrimental effect on the amount of light transmission specified in window designs. They have very constrained views on what they'll allow. I think there should be a lot more glazing used in both private dwellings and commercial buildings, and I believe that planners are a big part of the problem*

(Philip Fahy, Property Developer).

According to the findings of this current study, none of the respondents considered light transmission from the point of view that the glazing might allow too much light to enter a building, creating an uncomfortable environment for occupants.
4.5 Frame Material and the Window Selection Process

This research has found diversity in the preferences of the respondents regarding window frame materials. The most popular material choice of the respondents is aluminium, followed by timber. The study revealed that quantity surveyors, engineers, and representatives of construction companies have professional preferences which differ from their personal preferences. From a professional perspective, these respondents opt for the least expensive, and from a personal perspective they decide on the basis of aesthetics and sustainability:

> Obviously, the ultimate would be the best looking for the least cost. What I would normally be working with would be PVC as a frame, or aluminium as a frame. There are also various alternatives of wood, which can be very expensive, and obviously have an effect on the environment, and maintenance.

(Pat Murphy, Quantity Surveyor).

Another interviewee concurs and further states that the mind-set of the quantity surveyor will lead to the selection of the least expensive option for the client, however:

> In terms of a personal preference, if I was building a house tomorrow, I'd probably go with aluminium. I suppose it's because there are more design options there, and more flexibility. There's no doubt, overall, that PVC in terms of housing is, very much, the main force, with aluminium following behind.

(Karl Slyne, Quantity Surveyor).
This study has found that the majority of the respondents favoured u.P.V.C. for residential buildings, and aluminium for commercial and industrial buildings:

*Generally with u.P.V.C. in the residential, and curtain walling/aluminium window section in the industrial buildings — that would be our preference*

(Michael O'Driscoll, Engineer).

Another respondent stated that his preference is for aluminium followed by galvanised steel, however, he further states that he liked to use more than one frame material, or glazing system in the design of a building:

*Each application has its own merits, and they suit different project types, or application types, so, I wouldn’t necessarily say that I would take one frame type and use it throughout each project. I think that, maybe, that approach is not appropriate. It’s judging each project on its own merits, on a ‘Needs must’ basis*

(Paul Butler, Architect).

An interesting finding is that for the majority of the respondents, from a personal perspective, wood is the preferred frame material, based on aesthetics and sustainability:

*My preferences would be for timber whether it is cedar, teak, or pine. I suppose it’s a natural product. Timber is a low carbon product, and I
personally would prefer it as more aesthetically pleasing than PVC or aluminium

(Philip Fahy, Property Developer).

The study shows that, based on the separate professional preferences and personal preferences of the respondents, some consideration is given to the selection of window frame material in the Cork region. Another interviewee, in his selection of aluminium/wood clad composite window frames, supports this finding:

*My preference is timber, just for the natural look and texture of it, on the inside, and I think we’d probably have gone for timber on the outside except for the fact that the house is beside the sea, and it would be totally impractical*

(Peter Gough, Customer of C & W Windows).

4.6 Complex Fenestration Systems and the Window Selection Process

This current research has found that most respondents do not consider complex fenestration systems, (CFS) when selecting windows for buildings in the Cork region. The study further reveals that most of the interviewees have little knowledge of what constitutes a complex fenestration system. Most of the respondents focused their answers on the types of CFS which were mentioned during the interview, and five focused solely on the effects of CFS on window u-values. One respondent exhibited awareness of CFS use for the purpose of shading and the comfort of the building occupants:
You do need some reflective shield if the building is going to be south facing. If there’s an office in the building, from a heat point of view, it is important so that a person sitting inside can do their work. You could need a brise soleil. Sometimes, the brise soleils do not look very well on a building so, from my point of view, tinted glass is a better option

(Philip Fahy, Property Developer).

Another interviewee concurred and further stated:

I think, for commercial projects, the use of tints is now much more readily acceptable. It seems to be used, more as a means to reduce the overall budget. While the cost itself may be on the increase, it’s far cheaper than applying brise soleil to your external façade. It also has potentially less maintenance cost, than external, or motorised blinds, that might deal with the light transmittance through shading so, I think it’s more suited to commercial glazing at present

(Paul Butler, Architect).

