NewTREND

NEW Integrated Methodology and Tools for Retrofit Design Towards a Next Generation of ENergy Efficier and Sustainable Buildings and Districts

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NEW INTEGRATED METHODOLOGY AND TOOLS FOR RETROFIT DESIGN TOWARDS A NEXT GENERATION OF ENERGY EFFICIENT AND SUSTAINABLE BUILDINGS AND DISTRICTS

GA no. 680474

Deliverable D1.1

Analysis of Building Energy Renovation Value Chain(s)

Deliverable	D1.1 v.2.0
Document Identifier:	NewTREND Task 1.1 Rev 0
Preparation Date:	February 27, 2017
Nature of Document:	Report
Document Status:	Delivered
Author(s):	Paul O'Connor, Rose MacSweeney, Niall Dunphy (UCC)
Dissemination Level:	PU - Public

Deliverable Summary Sheet

Deliverable Details	
Type of Document:	Deliverable
Document Reference #:	D1.1
Title:	Analysis of Building Energy Renovation Value Chain(s)
Version Number:	2.0
Preparation Date:	February 27, 2017
Delivery Date:	February 27, 2017
Author(s):	Paul O'Connor, Rose MacSweeney, Niall Dunphy (UCC)
Contributors:	iiSBE, ABUD, STAM
Document Identifier:	NewTREND_WP1_D1.1_v1
Document Status:	Delivered
Dissemination Level:	PU - Public
Nature of Document:	Report

Project Details	
Project Acronym:	NewTREND
Project Title:	NEW integrated methodology and Tools for Retrofit design towards a next generation of ENergy efficient and sustainable buildings and Districts
Project Number:	680474
Call Theme:	EeB-05-2015: Innovative design tools for refurbishing of buildings at district level
Project Coordinator:	01. IES – Integrated Environmental Solutions Limited – United Kingdom
Participating Partners:	01. IES – Integrated Environmental Solutions Limited – United Kingdom 02. ABUD – ABUD Mernokiroda KFT – Hungary 03. JER – Uli Jakob – Germany 04. iiSBE IT R&D – International Initiative for a Sustainable Built Environment Italia Research and Development srl - Italy 05. REGENERA – Regenera Levante SL – Spain 06. GO – Granlund Oy – Finland 07. UCC – University College Cork, National University of Ireland, Cork – Ireland 08. NUID UCD – University College Dublin, National University of Ireland, Dublin – Ireland 09. MUAS – Hochschule fur angewandte Wissenschaften Munchen – Germany 10. LBS – London Business School – United Kingdom 11. STAM – Stam srl – Italy 12. Sant Cugat – Ajuntamento de Sant Cugat del Valles – Spain 13. UNIVPM – Università Politecnica delle Marche – Italy
Funding Scheme:	Innovation Action
Contract Start Date:	September 1, 2015
Duration:	36 Months

Project website address:	www.NewTREND-project.eu

Deliverable D1.1: Short Description

An analysis of the value chains(s) (including stakeholder interaction, power flows, drivers, conflicts, potential synergies *etc.*)

Keywords: building renovation delivery, value chain, stakeholders, value configurations

Deliverable D1.1: Revision History

Version:	Date:	Status:	Author:	Comments:
0.5	31/08/2016	Interim	UCC	
1.0	15/02/2017	Draft	UCC	
2.0	27/02/2017	Delivered	UCC	

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EXECUTIVE SUMMARY

The aim of this report is to provide an in-depth analysis of the value chain(s) associated with building refurbishment, both at the individual building level, and in the context of the district scale.

Section 1 introduces the report, following which, Section 2 comprises an overview of the theoretical background to the document, focused on the twin concepts of value and stakeholders. Value theory has evolved from being focussed on anthropocentric ideals and financial value to encompass more intangible values, and conferring value irrespective of something's specific utility or usefulness to humans. Value is subjective, and the surrounding social environment, levels of power and status can determine what is valued. The value of a building refurbishment project can be described in financial terms, in its architectural legacy, in its environmental impact, its levels of comfort, its aesthetic appeal, its purpose or function, or its historical value for example. Stakeholder theory involves the identification, characterisation, fair treatment and efficient management of stakeholders. Like value theory, much of the literature focuses on "The Firm" (company or organisation), although it is also applicable to projects, which consist of multiple organisations working in tandem for a particular outcome *i.e.* the building of, or refurbishment of a building, or buildings. Section 2 also introduces the Hubs of Activity model, developed within the UMBRELLA FP7 project, which provides a theoretical framework within which relevant stakeholders in building retrofit projects are identified and characterised. The combination of communication and stakeholder theory is elaborated in the notion of Participatory design, which is discussed towards the end of Section 2.

Section 3 outlines the methodology used in the research for the report, including the process of selecting and interviewing stakeholders, and the approach taken to the detailed analysis of the transcripts of those interviews. Information on interactions within the value chain(s) was collected from stakeholders connected with building refurbishment in the form of semi-structured interviews and thematic analysis of the resultant transcripts. The information obtained by this qualitative analysis was used to describe and map the interactions of stakeholders within the value chain and to ascertain the interests, drivers and motivations that influence their activities. In this value chain analysis, specific attention is dedicated to the role of occupants and users in order to understand their specific needs and priorities, and to ascertain how to involve them in the design of the refurbishment.

The findings of the research are discussed in detail in Section 4 of this document, beginning with the identification and characterisation of stakeholders, stakeholder roles, stakeholder salience, and stakeholder categories. Section 4.2 proceeds to map the stakeholder communication flows throughout the stages of a project, and outlines the findings specific to communication and stakeholder engagement elicited from the interviews. Section 4.3 summarises the findings on the interests, drivers and motivations of stakeholders in general, with Section 4.4 focused on the occupants and users in particular. Finally, Section 5 summarises the conclusions of the document.

1. INTRODUCTION

This report addresses Task 1.1 of the NewTREND H2020 project, which comprises an in-depth analysis of the value chain(s) associated with building refurbishment at both the individual building and district scales. The report is based on a review of the relevant literature, as well as detailed field research including in-depth interviews with 54 stakeholders in the energy retrofit industry across a range of European countries.

There are four inter-related aspects of the task which are covered by the report, based on the Description of Work:

a) Identification and characterisation of stakeholders.

'Utilising the Hubs of Activity model developed within the UMBRELLA FP7 project and building on previous work characterising construction value chains, relevant actors will be identified and characterised'

The Hubs of Activity model, which provides the theoretical background to this work of stakeholder identification, is outlined in Section 2.3. Early in the task UCC carried out a scoping exercise on a district-scale building refurbishment project in Cork, Ireland, and generated an exhaustive list to stakeholders involved throughout the building's lifecycle utilising the Hubs of Activity model. This was supplemented by both a literature review and the results of the other interviews as the task progressed. The stakeholders on the resulting list were categorised by 'project roles' and 'stakeholder categories', and characterised in terms of their core activities and relation to the project. The results of this process are presented in Section 4.1.

b) Mapping of stakeholder interactions and communication flows

'Information on interactions within the value chain will be collected from actors by means of semi-structured face-to-face interviews & thematic analysis of the resulting transcripts…The information obtained by this qualitative analysis will be used to describe and map the interactions of actors within the value chain….'

The results of the interviews were carefully analysed and used to map the interactions of stakeholders at each stage of a generic refurbishment project as identified in the 'Hubs of Activity' model. Key stakeholders were assessed in terms of their salience at each stage, using a tripartite model which takes into account the power stakeholders exercise over a project, and the legitimacy and urgency of their claims. Particular attention was paid to communication

flows, *i.e.,* which stakeholders should be involved in communications at each stage and what should be communicated. The results of this analysis are presented in Section 4.2 of the report.

c) Interests, drivers and motivations of stakeholders

'…and to ascertain the interests, drivers and motivations that influence their activities.'

A literature review was undertaken to assess the current state of knowledge about the motivations and drivers of stakeholders in building energy retrofit, in particular incentives and barriers to retrofit, the results of which are presented in Section 2.6. Certain key themes were identified and these helped to inform the interview process. The finding from the interviews regarding the interests, drivers and motivations of stakeholders are presented in Section 4.3.

d) Occupant and user needs and interests

'In this value chain analysis, specific attention will be dedicated to the role of inhabitants and users in order to understand their specific needs and priorities to be addressed and to ascertain how to involve them in the design of the refurbishment'

A particular focus of the interviews was on the needs and priorities of building users and the degree to which occupants and users are currently included in the design process. The theoretical framework adopted here was the concept of 'participatory design', which is outlined in Section 2.7. The results of the interviews and analysis are presented in Section 4.4.

Regarding the overall structure of the report, Section 2 presents the general theoretical framework used, introducing key concepts such as 'value chain', 'stakeholders' and 'participatory design', and summarises the existing literature relevant to the issues covered. Section 3 outlines the methodology used in the report, both for compiling the literature review and conducting the interviews and the analysis of the resulting transcripts. Section 4 outlines the findings of the report under the four headings listed above. Section 5 outlines some conclusions of the document.

2. THEORETICAL BACKGROUND

The aim of this report is to identify the stakeholders in energy-efficient building and understand the interactions between them which produce value. The purpose of this section is to introduce the two key concepts of 'value' and 'stakeholders' and survey the relevant literature. Value theories refer to a wide range of approaches to understanding how or why people value things, ideas, or other people. Stakeholders are all those individuals or groups that can affect or are affected by a project or by the achievement of an organisation's objectives (Freeman, 1984). This section of the report provides an overview of the literature on value chains and stakeholder engagement, including the issues of stakeholder salience (the relationship of stakeholders to a project and which of them exercise most influence or are in a position to assert their claims with the greatest urgency), communication between stakeholders, and the incentives and barriers to stakeholders' implementing an energy retrofit. We introduce the 'Hubs of Activity' model, which provides a way of breaking down a refurbishment project into its various stages and assessing the interactions of stakeholders in each stage and how they contribute to generating value. Finally, we introduce the concept of 'participatory design' as a model for incorporating the needs and interests of building occupants and users in the design of a refurbishment.

1.1 Value Theory

The literature on value theory dates back over a century. Lepley (1937) stated that the (then) current state of value theory was one of conflict and confusion and described value (in rather anthropocentric terms) as reflexive, as verified attractions and aversions to human ends and means, and as artistic products of intelligent effort. Non-anthropocentric value theory began to emerge in the 1970s and 1980s. Anthropocentric value theory conferred intrinsic value on humans, and only instrumental value (i.e. value that was instrumental in serving some human purpose) on non-humans and all other things. The non-anthropocentric view on the other hand allows that non-human living beings or the wider environment have intrinsic value in themselves, without this being defined by how much they serve human needs.