One respondent stated that the end use of the building is important when it comes to the inclusion of CFS in the glazing specification for that building:

In commercial construction, I would take the tinted glasses and all of that as ferociously important. In a retail store which sells clothes, you will find that if you put a folded jumper in the window, in a matter of two hours it will be faded and need to be discounted. If the light is coming in from the west at four
o’clock in the evening you will have a major problem so, in my opinion, glass is the number one priority for a commercial premises. You have to have the tinted glass in these circumstances

(Colm Mc Carthy, Murphy Construction).

One respondent further stated that CFS is not considered enough in the window selection process by those involved at the design stage of a construction project:

*I think you have to be aware of CFS, and I’d have to say that a lot of the architects we would be dealing with wouldn’t be familiar enough with what’s available in the market these days to be able to incorporate them in their designs, so they tend to go with the basic standard rather than finding out what’s available in the market today*

(Bob Deane, O’Shea Construction).

The current study has shown that complex fenestration systems are not considered by the majority of the respondents, and that there is a lack of awareness as to the full scope of what CFS cover. The majority of the respondents stated that CFS are important to consider in commercial construction, however, less important in the glazing specification for houses. Curtains, blinds, awnings, and glass specifications which regulate light and thermal transmission, are CFS which must be considered in the selection of windows for houses.
4.7 Building Orientation and the Window Selection Process

This current research has found that all the respondents have considered, or, would consider the orientation of a building in the window selection process in the Cork region. The majority of the interviewees cited energy savings through making full use of natural heat gain on the southern aspect of the building:

*From my own personal point of view, my house is faced to the south, and I find that even in the winter, from the winter sun, that there is a heated area almost permanently at the back of the house because it's just naturally kept warm. I have no doubt that it would reduce energy bills, so I do see value in the specific orientation of a house*

(Pat Murphy, Quantity Surveyor).

This study has found that the consideration of building orientation in the window selection process is not an issue for engineers, quantity surveyors, and construction companies. One respondent stated that building orientation is usually decided on before a design comes to them:

*From a professional point of view, we have little or no impact on deciding building orientation. We generally inherit designs for the building, so, it's probably not that relevant to us, other than a few "Design and build" projects that we've been involved in*

(Michael O'Driscoll, Engineer).
The current research found that, in some cases, planning restrictions dictate the orientation of a building. One interviewee states:

*If you have the possibility of orientation — and most of the time you don’t due to planning restrictions — but if you have the possibility of orientation, it is important to maximise the southerly aspect*  
(Brian O’Kennedy, Engineer).

This study has found that architects are becoming more aware of the benefits of building orientation and the consideration of it in the window selection process:

*It’s about the realisation now, just how much impact the built environment is having on our environment. That dictates more in how we are designing buildings, orientation, location, percentages of glazing. It’s coupled to it, but it’s the whole issue of certification again, and that’s causing architects to have to re-evaluate, or certainly, propose designs that are more sensitive to these issues, from the very first sketch. Where, previously, we might have come around to it after negotiation, or discussion with the client, we’re tending to start on the right track now*  
(Paul Butler, Architect).

An interesting finding in this research is that in considering orientation in the glazing selection process the majority of respondents concentrated on the size and amount of glazing allocated to each façade of a building, however, one interviewee further stated:
If I have a house which has a lot of glazing, I would tend to put it, from an energy point of view, on the southern aspect, I’ll put as much as I can on this façade. If I have specified triple-glazing for the building, I would probably revert back to double-glazing on that section, so that I would be getting more of the heat in. I don’t want to be letting heat out. I want to be bringing it in

(Colm Mc Carthy, Murphy Construction).

The research has found that building orientation is important when it comes to the window selection process. It has shown that most people do consider building orientation, but that the decision on orientation may not be in their hands.

4.8 Passive and Active Technologies and the Window Selection Process

According to the findings of this research the majority of respondents envisage a future for passive and active glazing technologies. When used in practical applications, however, a substantial minority view these technologies as gimmicks. All of the interviewees stated that they have not seen examples of these glazing technologies first hand:

I would say that there is a place for them. I haven’t come across them being widely used, in my experience. I would imagine it’s something that’s going to come into play in a big way in the future

(Philip Fahy, Property Developer).

One respondent disagrees and, cites another example of passive glazing technology:
I remember the self-cleaning glass a few years ago. That never really took off, in my mind, and certainly I haven't come across it the whole time. I remember there was so much talk about it two or three years ago, but, it never really took off in my circles. Maybe that is a good example

(Karl Slyne, Quantity Surveyor).

Another respondent offers a mixed view, and cites an example of brise soleil, which is a shading device fixed to the walls of a building above windows:

In this building it would have been of great benefit to have had a mechanism that could control the solar gain through the windows without losing your views, so yes . . . . brise soleil has become a gimmick on buildings, and similarly, this type of high technology glazing could also become a gimmick

(Nicolaas Bester, Architect).

A major finding from this study is that the majority of respondents, while seeing a future for both technologies, saw passive glazing technology as less gimmicky and closer in terms of time:

If they react naturally to light, yes — the electrically stimulated glass sounds like they're coming into complicated systems. I've seen them on "Our House", or "Grand Designs", and programs like that. I think it is early days, and probably a bit away.

(Michael O'Driscoll, Engineer).

Another interviewee agreed and further stated:
I think that the active glazing technology is a bit gimmicky, but then again maybe not. I guess it’s the sort of thing that if it was more widely used, people wouldn’t see it as gimmicky. If people saw practical applications of it, they wouldn’t see it as a gimmick. As for passive glazing technology, I think as energy efficiency, solar gain, and things like that become more mainstream that people will start looking at that

(Peter Gough, Customer of C & W Windows).

This current study found that the majority of the respondents believe that passive and active glazing technologies are gimmicky and costly in today’s environment, but, if developed into practical applications, have a future in the construction market.

4:9 Internal Environment Quality (IEQ), and the Window Selection Process

This study has found that the majority of respondents do not fully consider the internal environment quality of a building in the window selection process for the Cork region. Most of the respondents stated that it is the responsibility of the design team to consider the IEQ of a building:

To be perfectly honest, I don’t know how you would decide on the best possible glazing specification for IEQ optimisation without speaking to people within the business

(Philip Fahy, Property Developer).
One respondent agreed that consideration of the IEQ of a building is the responsibility of the design team, and further stated:

> Generally speaking, designers out there probably wouldn’t get into that level of detail in the busy environment that we’re in these days. I could be being a bit harsh on them now, but I would have thought that they don’t go to that level of thought in their process

(Karl Slyne, Quantity Surveyor).

This study has shown that some building designers do consider the IEQ of a building. One architect who was interviewed confirmed that he considered IEQ when designing windows, from the perspective of occupier comfort, but that regulation and certification conditions are barriers to this:

> For me the light quality is most important, but that is often over-ridden when we have to go for LEED certification, where it’s enforced to have a very high shading coefficient on glazing. We end up with tinted glazing, and a light quality that we wouldn’t have anticipated in the building. I think the effect of fading of the furniture is less important than the mental effect on occupiers of the building from sitting in a dark grey box, and not getting natural clear daylight in. I think, personally, the effects of the ultra-violet damage to furniture carpets, and things, in my mind would be negligible to the benefits of getting sufficient clear, natural daylight in, rather than filtered or tinted daylight

(Nicolaas Bester, Architect).
Another architect interviewed in this study, concurs and further states:

\[ \text{While the connection from internal to external is critically important for the owner of a house, they're not going to want rooms that they can't inhabit, because in the summer they get too hot, or they've got to open windows when it may not be safe to do so, or appropriate to do so. You need to be conscious of the overall effect that the glazing will have on the internal environment. I would be more concerned about the comfort factor, rather than its effect on furnishings, or carpet} \]

(Paul Butler, Architect).

The study found that IEQ is considered on a limited basis when building management systems are installed in buildings, however not from the perspective of the glazing:

\[ \text{I've seen buildings where they put in a building management system (BMS), and didn't take into account the light or the solar gain coming in with the sun in the morning. I know one building in particular where the occupants are still tinkering around trying to get the BMS working because it has been affected} \]

(Michael O'Driscoll, Engineer).

This current research has found that the majority of respondents do not consider the IEQ of a building in the glazing selection process. The majority of those interviewed further stated that it is not their responsibility to consider the internal environment quality of a building in the window selection process. Three of those interviewed
stated that they would seek professional advice from glazing experts, while another two believe that architects should lead the way in this area.