Value theories have evolved in the fields of philosophy, sociology and economics. In 1972 Duffy Hutcheon said that sociology should be concerned with the study of values in order to gain more understanding of 'man in society' and progress the behavioural sciences, where value is defined as any goal or standard of judgement which in a given culture is ordinarily referred to as if it were self-evidently desirable (Eckhart in Duffy Hutcheon, 1972). In dictionaries (Oxford English Dictionary, The Free Dictionary, Merriam Webster) value is described as being both a verb (e.g.,

a person's values are their principles and standards of behaviour) and a noun (*e.g.,* something considered as having a worth, being held in high regard as useful or important *e.g.,* money, privacy, honour *etc.*).

> 'The young human organism rapidly progresses from random selections to belief construction (learning to 'know' and to 'value') as he organizes inputs from the raw data of experience: data which include, in addition to momentary feeling-states, the ideals, norms, and established knowledge of his culture. According to this model, values are learned criteria that predispose us to act as we do. They emerge from the inextricably intertwined affective and cognitive belief systems. Attitudes are merely the surface, or more specific manifestations of these underlying values.' (Duffy Hutcheon 1972: 180).

Value can be strongly affected by power and status, for example, as Thye (2000) points out, a 'mundane' set of golf clubs sold for many thousands of dollars at auction, because they were once owned by John F. Kennedy, and a beautiful sculpture could become a national treasure if discovered to be a Rodin, and worthless if discovered to be a counterfeit – despite it still being the exact same, beautiful sculpture. Value is subjective, meaning different things to different people. In the past, value would often have been considered in terms of financial value *i.e.* profit. However, there is an increasing focus on the idea of the triple bottom line involving the three P's of Profit, People and Planet. This in turn is based on the three pillars of sustainability: economic, social and environmental value. In fact, the value produced by a firm or a project can involve many different dimensions. For example, in a building construction project value could be measured differently by each of the different people or organisations involved. It might be measured in monetary terms, for example, profit for the building contractor, increased property value for the owner, and reduced running costs for the occupant. Value might also be associated with less tangible aspects such as legacy (building owner), reputation (*e.g.,* of the designers or builders), or comfort, health and wellbeing (of the occupants).

Take the example of one of the projects analysed in T1.1, a former convent and associated schools that were renovated to provide a variety of educational, heritage, religious, and administrative uses. The religious congregation who owned the site were anxious to preserve both its heritage and spiritual value, as well to make provision for a variety of pastoral uses that would generate value both for groups within the surrounding community and for the international branches of the order. The development company, which had a long-term lease on

the site and was managing the project on the congregation's behalf, shared these goals, but were also very concerned with the future financial viability of the site, leading them to lease part of it to an educational institution. The architects were motivated partly by financial return, but also by the challenge of preserving the heritage of the site while creating an aesthetically pleasing and functional set of buildings. The local authority welcomed the development because it promised to revitalise the surrounding area of the inner city and attract tourists. For all these stakeholders and many others, the renovation promised to generate a variety of different kinds of value, many of which were not primarily financial. By contrast, the value generated by the office developments discussed in interview NT16011 was purely financial from the perspective of the client and design team, although factors such as comfort and aesthetics were important for the commercial tenants who would use the space.

Due to this subjective and thus, unquantifiable character of value, literature from the 1950s expressed some concern about using value theory in economics. In the 1960s and 1970s, analysts used the concept of a Value Chain to depict the development path of mineral-exporting economies (Van Rensberg, 2008:5-6). However, it was in the 1980s that the concept of value chains and value chain analysis became prominent in business management literature. One of the most cited authors in this literature is Michael Porter. Porter's conception of the value chain provides a model for 'systematically examining all the activities a firm performs and how they interact' (Porter, 1985). A value chain can be defined as 'the process by which technology is combined with material and labour inputs, and then processed inputs are assembled, marketed, and distributed. A single firm may consist of only one link in this process, or it may be extensively vertically integrated...' (Kogut, 1985: 15, quoted in Gereffi et al, 2005: 79). According to Porter, the 'Value Chain' concept 'divides an organization into the conceptually distinct activities it requires to do business. These activities create value, for which buyers are willing to pay. If the value exceeds the costs required to maintain activities, the organization is profitable. Thus, effective Value Chains generate profits' (Van Rensberg, 2008: 5). How various benefits are distributed across the value chain depends to a large degree on the balance of power between suppliers and manufacturers (Pil & Holweg, 2006:73).

Porter defines a value chain as incorporating nine generic activities. The five primary activities are: inbound logistics, operations, outbound logistics, marketing and sales, and service. In addition, Porter's (1991) model of the value chain includes several supporting services such as

firm infrastructure, Human Resources (HR) management, technology development and procurement. 'The Value Chain is a conceptual model of the organization. This model needs to guide the analyst in the structuring of business complexity to enable understanding and alignment between the organization's value-added activities' (Van Rensberg, 2008:6).

Porter's ideas were widely adopted by businesses as a means of understanding complexity in business environments, with the ultimate goal of structuring the business to maximize its competitive advantage (Van Rensburg, 2008:1). Van Rensburg uses a simplified version of Porter's framework to group activities in the value chain into strategic, tactical, operational, and supporting activities. In this process, the importance of the statement, "Value is in the eye of the beholder", becomes evident. 'This means that a Value Chain is created from the perspective of what the stakeholder perceives to be important to the organization' (Van Rensberg, 2008:5-6).

Porter's concept of the value chain, while still prominent in the literature, is not however applicable to every situation. It is rigid and sequential. For example, transport is listed as two distinct primary activities, inbound and outbound logistics, whereas in reality, in construction, transport is ongoing throughout the lifecycle of a building. If we take any product used in a building, we can see that there are many stages of transportation. The raw materials must be transported from the original extraction site (*e.g.,* a mine or quarry) to another site for processing or refining, then again to a manufacturing plant where they will be made into a construction product, and again to the wholesaler or merchant, before being transferred to the building site, and later to a recycling facility or waste treatment facility. Porter's value chain looked primarily at inwardly focused core activities from which companies traditionally derive value. However, business has changed significantly in the last 20 years, and given trends such as the overwhelming importance of intangible assets in the valuation of firms today, this purely inward focus is no longer appropriate (McPhee & Wheeler, 2006: 40). 'Successful firms are now replacing internally focused strategy-development models with alternatives that allow a broader view of the firm as a part of the world around it. If, as Porter describes, competitive advantage ''comes from all of the activities of a firm acting in harmony,'' then for the value-chain model to be effective for the firm, a full representation of all of the available activities should be included in the model – including those activities aimed at creating value through external relationships' (McPhee & Wheeler, 2006: 40).

Other value concepts have also emerged, and although they remain related to "The Firm" (or company, or organisation), the benefit of reviewing this literature is the emphasis on the concept of value – establishing who values what, and how value can be added or lost. A complete value analysis allows for a big picture or system view of a particular product (Kaplinsky & Morris, 2003), in this case a building or a group of buildings in a district. Value chain analyses can also help to identify constraints and bottlenecks, procedural and policy issues, or other issues that require attention (Rich *et al.,* 2011).

While conventional value chain analysis focuses on how value is generated through the relationships involved in the production of a particular product, in a value network or value constellation approach the focus is placed on the value-creating system itself. A value network can be defined as any set of roles and interactions through which people engage in both tangible and intangible exchanges to achieve economic or social good (Allee, 2008).

Porter and Kramer (2011) updated the concept of the value chain to include what they called 'shared value creation'. This means value that is mutually beneficial to both the value chain and society. It reflects a growing realization that a narrow focus on efficiency may result in reducing waste and costs but is unlikely to create any additional value (Fearne & Martinez, 2012: 575). Consequently, 'there is growing interest in looking beyond internal economic costs and benefits to investigate why and how to incorporate broader societal costs and benefits in ways which contribute to long term (sustainable) competitive advantage' (Fearne & Martinez, 2012: 575).

The value chain concept involves looking at construction as a system made up of subsystems, each of which has its own inputs, transformation processes and outputs involving the acquisition and consumption of resources (Sqicciarini & Askiainen, 2011: 677). A building unites two supply chains: the design and construction (D&C) supply chain, and the operations and maintenance (O&M) supply chain. These are separate supply chains, but due to increasing sustainability and lifecycle imperatives, would benefit from closer linkages. Consequently, 'a holistic approach to asset management can only take place effectively when these two supply chains are integrated' (Ling et al, 2014: 158). Integrated team-building activities between the two supply chains are recommended as a means to enhance value for stakeholders. This can help eliminate the kind of 'blame culture' in which team members seek to minimize their level of exposure to poor performance, rather than working together to achieve the best outcomes for the project (Ling et al, 2014:173). Innovation in construction is also typically incremental in nature, and leads to

dramatic transformations only in the long term. 'Examples of radical transformations that have occurred since 1950 include: changes in materials; the introduction of standardization and prefabrication; the use of information technologies (IT) in design and construction; the introduction of automation and robotics; and changes in the supply chain management' (Miozzo and Ivory, 2000, quoted in Sqicciarini & Askiainen, 2011: 676). Table 1 summarises the value created in a typical building project.

Value of & Created by…	**Initiation & Viability Stage**	**Design & Planning Stage**	**Construction & Installation Stage**	**Operation & Maintenance Stage**
Owners / Client	Initiates project, secures funding, delegates work, personal and business contacts, personal and professional knowledge and experiences, project brief	Pay PM and design team, approval of works, signing of documentation, making decisions	Pay PM, construction team and design team, approval of works, signing of documentation, making decisions	Ownership and upkeep of buildings, use of energy, asset management
Occupants / Users	Demand, urgency, impetus, money (rent *etc.*), design input	Personal experience, knowledge, and observation, requirements	Facilitate smooth operations on site	Occupation, use and upkeep of buildings, use of energy, rent/lease payments
Designers	Professional experience, qualifications, skills, talents, reputation, design ideas, options	Professional experience, qualifications, skills, talents, designs	Professional experience, qualifications, skills, talents, updated designs	Certification, warranties, post-occupancy works, post-occupancy evaluation, monitoring and lessons learned
Builders	Professional experience, qualifications, skills, talents, reputation, build ideas, options	Professional experience, qualifications, skills, talents, design input	Professional experience, qualifications, skills, talents, built/installed elements	Certification, warranties, post-occupancy works, post-occupancy evaluation, monitoring and lessons learned
Others	Demand (e.g., market demand, societal demand,	Feedback, comment, constructive critique, goodwill	Feedback, comment, constructive critique, goodwill	Development & use of the district, market values, on-going business

Value of & Created by…	Initiation & Viability Stage	Design & Planning Stage	Construction & Installation Stage	Operation & Maintenance Stage
	community needs *etc.*)			

TABLE 1: **VALUE CREATION ON A TYPICAL CONSTRUCTION PROJECT**

1.2 STAKEHOLDER THEORY

Stakeholder theory concerns itself with the management and treatment of its stakeholders by a business entity. Freeman describes a business as 'a set of relationships among groups which have a stake in the activities that make up the business. Business is about how customers, suppliers, employees, financiers (stockholders, bondholders, banks, *etc.*), communities and managers interact and create value' (Freeman, 2010: 7).