4:10 The Over-Supply of Glazing and the Window Selection Process

This current study found that a large majority believe that there is a tendency to over-specify the glazing in commercial buildings and architecturally designed houses, however, in housing estates with many houses of standard design, a majority believe that there is a tendency to under-specify the glazing. One respondent stated:

In the office where we have desks up against the window, there’s no need for the glass to go down to the floor, as the light that is brought in below the tables is lost to anyone in any case. In that sense, yes, there is over-specification in terms of amount of glazing sometimes

(Nicolaas Bester, Architect).

Another interviewee stated that, when dealing with clients who want their house to include large areas of glass, he would advise:

Clients that there would be potentially a great deal of heat loss in such an area, unless they were careful about what glazing they would use, and that they should choose the most efficient glazing design. We would see plenty of houses where people have gone for very large glazing areas, where for various reasons they might not go for the best available ‘U’ value window.
We would advise them that there might be some very cold areas of the building because of it

(Brian O'Kennedy, Engineer)

One respondent concurs with this appraisal, and further states:

_I don't think architects take the amount of glazing into consideration. The aesthetics of the building look lovely, but from the point of view of the worker inside, they don't take that into consideration. The Construction Industry Federation building in Little Island is all glass, and white paint on the walls. A person would be blinded going in there with all the light coming in through the windows, and reflecting off the white walls_

(Colm Mc Carthy, Murphy Construction).

An interesting finding in this study is that the minority of those interviewed believe that there are circumstances where the use of large areas of glazing in a building is acceptable:

_from a commercial point of view, and a developer's point of view, the more glass in a building the more people that can see into that building, and the more people will be drawn to that building. From this point of view, it has a benefit in the commercial world. I'm not sure it has a benefit in a domestic setting, because people want some privacy, but then again, some people are taken with it_

(Pat Murphy, Quantity Surveyor).

One respondent completely disagreed with the majority and further stated:
I'm one of those people who prefers to have too much glazing rather than too little glazing. If you have too much, you can do something to omit it, whereas if you haven't enough it's very hard to overcome that problem after a project is finished. I feel that you can never have enough light. If you do have too much light it's very easy to put up a blind, or to do something with the window

(Philip Fahy, Property Developer).

This current research has found, and can report that over-specification of glazing is common practise in both the commercial, and domestic markets. The majority of respondents stated that aesthetics takes precedence over the efficiency of the glazed area of a building which has been designed by an architect.

4:11 Initial Outlay versus Life-Cycle Cost and the Window Selection Process

An interesting finding emerging from this study is that the majority of the respondents are in favour of the construction of low maintenance buildings with low maintenance glazing, but they believe that the decision on whether to pay more now, and save on maintenance rests with the property developer or client. One respondent stated that low maintenance takes priority over sustainability:

Maintenance is, most definitely, a high consideration in frame specification, and that's why we often have to specify, or most often specify aluminium. It takes priority over sustainable issues where we would have preferred to have
specified timber or something else perhaps. It's definitely a requirement from clients, and developers to have low maintenance as a priority

(Nicolaas Bester, Architect).

Another interviewee concurred:

Some hard-nosed developers are looking to sell a building, in particular a commercial building, and they don't really get into that level of detail. They keep it cheap and cheerful, so they can sell it on, you know, without putting too much capital cost into it

(Karl Slyne, Quantity Surveyor).

This study has found that the majority of respondents consider maintenance as an issue in the window selection process, however, they will not advise a client on the possible options:

When you say low maintenance you mean non-timber window frames. Any other type would be low maintenance, whether metal or PVC. Regarding timber, it's a trade-off. We would be very quick to point out to clients that there's an on-going maintenance requirement with timber, but I find that most clients are well aware of that, and it's usually the aesthetics which win out when they decide to go for timber. They are usually well aware of the trade-off, so when the clients go for timber it's because they want to go for timber. I find that clients don't need education on that

(Brian O'Kennedy, Engineer)
One respondent in this study stated that low-maintenance glazing can be more than just economical, indirectly impacting in a positive way on health and safety issues which may arise out of building maintenance:

Yes, I think we would consider low maintenance frames and glass when selecting windows. I think that self-cleaning glass is quite appealing in the sense that it has other possible benefits. It may tend to have a positive impact on health and safety, for example. You have less of a need to be accessing mobile platforms as a result, and maybe you’re cleaning your building less

(Paul Butler, Architect).