The objectives of stakeholder theory are to consider the needs and impacts of various stakeholders (Fassin, 2012), and to understand how value is created and traded (Freeman *et al.,* 2004). The stakes of each stakeholder group are multi-faceted, and inherently connected to each other: 'no stakeholder stands alone in the process of value creation' (Freeman, 2010). According to Freeman *et al.* (2004: 364) the focus of stakeholder theory is articulated in two core questions:

- What is the purpose of the firm?
- What responsibility does management have to stakeholders?

Jones and Wicks (1999: 207) elaborate further on this, and describe the essential premises of stakeholder theory in four points:

- The corporation has relationships with many constituent groups ('stakeholders') that affect and are affected by its decisions (Freeman, 1984);
- The theory is concerned with the nature of these relationships in terms of both processes and outcomes for the firm and its stakeholders;
- The interests of all (legitimate) stakeholders have intrinsic value, and no set of interests is assumed to dominate the others (Clarkson, 1995; Donaldson & Preston, 1995);
- The theory focuses on managerial decision-making (Donaldson & Preston, 1995).

If business is considered as a set of relationships, stakeholder theory seeks to ensure that the treatment of those involved in those relationships, the stakeholders, is fair and responsible, a perspective which has in more recent times been incorporated into Corporate Social

Responsibility (CSR). Kaler (2003 & 2006) describes stakeholder theory as a reformist stance toward capitalism, moving in a direction of greater equity. He suggests its two main functions are to argue for an enhancement of distributive justice, and to be used as a way to understand CSR, with companies taking on obligations to society beyond those owed to shareholders. Stakeholder theory is also managerial, i.e. concerned with managing competing stakeholder interests (Harrison & Freeman, 1999).

Orts & Strudler (2009: 605) on the other hand suggest that stakeholder theory does not fulfil the promises often attributed to it, and argue that while it may be useful, the claims surrounding stakeholder theory are often overblown. They state that the primary appeal of stakeholder theory is that it promises to help solve large and often morally difficult problems such as:

- How to manage people fairly and efficiently;
- How to determine the extent of a firm's moral responsibilities beyond its obligations to enhance its profits and economic value.

Stakeholder theory can also be applied to projects (including construction projects). The construction industry is both corporate (firm) and project oriented (Liao et al, 2016). The Project Management Institute (PMI) defines a project as a temporary endeavour undertaken to create a unique product, service or result (PMI, in Yang et al, 2011). Building construction and renovation or retrofitting falls within the scope of this definition. Construction projects involve networks or constellations of persons, or groups of persons, who are involved for a finite period of time and for a specific purpose. Design and construction teams are generally temporary multi-firm configurations, or TMFCs (Dunphy & Morrissey, 2015) that have been assembled for the purpose of a particular project. There are four features of temporary organisations; time, task, team, and transition (Lundin & Soderholm, 1995 in Dunphy & Morrissey, 2015). Projects by their nature are one-off occurrences. The TMFC is created for a particular period of time, for a particular task. Those involved may or may not have existing relationships or prior experience of working with one another. Multi-objective optimization (Dunphy *et al.,* 2012) will be required to consider the trade-offs between multiple, and possibly competing objectives within an energy retrofit project, for example the trade-offs between short and long term gains, payback or savings versus initial capital outlays and other costs.

However, many stakeholders in these networks tend to go un-noticed. In all types of Project Management (PM), including construction project management, stakeholder identification and

management is now recognised as crucial to success. Nonetheless, according to Berardi (2013), construction companies and project managers seldom ascertain their customers' preferences through stakeholder engagement, and prefer instead to hypothesize about them according to previous experience and expectations. The complexity and uniqueness of the organizational structures surrounding construction projects, and the various relationships between stakeholders within and around them (Genovese *et al.*, 2013), can also create challenges for effective stakeholder engagement and management.

Why should we be concerned with identification of stakeholders? As Svenfelt *et al*., (2011) point out, there is sufficient technical potential to achieve energy saving targets; however, without radical changes to social structures, incentives for actors to act, enhanced communication and feedback, and changes in the attitude and behaviour of stakeholders, these targets cannot be met. Corporate Social Responsibility (CSR) already recognises the need to treat stakeholders fairly and increase dialogue and collaboration between them. Whether that is applied in practice is of course a different matter.

Integrating stakeholder knowledge adds flexibility to social-ecological systems because it reduces rigidity, represents multiple perspectives, produces different types of value and promotes adaptability in decision-making. Knowledge is not a static resource – it is linked to the organisations and individuals who use it (Girodon *et al.,* (2015). The ability of a system to transfer knowledge from one partner to another is described as its absorptive capacity (Kazadi *et al.*, 2016). A knowledge system refers to a coherent set of mental constructs, cognitions, and practices held by individuals within a particular community (Richards, 1985 in Gray *et al.,* 2012).

Knowledge is often divided loosely into two groupings, though all stakeholders possess both types to different extents; local knowledge and scientific knowledge. Local knowledge includes individual experiences, and non-expert, localised information as well as traditional, indigenous and lay knowledge mediated by personal or cultural experiences. Care must be taken however, not to assume that the integration of stakeholder knowledge is a panacea (Gray *et al.,* 2012). The term informal learning relates to another form of stakeholder knowledge referred to in the literature. According to García-Peñalvo & Conde (2014), informal learning is an essential element in the decision-making process, which takes place in the context of everyday experiences. Facts, observations and data are obtained, and then interpreted or transformed to develop coherent information sets that can be added to existing conceptual models and data.

There are numerous definitions of stakeholders, and they are for the most part definitions from a corporate point of view. The most frequently cited definition is Freeman's from his book Strategic Management: A Stakeholder Approach, which defined a stakeholder as: 'any group or individual who can affect or is affected by the achievement of the organization's objectives' (1984: 25). In addition to this, according to Freeman, 'the stakeholder approach is about groups and individuals who can affect the organization, and it is about managerial behaviour taken in response to those groups and individuals' (Ibid: 48). In other words, it is about who has input in decision-making, and who benefits from the outcomes of such decisions (Phillips et al, 2003 quoted in Crane & Ruebottom, 2011).

Stakeholder fairness, as a principle, involves recognition of the obligations and duties of stakeholders (Fassin, 2012). Reciprocity must also be considered: obligations of fairness are not restricted to just one group of stakeholders, *e.g.,* the directors of a large company/corporation. The social identity of a stakeholder is also important: how the stakeholder views themselves with regards their wider social surroundings, the 'mutual understandings regarding the characteristics that distinguish (members) from non-members' of a particular social identity (Crane & Ruebottom, 2011). This will require recognizing and understanding the social identities of the stakeholders as social groups as well as individuals.

The literature is divided however, on whether stakeholder theory should adopt a strictly anthropocentric viewpoint or not. A big question for many is whether the natural environment should be considered as a stakeholder in its own right. It is not a person, group or organization, and yet it can affect, or be affected by their activities. It can also create value. According to some authors stakeholder analysis can be categorised into four steps, namely: (1) identifying key stakeholders, (2) assessing stakeholders' interests and the potential impacts of the project on these interests, (3) assessing stakeholder influence and importance, and (4) outlining a participation strategy (Johnson and Scholes, 1999 in Heravi *et al.*, 2015).

It should also be noted that for stakeholder theory to be of any use, the term stakeholder should not be synonymous with 'citizen' or 'moral agent'. The theory is not a comprehensive moral doctrine, and nor is it a theory of political economy (Phillips *et al.*, 2003). Nor should it be synonymous with the term actor as that implies a stakeholder actively participating in the project, whereas in reality some stakeholders are active, while others are passive. In the case of a project, such as a building refurbishment, the stakeholders are issue-focussed, and more likely

to be part of, or in some way associated with a multi-stakeholder network, as opposed to an organization-focussed corporate situation (Roloff, 2008). Participation is often voluntary and engagement is often deliberative and collaborative.

1.3 HUBS OF ACTIVITY MODEL

In seeking to identify the stakeholders in an energy retrofit and understand their relationships, it is helpful to break down the project into generic stages and distinguish the activities that take place during each stage. This is the purpose of the 'Hubs of Activity' model developed as part of the UMBRELLA[1] FP7 project. Drawing on a broad-based review of the literature, including approximately twenty different models of the building life cycle, Dunphy *et al.* (2013) identified six stages in the life cycle of a generic building.

Although the stages are labelled one to six, this does not mean that they are intended to be strictly linear and chronological. Over its entire lifecycle a building may move forward and backward through the stages several times. A building can be designed, built, occupied, sold, then later redesigned, extended, refurbished, reoccupied and so on. For any given construction project, life cycle impacts are also highly inter-dependent, as one phase can influence one or more of the others. Table 2 below is based on Dunphy *et al.* (2013) and outlines the six 'Hubs of Activity' along with examples of the types of activity characteristic of each:

Hub	**Example of Activity**
(1) Upstream activities	Extraction of raw materials, manufacture, transport, *etc*.
(2) Initiation & viability check	Original proposal, making business case, *etc*.
(3) Design & planning	Designs, building plans, project plans, *etc*.
(4) Construction and/or installation	All site activities

[1] The UMBRELLA FP7 project aimed to support the development of the market for building energy retrofit through the creation of innovative business models tailored to different stakeholders (*e.g.,* building owner, building occupant, management company, public authority *etc*.), building types, climate and policy. A web-based decision support application, which provides independent evaluation tools built around adaptable business models, was developed as part of the project. For more information see http://www.umbrella-project.eu/

(5) Operation and maintenance	Use and upkeep
(6) End of life and downstream activities	Deconstruction, reuse, recycling, disposal, *etc*.