An interesting finding in this study is that, regardless of the possible advice which could be offered by the recognised professionals in the field, the window choice and selection decision does ultimately rest with the developer or customer:

Yes, definitely. I guess, using our exact example, what we’re saying is that we want to do this right the first time, and not have to think about it for a long time. We don’t want to have the annual maintenance, or the hassle of it. In terms of cost and opportunity cost, that’s all a consideration. We just want to do the right thing now, and not have hassle down the road

(Peter Gough, Customer of C & W Windows).

The study found that there is not enough input from window and glazing specialists at the early stages in the design process:
One of the issues — and I would see this covering all the questions for the glazing industry — is that glazing companies are not involved early enough in a project. The window company normally don’t come in until the builder is appointed, and the architect has already done the drawings. Then there’s a builder phoning window companies looking for prices for the glazing, and at the end of the day it’s the cheapest quote that will satisfy the architect and the client. To get the life-span costs across to the decision makers you need to be in at the earliest possible stage

(Michael O’Driscoll, Engineer).

This current research found that a majority of the respondents do consider the initial expenditure and the potential savings over the life-span of a building in the window selection process, but that there is little advisory input from glazing specialists, and the decision is left to the developers and customers. Glazing specialists are usually consulted after the decision has already been made, and, in many cases, merely comply with the requested specification instead of offering a specification solution which suits the building.

This chapter has presented the findings of the research study which examines the selection process for windows and glazing in the Cork region. Chapter five will summarise it and make future recommendations.
Chapter 5

Conclusions and

Recommendations
Chapter 5

Conclusions and Recommendations

5:0 Introduction

Chapter four outlines the findings of the research regarding the selection process for glazing in the Cork region. The main objective of this study is to use the information gathered from empirical research to improve existing window and glazing selection systems and to develop new systems which will ensure that the correct glazing specification is selected for buildings in the region. The findings of this study come from the contributions of ten stakeholders in the glazing industry, two engineers, two architects, two builders, two quantity surveyors, and two customers, one of which is a property developer, the other is a domestic customer of C & W Windows.

As outlined in chapter three, the main objectives of this research study are threefold; to identify those people, or groups of people who have most knowledge in the window selection process in the Cork region, to identify where improvements are required in the selection process for windows and glazing, and to justify the inclusion of glazing company representatives on design teams early on in the design process.

This study has found that there is a significant difference in the level of knowledge of windows and glazing between the categories interviewed, and that there is a flaw in the selection process for glazing in the Cork region; i.e. window company representatives are not included in design teams at the early stages in the building design process.
5:1 Review of the Main Findings

5:1.1 The Carbon Footprint and the Window Selection Process

This current study has found that, in the selection of glazing and windows in the Cork region, the carbon footprint is not an important deciding factor. The study has identified the important deciding factors as cost, aesthetics, conforming to regulation standards, and energy efficiency. One respondent in this study stated that he is interested only in getting value for money for his client, and has no interest in the carbon footprint (Chapter 4: 40). Another significant finding emerging from this research is that the majority of those interviewed do not distinguish between the carbon footprint and sustainability, and believe that reducing carbon emissions and energy conservation are one and the same. “I had known about triple-glazing and double-glazing, but a lot of engineers who specialise in energy ratings say that double-glazing is sufficient and that you don’t need triple-glazing” (Chapter 4: 41). A very important finding from this current research is that building designers consider the carbon footprint only to conform with regulations and building standards. “We are also doing work where we are pursuing LEED, (Leadership in Energy and Environmental Design) certification” (Chapter 4: 40).

5:1.2 Heat Insulation and the Window Selection Process

An interesting finding emerging from this current study is that the Building Energy Ratings, (BER) are taken into consideration by all of those who were interviewed. The research found that the main reason for this is the potential for financial savings. One interviewee stated that house buyers are prepared to spend the extra money on
more expensive windows if they save on energy bills as a result, (Chapter 4: 43). Another important finding is that, according to two of those interviewed, the mild climate in the Cork region has a significant impact on the window selection process, in that the savings achieved by installing the more expensive triple-glazing are too little to be worthwhile, (Chapter 4: 42). This current study has found that those interviewed do not distinguish between ‘u’ values and energy ratings. ‘U’ values are one element of three which make up energy ratings. The other two are ‘G’ values, (solar gain) and ‘L’ values, (air leakage), (Spectus Window Systems Specifiers Guide, 2007).