TABLE 2 : HUBS OF ACTIVITY OF GENERIC CONSTRUCTION PROJECT (INCLUDING ENERGY RETROFIT PROJECTS)

In the succeeding graphic, Figure 1, the model is represented in a circular format to allow for a cradle-to-cradle approach, where both the buildings, and/or the components can be used, reused, recycled, and up-cycled many times:

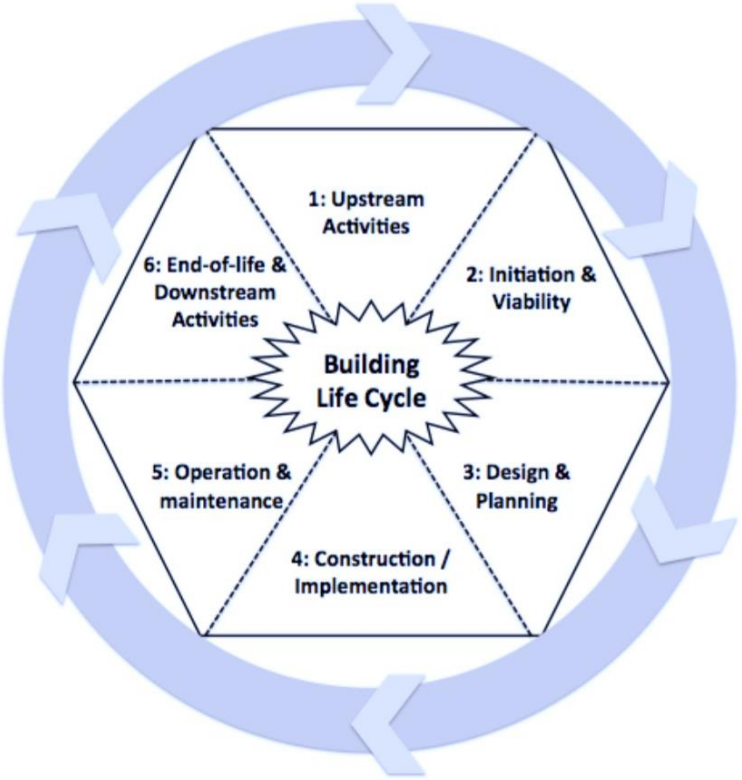

FIGURE 1 : THE UMBRELLA HUBS OF ACTIVITY SIX-STAGE MODEL OF THE LIFECYCLE OF A BUILDING (DUNPHY *ET AL.*, 2013)

Categorising activities into Hubs of Activity in this manner assists in the identification of key stakeholders. It also provides a framework for the analysis of stakeholder relationships, power flows, drivers, conflicts, and potential synergies. It is important to recognise that different stakeholders will have different ideas of what they require out of a project and of what constitutes success. These will depend on their individual concepts of value, as well as the

characteristics of the particular project. These differing requirements and perceptions of value help shape stakeholder interactions across the lifecycle of a project. The Hubs of Activity model enables carrying out a value mapping exercise for each lifecycle stage to characterise value-generating activities, with a particular focus on stakeholder roles and positions within wider supply chains and on the interactions between stakeholders. The table below provides a list of potential stakeholders in an energy retrofit project, and is reproduced from Dunphy *et al.*, 2013. Initial stakeholder groupings were derived through a literature search and the stakeholders involved at each Hub of Activity were articulated through a series of brainstorming workshops. For each Hub, techniques such as mind-maps and spider-diagrams were applied to further elaborate on linkages between the primary actors involved and secondary stakeholders present. The result is a generic list of stakeholders associated with each Hub of Activity of a typical energy retrofit project as shown below in Table 3:

Hub of Activity	**Key stakeholders**	**Other stakeholders**
Stage 1: Upstream activities	Manufacturers; Policy Makers; Legislators; Statutory Regulators; Investors	Primary Producers; Material Processors; Financiers; Standard Bodies; R&D Institutions; Retailers and Distributors; Logistics; End-users.
Stage 2: Initiation & viability check	Owners; Investors; Solution Providers; Designers	Occupants / Tenants; End Users; NGOs; Neighbours; Municipalities; Insurance Companies; Utility Companies; Financiers; Policy Makers, Legislators; Public
Stage 3: Design & planning	Designers; Owners; Project Managers; Investors; Solution Providers; Planning Authorities; Building control	Occupants; Public; NGOs; Neighbours; Financiers; Third Party Product Certification; Infrastructure providers / Utility companies
Stage 4: Construction and/or installation	Designers; Owners; Project Managers; Neighbours; Solution Providers	Occupants; Public; NGOs; Investors; Infrastructure providers; utility companies; Policy Makers; Legislators; Financiers
Stage 5: Operation and maintenance	Owners; Users; Occupants; Neighbours;	Designers; Investors; Solution Providers; R&D Institutions; Public; NGOs; Infrastructure providers; Utility companies; Financiers; Retailers and Distributors; Logistics
Stage 6: End of life and downstream activities	Owner; Planning Authorities; Waste Authorities; Local Government	Environmental Protection Agencies; Service Providers; Contractors; Public; Retailers and Distributors; NGOs; Infrastructure providers; Utility companies.

TABLE 3: TYPICAL ENERGY EFFICIENCY RETROFIT STAKEHOLDERS ASSOCIATED WITH HUBS OF ACTIVITIES

This is not an exhaustive list, since stakeholder groups have been summarised and classified broadly in order to encompass as many potential stakeholders as possible. Stakeholders' involvement in a project 'generally is not continuous and is not uniform. Another dilemma…is to identify at what scale the 'group' should be formed to best represent the 'uniqueness' of interests, needs, priorities and values of the 'group'' (Voinov *et al.*, 2016: 200). Formal groupings are readily classified, *e.g.,* designers or building contractors. At the same time, generic terms are used, for example designers includes architects, architectural technicians, technologists, interior architects, civil and structural engineers, mechanical and electrical or building services engineers and so on.

However, care must be taken to attempt to identify informal groupings, which are likely to occur on a case-by-case basis in response to individual projects *e.g.,* a local protest group consisting of persons not otherwise connected who have been brought together by their common opposition to a proposed project. These groups are certainly not homogenous; they may span a broad array of demographics (gender, age, income, education *etc.*), and will have varying attitudes and beliefs on other topics. The complexity and uniqueness of the organizational structures surrounding construction projects (Genovese *et al.*, 2013) lead to a multiplication of stakeholders, if we take these as all those with potential to affect or be affected by the project. Many stakeholders in construction tend to go un-noticed. According to Berardi (2013), construction companies and project managers seldom conduct surveys into their customer preferences, and prefer instead to hypothesize about them according to previous experience and expectations. Nor is it the case that all stakeholders are involved in all projects; many projects will operate successfully with only a fraction of the stakeholders identified.

The NewTREND project IDM (Integrated Design Methodology) expands on the Hubs of Activity (HoA) model by breaking down the Design & Planning stage into a series of sub-stages, namely preparation, diagnosis, strategic definition, concept design and decision-making. However, for the purposes of this report, which is concerned with stakeholder identification and value-chain mapping across the duration of a project rather than primarily with design, it was felt the incorporation of these sub-stages would lead to considerable redundancy. At the same time, the first and last stages of the HoA model – upstream activities such as the mining and extraction of raw materials, and downstream activities such as recycling and incineration – were felt to be not relevant to this document. Consequently, for the purposes of analysing stakeholder interactions,

value-generation and the needs and interests of building occupants and users, the four central stages of the HoA model will be utilised at a framework in this report. Table 4 outlines the 6-Stage HoA model by Dunphy *et al.* (2013) cross-referenced with the 11-Stage NewTREND model.

6 Stage Umbrella HoA Model	11-Stage NewTREND Model
Upstream Activities	N/A
Initiation & Viability	Initiation
Design & Planning	Preparation, Diagnosis, Strategic Definition, Concept, Decision Making
Construction & Installation	Implementation
Operation & Maintenance	Handover & Closeout
Downstream & End-of-Life	N/A

TABLE 4: HOA MODEL & NEWTREND STAGES

1.4 Stakeholder Salience

Construction is a fragmented, heterogeneous, multi-relational, multi-dimensional and multi-disciplinary industry (Dunphy & Morrissey, 2015). Moreover, activity in the sector, including energy renovation projects, typically comprises one-off undertakings resulting in projects and resultant products that differ significantly in their individual 'design, specifications, and context' (Yu, Tweed, Al-Hussein, & Nasseri, 2009). These projects are delivered by multiple interconnecting supply chains, which have complexity not only in-and-of themselves, but also in the interactions between the various processes, disciplines, and organisations involved, all of which are subject to effects of dependence and variation (Arbulu & Tommelein, 2002). Dahlgren & Söderlund (2001) note that project industries such as construction are typically characterised by the frequent lack of a continuing relationship between the main stakeholders, which complicates attempts to coordinate interdependent activities.

Stakeholder salience and the determination of who or what counts as a stakeholder is the cause of an on-going debate in stakeholder theory, a continuing source of "*conceptual confusion, a slippery creature, and meaning almost anything the author desires*" (Orts & Strudler, 2009). In order to assess stakeholder salience, several questions about the stakeholders will need to be answered. What is important, noticeable, or prominent about a particular stakeholder, or group

of stakeholders? What are their traits, their positions, and their behaviours and attitudes towards the project (and towards one another)?

Fassin (2012) states that besides loyalty and moral responsibility, two very important stakeholder traits are influence and power. These tend to be used interchangeably in the literature, and are also very much the focus of project management theory. Stakeholders are often mapped on a 4 x 4 grid relating their level of power (or influence) and interest (or stake). This indicates the degree to which the project manager should attend to them – whether they should be merely kept informed of progress on an intermittent basis, or have a key role in decision-making, for example. Mitchell *et al.* (1997) in Neville *et al.* (2011) extend this typology to cover three traits – power, legitimacy and urgency – describing stakeholder salience as the degree to which managers give priority to competing stakeholder claims. A stakeholder is said to be powerful if they can get another stakeholder to do something that they would not have done otherwise, one that is in a position to pursue their own wishes despite resistance, i.e. they can gain access to coercive, utilitarian, or normative means to impose their will in a stakeholder relationship (Mitchell *et al.*, 1997:865). Powerful stakeholders appear dormant – however, they can greatly affect the outcome of a project if they so wish.

The legitimacy of a stakeholder is a little more difficult to define; however, it can be approximated as a stakeholder that is recognised socially or morally as having rights or a claim to the project. For example, the occupants of a building do not own it, but – depending on moral, social and cultural circumstances – they would be considered to have certain rights. These are therefore discretionary stakeholders. Urgent stakeholders are those calling for immediate action, compelling a response due to the nature of a project or a time limitation. They are termed 'demanding' stakeholders. Crucially, these stakeholder attributes are variable; they can change over time and they are socially constructed. In addition, stakeholders may possess more than one of these attributes at any given time (Mitchell *et al.*, 1997).

Key Terms in the Theory of Stakeholder Identification and Salience		
Term	**Definition**	**Sources**
Stakeholder	Any group of individual who can affect or is affected by the achievement of the organisations objectives	Freeman, 1984; Jones, 1995; Kreiner & Bhambri, 1998

Key Terms in the Theory of Stakeholder Identification and Salience		
Power	A relationship among social actors in which one social actor, A, can get another social actor, B, to do something that B would not otherwise have done	Dahl, 1957; Pfeffer, 1981; Weber, 1947
• Bases	• Coercive – force/threat • Utilitarian – material / incentives • Normative – symbolic influences	Etzioni, 1964
Legitimacy	A generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs and definitions	Schuman, 1995; Weber, 1947
• Bases	• Individual • Organisational • Societal	Wood, 1991
Urgency	The degree to which a stakeholder claims call for immediate attention	Original – builds on the definition from the Merriam-Webster Dictionary
• Bases	• Time sensitivity – the degree to which managerial delay in attending to the claim or relationship is unacceptable to the stakeholder • Criticality – the importance of the claim or relationship to the stakeholder	Original – asset specificity from Hill & Jones, 1992; Williamson, 1985
Salience	The degree to which managers give priority to competing stakeholder claims	Original – builds on the definition from the Merriam Webster Dictionary

TABLE 5: KEY TERMS IN THE THEORY OF STAKEHOLDER IDENTIFICATION AND SALIENCE (MITCHELL *ET AL.*, 1997: 869)

If there are three overall attributes – power, legitimacy and urgency – then it is possible to have seven different classifications of stakeholder, as indicated in Figure 2 . Three of these possess only one attribute: power (dormant stakeholders), legitimacy (discretionary stakeholders), or urgency (demanding stakeholders). Three possess two attributes each: these are dominant, dependent and dangerous stakeholders. One category possesses all three attributes: these are the definitive stakeholders (Mitchell et al, 1997).

- Power (dormant stakeholders);
- Legitimacy (discretionary stakeholders);
- Urgency (demanding stakeholders);
- Power + Legitimacy (dominant stakeholders);

- Power + Urgency (dangerous stakeholders);
- Legitimacy + Urgency (dependent stakeholders);
- Power + Legitimacy + Urgency (definitive stakeholders).

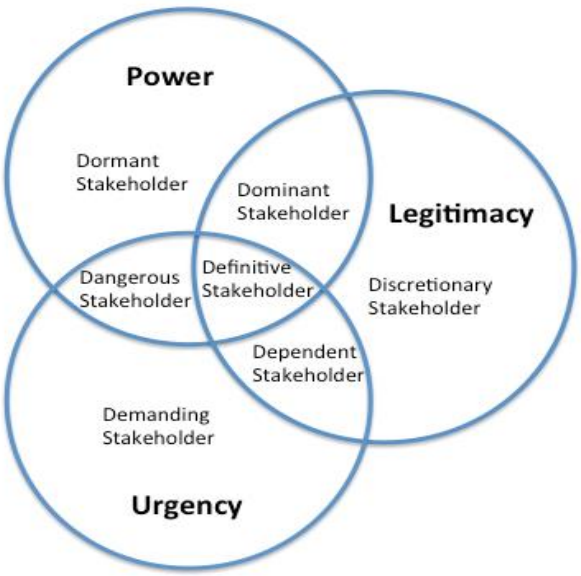

FIGURE 2: **STAKEHOLDER TYPOLOGY (MITCHELL *ET AL.*, 1997:874)**

Dominant stakeholders, because they possess both power and legitimacy have a very strong influence on a project. An example is a building owner who can decide whether to go ahead with a project or not. Dependent stakeholders have something at stake, and maybe even urgency – but are ultimately powerless, for example a residential tenant in a block of apartments. Dangerous stakeholders possess both power and urgency, for example, the planning authority that has the power to decide not to grant permission for the project to go ahead.

This typology can be used to tease out the differential relationships of stakeholders to a building project, assessing the different levels of power they exercise and the legitimacy and urgency of their claims. Consequently, it provides a valuable tool for the mapping of stakeholder interactions within the value chain of energy efficient buildings.

1.5 COMMUNICATION BETWEEN STAKEHOLDERS

Many project management manuals and websites state that approximately 80% of a project manager's time is spent on communication. This is a manifestation of the 80/20 rule, or Pareto Principle, which suggests that 80% of events are a result of 20% of causes. Other examples often used are the fact that 80% of land is owned by 20% of a population, or 80% of sales come from 20% of customers. "Project Management is 80% communication, 20% perspiration which is why the Communication Plan is one of the most important sections of any project" (Boon, 2012:12). While this is, generally speaking, a rule of thumb, it does serve as a reminder of the importance of communication in project management.

There has been increasing recognition of the value of intangible assets in general, and that communication plays an increasingly important role in the value of an organisation, or project (de Beer, 2014). Intangible assets are everything apart from its material, financial and physical assets (Melmelin, 2000 in de Beer 2014), including skills, knowledge, experience, intellectual properties, communication, relationships and so on. They also include intellectual capital possessed by individuals, organisations, regions *etc*., and social and relational capital, created by the sum of various phenomena; education, training, experience, know-how, science, routines, and social relations (Tomé, 2008 in de Beer, 2014).

In construction, fast decisions are needed to allocate scarce resources efficiently, and good information is required to ensure effective decision-making (Elonen and Artto, 2003; Blichfeldt and Eskerod, 2008). This is often rendered problematic by the lack of information sharing. In addition, information gathering, reporting and management activities can frequently be uncoordinated and duplicated. 'This leads to time wastage, unnecessary costs, increased errors and misunderstanding. To enable the built facility to achieve better value, it is recommended that…teams share relevant information in an integrated way' (Ling *et al.*, 2014:168-170). Information that needs to be shared includes specifications, as-built drawings, construction records, details of how sustainability is to be achieved, asset management performance data and facility management methods.

The use of a web-based database is one way of enabling intangible resources such as knowledge and information to be shared between stakeholders (Ling *et al.*, 2014:168-170). Another advantage is the facilitation of collaborative knowledge. 'A significant amount of knowledge is generated in every project, yet most of this knowledge is stored in the minds of team members as tacit knowledge, hence not transferred within the organization much less throughout the

industry, making knowledge capabilities difficult to be built up' (Ling *et al.*, 2014: 170). With a linked database, knowledge sharing is enhanced, leading to increased productivity, profitability and competitiveness (Ling *et al.*, 2014: 170).

Communication is described as the process of acquiring all relevant information, interpreting this information and effectively disseminating this information to persons who might need it. (Zulch, 2014b). Critically, communication is a process, not an end product. Communication skills include, but are not limited to; listening actively and effectively, educating, fact-finding, setting and managing expectations, persuasion, negotiating, conflict resolution, summarizing, recapping, and identifying the next steps (PMI, 2008:245). According to research on conflict and negotiation within groups, conflicts are more likely to be resolved or prevented when group members share common goals. This leads to better cooperation, more positive attitudes towards one another, increased mutual understanding of viewpoints and the development of shared frames of reference. (Oosterhuis *et al.,* 2012).

The single most significant factor affecting the success of a project, according to Zulch (2014b), is the project manager's ability for communication and leadership. According to Stephenson (2008, in Zulch, 2014a), the value added to a project is unique, and no other method or process can add similar value, and the most important skills for a project manager are communication skills (Heldman, 2011 in Zulch, 2014). It is the project managers' responsibility also to develop a communication plan for a project. This will need to identify the communicators (both senders and recipients of information), those with responsibilities for communication, what is the scope and format of information, and how and when should it be sent.

Stakeholder identification is a crucial part of the communication management planning. The basic communication model often cited in literature is indicated Figure 3, which indicates that for communication there must be a sender and receiver to encode, and decode the message (*i.e.* translate and interpret the message into thoughts and ideas) and a medium to convey the message. There may also be interference, which can cause the message not to be transmitted or understood correctly *e.g.,* a language barrier or technological barrier, which is labelled as noise. Broadly speaking the main mediums of communication are; oral/verbal (*e.g.,* meetings and interviews), written (*e.g.,* letter and meeting minutes), non-verbal (*e.g.,* gestures and attitudes), electronic and visual (3d models and movies).

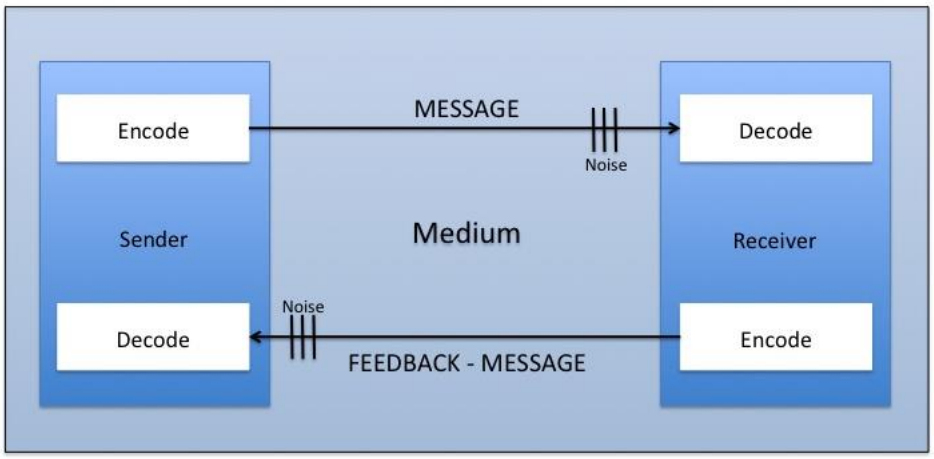

FIGURE 3 : **BASIC COMMUNICATION MODEL (PMI, 2008:255)**

There are many types of communication, but the simplest distinction in the literature is between formal and informal communication. Zulch (2014a) states that there are three types of communication; vertical (upward and downward between levels of hierarchies), horizontal (among peers) and diagonal (across any or both). According to Tubbs and Moss (2008, in Zulch, 2014b), formal communication flows in four directions, downward (from the higher levels of management to the lower levels), upward, horizontal or lateral (between peers), and diagonal between people at different levels of management. Gronstedt (2000, in Zulch, 2014), adds a fifth type; external*, i.e.* communication with stakeholders outside of the organisation, or in this case, the official project team, such as neighbours and so on. However, the extent or formality of communication with persons external to the project team in a construction project is debatable. Informal communication is likely, and valuable in some cases. Informal communication can be described as consisting of rumours, grapevine, social and "water-cooler" talk. The PMBOK Guide (4th Ed) from the Project Management Institute, regularly cited in industry, describes three methods of communication as follows:

- Interactive Communication – between two or more parties performing a multidirectional exchange of information. It is the most efficient way to ensure a common understanding by all participants on specified topics, and includes meetings, phone calls, video conferencing *etc.*;
- Push Communication – sent to specific recipients who need to know the information. This ensures that the information is distributed, but does not certify that it actually reached or

was understood by the intended audience. Push communication includes letters, memos, reports, e-mails, faxes, voicemails, press releases *etc*.;

- Pull Communication – use for very large volumes of information, or for very large audiences, that requires the recipients to access the communication content at their own discretion. These methods include intranet sites, e-learning, and knowledge repositories *etc*. (PMI, 2008: 256).

As stated earlier, while communication is the process of acquiring all relevant information, interpreting this information and effectively disseminating this information to persons who might need it, stakeholder engagement consists of the practices that an organisation undertakes to involve stakeholders in a positive manner in organisational, or in this case project activities. Engagement alone does not automatically equate to Corporate Social Responsibility or Communication Management. Furthermore, the engagement of stakeholders does not automatically ensure the responsible treatment of stakeholders (Greenwood, 2007). Stakeholder engagement forms part of the overall communication in a project, and needs to be incorporated into both the communication and stakeholder management planning processes. Not all stakeholders want, or need to be fully engaged or part of a co-design process – it will be the task of the project manager to determine the level, breadth and inclusivity of stakeholder engagement required on a project-by-project basis. The levels, activities and channels of communication may also change over the duration of the lifecycle of a building or a project.