5:1.3 Light Transmission, Internal Environmental Quality, and Complex Fenestration Systems

This current research has found that glazing in buildings has been over-supplied and under-specified for light transmission during the window selection process. In commercial buildings and architecturally designed houses, glazing has been over-supplied causing cold areas in the building together with occupant discomfort, (Hagan, 2001) poor internal environmental quality, and energy wastage, (Chapter 4: 60). In housing developments the trend is to minimise the glazing area in an attempt to conserve energy through improved insulation against heat loss and a reduction in air leakage, however, this trade-off leads to reduced solar gain, and an increase in the use of artificial light, (Chapter 4: 48). One interesting finding emerging from this current research is that architects, planning restrictions, and government regulations have been attributed with the responsibility for the under-supply of glazing:
In houses in Ireland, up till now, the planning restrictions are so tight that it's very difficult to give, or achieve the amount of light that you want to get into a building (Chapter 4: 48).

This study has found that the selection of windows directly affects the internal environmental quality of a building, and that complex fenestration systems are required to bring balance between light and sound transmission, heat and air leakage, and solar gain, (Teicholtz, 2001). An important finding emerging from this research is that the majority of the respondents do not consider the internal environment quality in the selection process for glazing in the Cork region:

I think you have to be aware of CFS, and I'd have to say that a lot of the architects we would be dealing with wouldn't be familiar enough with what's available in the market these days to be able to incorporate them in their designs, so they tend to go with the basic standard rather than finding out what's available in the market today (Chapter 4: 53).

5:1.4 Building Orientation and the Window Selection Process

A very important finding emerging from this research is that all of those interviewed do consider the orientation of the building in the glazing selection process, however, only one respondent stated that the glazing specification should be tailored to each façade:
If I have a house which has a lot of glazing, I would tend to put it, from an energy point of view, on the southern aspect, I’ll put as much as I can on this façade. (Chapter 4: 56).

Significantly, the study has found that government regulations and certification have forced designers to consider building orientation in the window selection process in the Cork region:

It’s coupled to it, but it’s the whole issue of certification again, and that’s causing architects to have to re-evaluate, or certainly, propose designs that are more sensitive to these issues, ( of orientation) from the very first sketch. (Chapter 4: 55).

The study has found that the majority of the respondents believe that they have no influence on the orientation of a building, and do not pursue this issue, resulting in reduced savings and less efficiency in the window selection process:

From a professional point of view, we have little or no impact on deciding building orientation, (Chapter 4: 54).

5:1.5 Frame Material Preferences — Initial Outlay versus Life-Cycle Cost

This study has found that the majority of respondents will opt for less expensive frame materials in their professional capacity but privately consider aesthetics and sustainability more when building their own houses:
Obviously, the ultimate would be the best looking for the least cost. (Chapter 4: 49).

In terms of a personal preference, if I was building a house tomorrow, I’d probably go with aluminium. I suppose it’s because there are more design options there, and more flexibility. (Chapter 4: 49).

This study has found that frame material costs are related to the initial outlay comparison with the life-cycle cost of the glazing. In most cases the respondents made a distinction between the construction of a building for ‘selling on’, and the construction of a building for personal use or as part of a property portfolio. (Chapter 4: 64 – 65).

An interesting finding emerging from this research is that low maintenance and saving on costs are considered above sustainability, but only when the building is not for ‘selling on’. (Chapter 4: 64 – 66).

5:2 Summary of Main Findings

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<td>Building Energy Ratings</td>
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<td>Knowledge of Glazing Issues</td>
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5:3 Recommendations

The author of this current study has a number of recommendations to offer. When a developer embarks on a building project, in order to save time and money at a later stage in the process, window companies should be included early on in a design team as consultants.

It is necessary that window companies employ glazing experts to participate in project design teams in order to assist in specifying the best products, not specific brands, and to stay current with new technological advances in the glazing industry.

It is essential that communication between the relevant people is improved, and that a system is developed around the glazing selection process which will compile and distribute all the important information necessary to make good decisions.