1.6 Incentives and Barriers to Energy Efficient Building

Regarding the interests, drivers and motivations of stakeholders in energy efficient building, the incentives and barriers to investing in this type of project play a critical role. A substantial literature exists on this topic, and was drawn upon in formulating our research questions for stakeholders in energy efficient building during the preparation of this deliverable. Based on this literature, some of the principle factors operating as either incentives or barriers to energy efficient building are summarised below.

1.6.1 Payback Times/Return on Investment

Payback times and the rate of return on investment – in the form of reduced energy bills – in retrofitting can vary widely, depending on the method used, the state of technology, and the age and condition of the building. A survey of 100 architectural companies in the UK with housing refurbishment experience carried out by Osmani & Davies (2013) found that long

payback periods of micro-generation technologies are a particular concern to clients and end users. In Germany, a survey of over one thousand case studies of building refurbishments found that more than half of those surveys indicated that they were unsure whether refurbishment measures are profitable (Weiss *et al*., 2012). One 2012 study suggests that draught proofing, floor insulation, and loft insulation in cases where there are over 150 mm of insulation already in place are marginally uneconomic (Dowson et al, 2012: 297). Likewise, double-glazing offers a poor financial return since the payback period of 98 years exceeds the predicted product lifespan, and the energy savings alone do not justify the capital investment. Other conventional retrofitting measures show positive returns on investment, with the largest benefit occurring from filling cavity walls within pre-1976 building stock (Dowson et al, 2012: 297). The shortest payback time is for insulating a loft that previously had no insulation, which is just over 3 years (Dowson et al, 2012:297).

1.6.2 *Upfront Costs*

High upfront costs present a significant barrier to the adoption of EeB, especially in combination with lengthy payback times. The 'costs of investing in energy-efficiency measures (*e.g.,* buying new low-emission technology) are often immediate and large, whereas the benefits are delayed and gradually accrue over time' (Frederiks *et al*. 2015). A German survey found that a lack of sufficient financial resources or credit availability was a significant barrier to energy-efficient building projects (Weiss *et al*., 2012). These barriers continue to operate even where policy measures, such as building energy ratings, have been introduced to incentivise EeB measures. 'Bartlett and Howard (2000) indicate that UK quantity surveyors believe energy efficient and environmentally friendly buildings cost 5%-15% more from the outset compared to traditional buildings' (Zhang *et al*, 2014). While this perception may not always reflect reality, it remains the case that novel technologies can be more expensive, at least initially, even though they reduce operation costs over the longer term.

Likewise, financial institutions tend to focus on upfront costs rather than taking a life-cycle perspective when making decisions on investing in, or providing loans for, EeB projects. According to Persson & Gronkvist (2014), banks have short-term perspectives and little knowledge of the industry, and therefore fail to incorporate energy and life-cycle costs in their capital budgeting templates and mortgage calculations. Lifecycle thinking is beginning to be adopted by builders, but has yet to impinge on the capital budgeting plans used by banks. The banks adopt too short-term a perspective and have too little knowledge of the industry' (Persson

& Gronkvist, 2015: 300). The result is a misfit between the short-term nature of the business cycle and the long-term character of the benefits of energy efficient buildings (with its associated risks).

Consumers likewise tend to emphasise initial costs rather than operating costs in their decisions, and in the energy sector this leads to the choice of inefficient systems (Hirst, 1991, referenced in Bertone et al, 2016). Studies of consumer choice in the case of air conditioning and heating systems have found that consumers apply a discount rate to potential future energy savings of 15 to 25 per cent of their value (Allcott & Greenstone, 2012: 18). Here again, the lesson is that a lifecycle perspective needs to be systematically integrated into decisions on building refurbishment in order to make energy retrofit more financially attractive.

1.6.3 PROJECT RISKS

There can be considerable difficulty in estimating the future costs and energy performance of buildings, and consequently determining the balance of risk and return for an investor. This is especially the case when novel technologies are involved. Zhang *et al.* (2004) note that while 'existing research has shown that green building is often a commercial practical proposition for providers in life-cycle terms…little information is available to providers'. Risk aversion is an important feature of decision-making among both businesses and homeowners. Compared with proven alternatives, untested technologies or methods can be seen as risks and businesses, consumers and project managers tend to stick to experienced and proven technologies even when there are cost effective alternatives available (Persson & Gronkvist, 2015).

A number of studies have sought to systematically identify the risks to which investors in energy efficient buildings or retrofits are subject. Mathew *et al.* (cited in Dunphy & Henry, 2012) identified two principal broad categories of risk: (i) the inherent uncertainty of the estimated savings, due to various unknown or unknowable factors that affect the amount of energy that will be saved and its value; and (ii) potential inaccuracies in the way energy savings are measured. Dunphy & Henry (2012), in a comprehensive analysis of the risk factors affecting energy retrofit projects include the following:

- *Technological risk*, arising from the failure or underperformance of novel (and by definition unproven) technologies;
- *Technical risk*, the installation and/or commissioning of the energy-saving technologies may not be of sufficient quality;

- *Maintenance*, for example the level of upkeep needed by equipment may be greater than expected;
- *Longevity uncertainty*, the technology may have a shorter life-span than expected, or the building may be decommissioned earlier than originally planned;
- *Human factor*, the risks deriving from the occupants (inhabitants and users) of the building *e.g.*, they may not operate the equipment so as to maximise its efficiency, or may use some of the energy saved to increase their own level of comfort;
- *Energy pricing*, arising from unforeseen trends in energy markets;
- *Decommissioning*, the end-of-life of the building and its constituent systems may not go according to plan;
- *Energy Sources*, GHG emissions avoidance may be over-estimated due to changes in the GHG intensity of the central grid.

Yan & Zou (2014) also reference increased costs and unproven technologies as being among the risks involved in the introduction of sustainable materials, concepts or practices in building development. Various uncertainties about green technologies, such as their performance, life expectancy and maintenance cost, arise from the fact that many of these technologies are relatively new. The interaction of a building's occupants with these technologies imports an added layer of uncertainty. Frequently, this results in failure to achieve the expected energy savings. One recent study shows that 'even in recently built structures actual operational emissions are still typically 2-6 times the anticipated design values' (Giesekam *et al*., 2014). The effect of human behaviour on household energy consumption is estimated to account for 51% of the variance in heat demand and 37% of the variance in electricity demand between different energy users (Kelly *et al.,* 2012).

The more the time horizon is extended into the future, the more difficult it is to estimate performance. These multiple risk factors combine to make it difficult to estimate the level of savings to be achieved either in an energy retrofit or over the life-cycle of a green building, making EeB a less attractive proposition to investors (Mills *et al.*, 2006). In reality, actual energy savings achieved are often less than predicted, reinforcing investor caution. 'Study after study has shown that measured energy savings often deviate significantly from predictions, and typically in unfavourable ways' (Mills *et al.*, 2006). In the words of Deng *et al.* (2014), 'the ambiguity regarding realisation of estimated savings was ranked as one of the highest market barriers for the adoption of EPC in the private building sector'.

Finally, risk aversion can be increased by the modelling challenges associated with energy efficient buildings. Models may fail to consider all the costs, benefits and uncertainties of a retrofit project. There is also difficulty in accessing energy-use data. Consequently, the evidence of the cost-effectiveness of a retrofit may be insufficiently clear to support capital investment. 'More emphasis should be put on the modelling and verification part of a project in order to reduce uncertainty, improve model predictions and thereby enhance the building owners' and lenders' trust in the contractors' (Bertone et al, 2016: 542).

1.6.4 *Externalisation of Energy Costs*

Persson & Gronkvist (2014) argue that many of the costs of conventional energy generation and use are externalities, and 'As long as the costs of social and environmental aspects associated with fuel production, distribution, and consumption, as excluded from the fuel prices, this will sustain less than optimal energy-efficient technologies'. Giesaker *et al.* (2014) also note that the costs of carbon emissions are still not effectively absorbed by either the emitter or consumer. The result is to limit the premium for 'green' properties in both the residential and commercial property markets. An internalisation of the full costs of energy use and generation, for example by integrating sustainability issues into property valuation theory and practice, would significantly increase the competitiveness of energy efficient homes (Persson & Gronkvist, 2014).

1.6.5 *Impact on Property Value*

Energy retrofit can have a significant impact on both the resale and rental value of a property. A number of studies in the US and Europe have suggested that the market value of retrofitted buildings can increase substantially, by 13.5% for green buildings compared to non-green buildings (Pivo & Fisher, 2009, referenced in Bertone et al, 2016) and up to 6.6% for buildings with high energy efficiency (Brounen *et al.*, 2009, cited in Bertone et al, 2016). 'The literature reports that green buildings have a greater market demand, willingness to pay and rental values than conventional buildings' (Olumnunmi et al, 2016:1616). The increased value of energy efficient or green buildings is due to lower energy costs, better indoor climate and higher energy class (Holopainen et al, 2016:157). This represents an immediate investment return and should be regarded as such by the stakeholders (Bertone et al, 2016: 540). However, this added value of the property resulting from energy retrofit is often disregarded, and is at present insufficiently reflected in property valuation practice and techniques.

1.6.6 *SPLIT INCENTIVES*

Split incentives can occur both between the developers of buildings and their future users, and between landlords and tenants. In the first case, a construction firm is unable to benefit from the energy savings of an energy efficient building; consequently, in the absence of strong market demand, there are limited incentives to build them (Persson & Gronkvist, 2015). Problems also arise where the owner of a building pays for an upgrade, but the savings from this will benefit the tenants. One result is that in some countries, such as the UK, most retrofitting of commercial buildings has taken place in properties occupied by the owner (Rhoads, 2010, cited in Bertone et al, 2016: 540). Gillingham, Harding, and Rapson (2012) show that owner-occupied houses in California are 12 to 20 percent more likely to have insulation than rentals, conditional on other observable characteristics of the property, occupant, and neighbourhood (Allcott & Greenstone, 2012: 20).

1.6.7 *INFORMATION*

The existence of independent and impartial information about the benefits of energy-efficient technology is crucial for its widespread adoption, and the frequent absence of sufficient information represents a significant market failure. 'One English study found that 78% of survey participants felt the lack of data on the cost of zero carbon homes was a significant or major barrier' (Osmani & O'Reilly, 2009, cited in Persson & Gronkvist, 2015). Even when information is available, it is often too complicated to analyse. In particular, there may be little reliable information on the costs and benefits of different potential interventions to improve the energy efficiency of buildings (Bertone et al, 2016: 540). In response to these deficiencies, the active involvement of government in setting up and maintaining knowledge transfer can help producers and consumers to make more informed and rational decisions and highly influence the rate of diffusion (Persson & Gröknvist, 2015: 298). Rogers (2003) stresses the importance of good communication channels through which trustworthy information can flow in increasing the diffusion of energy efficient solutions. Information creates both awareness and acceptance of new energy technologies, with awareness being enhanced through the mass media, while acceptance can often be generated most effectively through face-to-face communication (Rogers, 2003). 'In order to increase the possibility of becoming accepted, information should be specific, vivid, simple and personal' (Stern and Aronson, 1984, quoted in Persson & Gröknvist, 2015: 298).