More information must be made available to distinguish between the carbon footprint and sustainability. Both are important, but the full impact on society will not be realised until people are fully aware of what each is. Leaflets or brochures which explain in detail about the carbon footprint, and sustainability should be made available to the public.

5:4 Recommendations for Future Research

This research should be repeated after a period of three to five years, in order to assess any progress made in the selection process for windows in the Cork region, and to stay current with technological advances and changes in the industry, such as the entry into the current recession, or the return to economic growth in the future.
This research should be repeated for other regions of Ireland, and further developed into national research.

An important area of future research is to examine window and glazing companies in the Cork region in order to assess the level of knowledge and experience they have to offer to building design teams.

5:5 Conclusions

This study has found that the group of people who exhibited most knowledge of glazing in this study were the architects, however the study also showed that they are not strong influencers in the window selection process. Both architects who were interviewed in this current research stated that tradition was a strong influence in the glazing selection process in the Cork region, and one further stated that severe planning restrictions limit the influence of designers in relation to glazing specification.

The engineers interviewed in this research were much less knowledgeable when it came to window selection and were interested only in the structural strength, and air-tightness of the glazing. This study showed that the engineers did not want to influence the glazing selection process outside these criteria, and were mainly concerned with meeting regulation standards. One engineer stated that, when an architect presents drawings of the windows for a building, his main concern is that the windows pass whatever certificate is required by Department of the Environment guidelines; that, for example, it meets the minimum safety standards set out in the Department of the Environment Technical Guidance Documents.
This research has found that builders were also unwilling to consider criteria outside their direct scope of works, and were not prepared to influence the glazing selection process, preferring to leave it to the architects. The builders who were interviewed stated that the decision on the selection of glazing is made before they become involved in projects. If builders will not question the designs and specifications they are given those designs and specifications must be finalised with window companies before the main contractor is appointed.

The property developer and the window company customer who, as the decision makers, are the most important stakeholders in the glazing selection process showed little knowledge of glazing and the multitude of specification choices available to them.

Surprisingly, the quantity surveyors who were interviewed showed the least knowledge of glazing and windows in relation to selection criteria. The two quantity surveyors who contributed to this study stated that they were interested only in the financial 'bottom-line' and that they had no interest in influencing the decision makers in any way other than in relation to the costs of the project. Both respondents further stated that their role is to get the best possible value for their client. It is a significant finding that the quantity surveyors hold strong influencing power in relation to the financial cost of a building, while having the least knowledge of the glazing specification which may be required or the cost of that specification.

The study has shown that when it comes to the selection of glazing for buildings in the Cork region, there is no applied system and there is little communication between
the relevant interested people. This study has also found that if communication is improved and extended, and a design system developed, the positive repercussions will be substantial not only for cost and energy savings, or improved efficiency, but also for the environment in the long term.
Appendix
Appendix

Interview Guide-lines.

1. Do you consider the carbon footprint, when choosing windows? Elaborate please.

2. Do you believe that there is value in the installation of high energy rated windows, with low u-values in Cork?

3. How would you rate acoustic insulation as factor when deciding the specification of windows?

4. Do you believe that enough thought is given to the importance of light transmission in the design of houses using windows, and large buildings using glass walls?

5. What are your preferences regarding materials used in frame fabrication, and why you would opt for these materials?

6. What is your opinion of the use of Complex Fenestration Systems, eg. double/triple-glazing, tints, solar reflective glass etc. in commercial and domestic construction?

7. Do you consider building orientation, when deciding on the specification of glazing products? Do you see any value in this?
8. In your opinion, is there a future for passive and active technologies in glazing, eg. glass which reacts to sunlight, and glass which reacts to electric stimulation? Or do you see them as gimmicks?

9. The influence of glazing options on internal environment quality is wide ranging. Eg. fading carpets/curtains, light imbalance, fluctuation in room temperature. On what criteria would you base your glazing specification?

10. And the over supply of glazing, where there is too much light. Would you see examples of that in the course of your work?

11. Self-cleaning glass and low maintenance window frames come at a high point of sale premium, but are more cost effective over their life-span. Would you consider this as a deciding factor in window selection?
References
References


www.norsonic.com, 10.00 pm. August 8, 2008.