1.6.8 *NATIONAL AND EU POLICY*

National and European policy and regulations have emerged as a key driver for energy efficient buildings (Dowson et al, 2012:299). Government supports include a mix of financial and non-financial incentives. Financial incentives are the most common, and involve a direct financial benefit to recipients. They include grants, tax incentives, rebates and discounted development application fees (Olumnunmi et al, 2016: 1615). Non-financial incentives include easing regulations on floor-to-area density, technical assistance, expedited permitting, business planning assistance, marketing assistance, regulatory relief, guarantee programmes, and dedicated green management teams in building and planning departments (Olumnunmi et al, 2016:1615). They usually involve the government granting building owners additional rights beyond those normally allowable, provided certain conditions are fulfilled.

European regulations have arguably been even more significant than national policy as a driver for energy efficient buildings. On 19 May 2010, the European Parliament and the European Council adopted a recast of the EPBD. This stipulated that by the end of 2020 EU Member States must ensure that all newly constructed buildings consume 'nearly zero' energy and that their energy needs must be met, to a significant extent, by renewable sources, including energy produced on-site or nearby (Schimschar *et al*., 2011). A range of policy measures have been adopted in different member states to assist in achieving this goal. As a result of these national and European policy initiatives, 'green practice is well on the way to becoming mandatory for all construction projects, rather than a socially conscious, idealistic option. In other words, green or sustainable building may cease to be an environmental or commercial business option but rather an unavoidable requirement' (Olumnunmi *et al.,* 2016: 1615).

1.6.9 Regulatory Deficiencies

On the other hand, the regulatory framework for energy efficient building also suffers from some deficiencies. Existing regulatory policies can be poorly designed – for example when they offer the same benefit for different retrofitting strategies, irrespective of their effectiveness. 'In 2007 the Italian government provided a tax deduction of 55% of the capital cost of any intervention on existing buildings leading to a reduction in carbon emissions, but later analyses showed that many of the retrofitting solutions which were adopted as a result were not the most energy-efficient' (Sardella, 2016, cited in Bertone et al, 2016). Moreover, the development of building codes and standards can lag behind the development of technologies, resulting in barriers to

energy-efficient innovation. For example, new building regulations adopted by Sweden in 2012 were widely criticised for being too lenient (Persson & Gronkvist, 2015: 298). Kelly *et al.* (2012) suggest that building performance codes can hinder innovation, because when innovative products and technologies are not included in them, this acts as a barrier to market uptake. Writing from a UK perspective, they note that if a new technology does not contribute to the calculation of the SAP rate, there is no motivation to include it in design, construction or renovation of a building. 'It is therefore important that SAP procedures explicitly foresee the possibility of new technologies and innovative systems, which are not covered by the standard procedure' (Kelly *et al.*, 2012).

1.6.10 Ownership

Change of ownership of a building can open a window of opportunity for refurbishment. Weiss *et al.* (2012) suggest that the period of transfer of ownership represents a unique window of opportunity during which a greater willingness to carry out energy efficiency improvement measures often exists. This could be exploited by, for instance, insisting on an obligatory energy consultation at which an energy efficiency consultant could discuss the energy efficiency of the structure with the new homeowners and, where necessary, advise them on ways to improve it (Weiss *et al*. 2012).

1.6.11 Occupant and User Considerations

Occupant and user considerations such as comfort, utility, aesthetics, or environmental consciousness can impact on the attractiveness or otherwise of an energy retrofit. The inconvenience associated with building refurbishment can also act as a disincentive. Allcott & Greenstone (2012) note that retrofitting takes time, and for building occupants it is not highly enjoyable: 'the process requires one or sometimes two home energy audits, a contractor appointment to carry out the work, and sometimes additional follow-up visits and paperwork' (Allcott & Greenstone, 2012: 16).

1.6.12 Pro-environmental Values

Another non-monetary incentive driving energy-efficient building is pro- environmental beliefs, which are based on altruistic or personal moral norms and values (Olumnunmi et al, 2016: 1616). The values and attitudes of stakeholders, including building owners, designers, contractors and the general public have a decisive effect on the diffusion of energy retrofit and green building technologies. These determine what non-financial aspects of an energy efficient building are seen as significant or valuable. Such characteristics include 'various unique benefits as resource

use efficiency, increased marketability and enhanced societal reputation, which appeal to the goodwill of stakeholders (including project owners) and, as a result, encourage their interest in adopting green building practices' (Olumnunmi et al, 2016:1615-1616). Building owners and designers can also achieve recognition through awards and green certification through assessment systems. 'To owners, these are gratifying as it leads to a feeling of gratification since their image and reputation are increased' (Olumnunmi et al, 2016:1616). Consequently, public relations and peer pressure can be important incentives of energy efficient building among commercial and institutional clients.

The evidence for consumer attitudes more broadly is ambiguous: there are indications both of reluctance to pay a premium for EeB and of the emergence of a low-carbon culture and more sustainable lifestyles (Persson & Gronkvist, 2014). Several studies do indicate that an increasing number of customers are willing to pay more for green products and services (Al-Saleh & Mahroum, 2015). One survey found that over two-thirds of respondents would pay more for an energy-efficient home (Kelly *et al.,* 2012). 'From a consumer perspective, it is often the non-energy benefits that motivate decisions to adopt energy efficient measures' (Reddy, 2013: 414). These include an improved indoor and outdoor environment, better comfort, health, safety, and productivity, reduced noise, labour and timesavings, improved process control, and increased reliability, amenity or convenience (Reddy, 2013: 414).

The holistic approach required by low energy building also stands in contrast to many traditional features of the construction industry. This is characterised by a 'building process in which there are many steps between the intentions of the customer and the finished product' according to Persson & Gronkvist (2014). The culture of the industry is also predominantly conservative, cost-driven, and risk-averse, with the result that stakeholders are reluctant to use new sustainable materials or technologies in circumstances where they stand to suffer the consequences of any failures. 'Consequently, new materials, technologies or practices are often faced with significant barriers to market entry and expansion' (Giesekam *et al*., 2014).

1.6.13 Project Champions

In a study of the Swedish market for energy efficient houses, 'Many of the interviewees talk about ideology and their attitude towards environmental issues as part of their motives' (Persson & Gronkvist, 2015: 302). Since the Swedish market has been characterised by a fairly weak demand from consumers, it has had to rely on 'driving spirits who passionately have

worked for the societal importance of improving the energy efficiency in the housing stock' (Persson & Gonkvist, 2015: 297). The authors conclude by stating that 'There is not one specific barrier that keep energy-efficient housing from taking off. Instead the barriers include a whole range of issues that have to be considered. The results indicate that personal commitment is central and perhaps the strongest driver' (Persson & Gronkvist, 2015: 302).

1.7 Participatory Design

Participatory design refers to family of approaches that attempt to widen participation in design and integrate the perspectives of end-users in the design process. Participation in this context is not just a matter of consultation or conducting research into end-users' habits or opinions. It involves a fundamental transformation of the user's role 'from being merely informants to being legitimate and acknowledged participants in the design process' (Robertson & Simonsen, 2013: 5). Participatory design can also have the potential to bring researchers and end-users closer through dialogue and continuous learning (Svenfelt et al, 2011). The literature on participatory design derives from research in a wide range of areas including information and communication technologies, consumer goods, planning and urban development, and architecture and building design. It should be noted that participatory design is not a new concept; it dates back several decades at least (Woolley, 1985). Participatory design promotes the active involvement of stakeholders, such as citizens, employees, customers and end users, who are not usually afforded a central role in the design process (Cross, 1993). Robertson & Simonsen (2012) describe it as comprising 'the direct involvement of people in the co-design of tools, products, environments, businesses, and social institutions'. They see the participatory design approach as 'a process of investigating, understanding, reflecting upon, establishing, developing, and supporting mutual learning between multiple participants' (2013: 2). Users move from being passive informants to having an active design role that is acknowledged by other stakeholders as both legitimate and valuable (Robertson & Simonsen, 2013). They are recognised as experts on their own experience, and consequently play a large role in offering knowledge, generating ideas and in concept development (Sanders & Stappers, 2008). The design professional supports the user by providing tools for ideation and expression. Participatory design is therefore a two-way process of mutual learning for both designers and users (Robertson & Simonsen, 2013).

To date, however, participatory design has tended to be deployed on smaller-scale projects rather than on large-scale developments (Dalsgaard, 2012). User involvement 'remains a vague

concept and a highly varied practice' while 'design discourse has merely scratched the surface in unpacking meanings about participation and the ways these meanings affect design outcomes' (Winschiers-Theophilius *et al*, 2012). In urban regeneration and planning, in particular, there is often a profound contradiction between the declared intention of participatory processes and their actual achievement in terms of community involvement and impact on project outcomes (Ferilli *et al*, 2015). While inclusivity is acknowledged as a key component of new approaches to building design such as integrated design process, there is still no consensus on how to achieve it.

There is increasing recognition in the literature of the benefits of inclusive, collaborative approaches to building design. In particular, the involvement of occupants and other end-users in the design process has important advantages for building energy retrofit projects. At the same time, effective implementation of participatory design encounters a number of challenges. One benefit of participatory design, which has been touched on already, is that building occupants and users are by definition the experts on their own lives. By actively involving them, the design process benefits from a uniquely informed perspective on their needs and requirements. This provides for a better design fit and for retrofit solutions that are more appropriate for the occupants' needs. Moreover, early engagement with building occupants, which incorporates their needs and desires in the design process is the most effective way of avoiding conflict – and the delays, cost overruns and planning difficulties that often accompany it. It is widely acknowledged in the literature that occupant and user participants in the design process bring new information, motivation to address problems, and new ways of understanding issues to the design process. These can be used to generate better projects and policies, secure buy-in for decisions, and limit delays, mistakes, and lawsuits. The process of participation may enhance trust, build social capital, and generate infrastructure for on-going community action (Bryson et al, 2013). Occupants also have a key influence on the successful operation of energy retrofit solutions. This is particularly important given that studies show household behaviour affects residential energy use to the same extent as equipment and appliances (Lindén, Carlsson-Kanyama, & Eriksson, 2006). Even where buildings have been retrofitted to high thermal standards or incorporate energy-efficient technologies, ingrained patterns of behaviour mean that many households continue to consume more energy than expected (Galvin, 2013; Gram-Hanssen, 2011).

1.8 CONCLUSION

The concepts outlined above help us understand how value is generated in the energy-efficient building sector, including retrofit, and how it can be maximised for the different stakeholders. The value network in a sustainable building project embraces all those stakeholders whose interactions give rise to the different dimensions of value generated by the project. This network includes the design team, client, building contractors and others directly involved in the project. But it also includes stakeholders such as building occupants and users, public bodies (local authorities, planning bodies), financiers (public or private), neighbours, facility managers, and others. Their interactions can produce a wide variety of values. As noted earlier, these are likely to include monetary values, but also less tangible values such as heritage preservation, professional reputation, aesthetics, environmental benefits, occupant comfort, or health and wellbeing.

Critical questions to be addressed for this perspective include: Who are the stakeholders in building refurbishment projects? How do their relationships produce value at the different stages of the building refurbishment process? Can we identify points at which conflicts of interest; failures of communication, or the exclusion of certain stakeholders diminish the process of value-creation? Can stakeholder management be improved to enhance the value generated? In particular, how can the relationships of occupants and users to a refurbishment project be cultivated so as to enhance the value it produces for everyone involved? Providing data that will allow us address these questions is the central purpose of Task 1.1. In carrying out this work, we have followed a modified version of the steps for stakeholder analysis identified by Johnson and Scholes (1999) in combination with the typology of stakeholder salience developed by Mitchell *et al.* (1997). This involves:

- Identifying and characterizing key stakeholders;
- Assessing stakeholder salience according to the criteria of power, urgency and legitimacy;
- Assessing stakeholders' interests, drivers and motivations, in particular as regards whether they incentivise or disincentivise energy efficient building, and how this might evolve given changes in policy, market and technological drivers;
- Assessing the participation of building occupants and users in the design process.

Stakeholders in building energy retrofit are identified in Section 4.1, based on a combination of previous research and a scoping exercise carried out at the outset of T1.1. Section 4.2 undertakes

an assessment of stakeholder salience, maps out the interactions between stakeholders at each project stage, and suggests how these generate value. Section 4.3 outlines stakeholders' interests, drivers and motivations in respect of energy retrofit based on the results of the interviews, while 4.4 addresses occupant and user considerations.

2 METHODOLOGY

In addition to the literature review and stakeholder identification, the research for T1.1 to date has included interviews with 54 stakeholders in building refurbishment projects in a range of European countries. This section outlines the methodology of the literature review as well as the field research and the analysis of the resultant transcripts. Section 4 summaries the relevant findings.

2.1 REVIEW OF LITERATURE

A critical part of any research study is a review of literature relevant to the topic at hand. Schwandt (2007:266) notes that literature reviews involve the comprehension, analysis and synthesis of multiple studies with a view to solve a problem, understand an issue, explain a relationship, *etc.* Literature reviews are often considered almost a precursor to 'actual' research, while in fact it is an integral and a crucial part of the research process. Moreover, a review of literature can in and of itself constitute a worthwhile research method leading to new knowledge and insights (Torraco, 2005).

The primary sources use of literature used for this research were bibliographic databases. As the strengths of various database services differ, it is considered advisable to use a number of these, so as to overcome the weaknesses that may be associated with individual services (Falagas *et al.*, 2008). For the purposes of this research, the primary bibliographic databases utilised were: Science Direct, Web of Science, SCOPUS, and JSTOR.

These databases were queried using Boolean keyword searches (i.e., based on Boolean logic limited to two values: 0, 1; yes, no; *etc.*), where combinations of words and phrases using Boolean operators 'and', 'or', 'not' were used to search for relevant material. Such queries are flexible and allow for sophisticated searches. Examples of some initial search term combinations employed include: 'built environment' OR 'buildings' AND 'value chain; 'buildings' AND 'renovation OR 'retrofit.

In addition, relevant literature which may have been missed through the database searches was identified through what might be termed a snowballing strategy comprising:

- 'backward snowballing' – literature listed in bibliographies of papers identified through keyword search;

- 'forward snowballing' – literature that has cited the identified papers or which has been recommended by the bibliographic databases based on relevance scoring.

The next stage involved the application of screening criteria to reduce the amount of literature. This involved both practical screening (*e.g.,* language of document; availability through University library; availability through other sources; availability of electronic format, *etc.*) and methodical screening (*e.g.,* methodological background; quality and rigour of the work, *etc.*) The outcome of this screening, which was an iterative process, was a pruning of the literature to a manageable quantum.

The final step comprised the actual review of the documents themselves, which comprised an iterative process of search – read – annotate – organise – summarise – analyse – synthesise. The use of the reference management software greatly facilitated an effective literature review, enabling efficient reading, note-taking and organisation of documents. The aim of this was in the words of Jesson and Lacey (2006) to produce a review that would be "original, perceptive and analytical".

2.2 Approach to Stakeholder Engagement

There are three main types of research, quantitative, qualitative and hybrid blends of quantitative and qualitative. Quantitative research investigates what happened or how many instances of a phenomenon exist; qualitative research is more interested in the why and the how (Walker, 1985 cited in Heyink & Tymstra, 1993). The stakeholder engagement process for NewTREND is of a qualitative nature, and aims to provide an inside view and helps us to understand the nature, strengths, interactions or variables of a subject. Qualitative research is most revealing when the variables of concern are unclear (Black, 1994). Qualitative research seeks depth rather than breadth and falls within the context of discovery rather than verification (Amber et al, 1995). According the Ritchie (2003) the functions of qualitative research are as follows (Ritchie, 2003:26-27):

- Contextual - describing the form or nature of what exists
- Explanatory - examining the reasons for, or associations between, what exists
- Evaluative - appraising the effectiveness of what exists
- Generative - aiding the development of theories, strategies or actions.

Qualitative data can come from three types of sources; interviews: one-to-one or group discussions (workshops, focus groups, interviews, *etc.*), documents, and observation (Brod *et al.*, 2009). The methodological approach taken to the sources, or to the engagement process is known as Action Research, which is an umbrella term for various types of learning and inquiry. It can comprise several methods including interviews, focus groups, questionnaires, dialogue and analysis seminars as well as participatory experience and self-evaluation (Svennson et al, quoted in Martinez & Olander, 2015). The purpose of this form of research is to bring together theory and practice through close interaction with the stakeholders and evaluation of day-to-day realities on the ground in tandem with the theoretical and academic literature, with a focus *on* action rather than *about* action (Martinez & Olander, 2015). Different actors and stakeholders (potential interviewees) experience and evaluate the qualities of their environment in different ways (Gustavsson & Elander, 2015). Participatory research as described by Kersten *et al.* (2015) incorporates a human-centred approach that takes into account the role of people in the energy use of buildings, and consequently foregrounds the importance of stakeholder engagement and occupant behaviour. The acknowledgement of the 'human factor' is especially important in building projects, as retrofitting can be viewed as both a social and technical challenge (Dowling *et al.,* 2014). The aim of the interviews for Task 1.1 was to endeavour to understand the interviewees, their views, values, behaviours, relationships and interactions. This in turn enabled researchers to elicit data on the two main indicator categories: value and stakeholders.

2.3 Short-listing of Potential Interviewees

Interviewees were selected from the various stakeholder categories associated with building construction projects. The list of stakeholder types was then used to generate a long list of possible sectors and organisations from which to select potential interviewees. The long lists were reviewed and categorised into shorter lists to select the most relevant stakeholders from the perspective of the aims of this task. Contact with each of these organisations (or individuals) was made by the project partners in their own countries for reasons of language, convenience and efficiency. Initial contact was via e-mail, phone, letter or social media (*e.g.,* Linked-in), depending on which was most appropriate to the interview candidate. The selection process prioritised candidates who had been stakeholders in an energy upgrade/retrofit project in the recent past. In total so far there have been 30 interviews. The final interviewee selection consisted of a wide array of stakeholders associated with the design process, from the traditional

design team members such as architects and engineers, to local authority personnel, project and property managers, owners and consultants. The breakdown in indicated in Figure 4. The interview participants, the interviewees, are referred to by code, *e.g.,* NT16001, NT16002, NT16003 and so on, as they were assured of the anonymising of data, and any information that might identify them, such as their names or the names of their organisation.

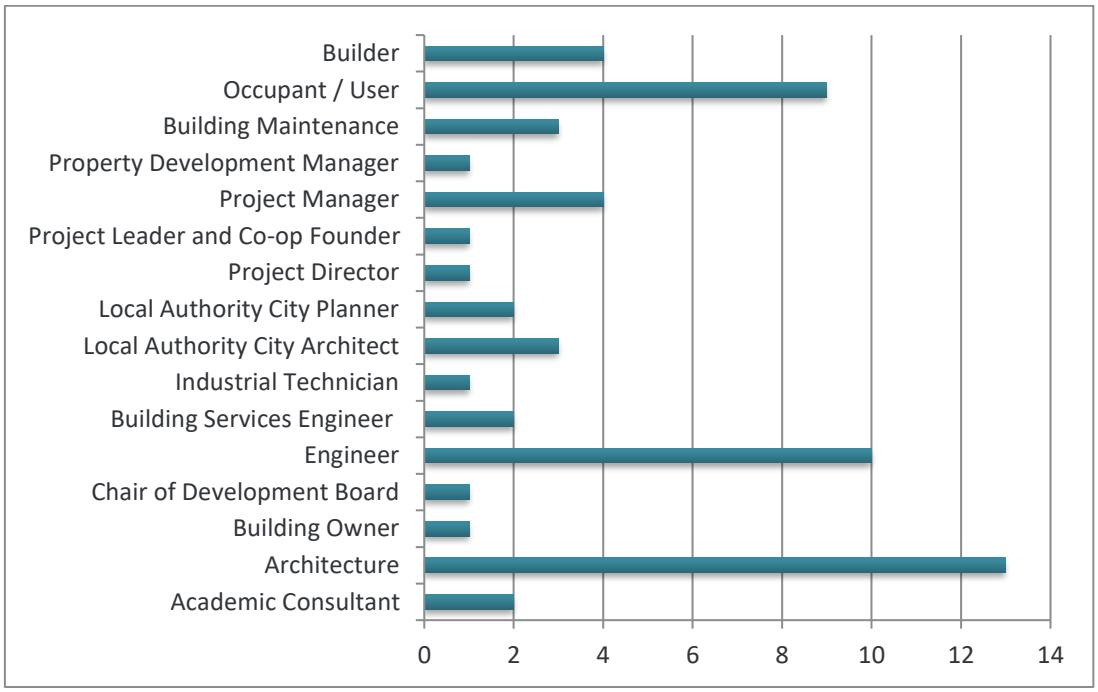

FIGURE 4 : BACKGROUND OF INTERVIEWEES SELECTED

2.4 INTERVIEWS

The interview is considered pre-eminently appropriate for research into feelings, attitudes, intentions, motivations and behaviours (Kerlinger, 1970 in Heyink & Tymstra, 1993:295). Interviews were carried out in a private environment, in this case the place of work of the interviewees, a familiar and comfortable environment. This method was chosen in the hope that the interviewees might be more candid in their responses than in a group or unfamiliar environment. Interviews provide opportunities to treat those whose perspectives and experiences are being sought as knowledgeable, capable, and reflective participants in the research process (Wiles *et al.,* 2005:90).

Random, or probability sampling is considered to be the most rigorous approach for statistical research, where samples, i.e. elements of the population are chosen at random (for interview) and have a known probability for selection to represent a sample of the population (Ritchie *et*

al., 2003:78). This method of sampling would be inappropriate to this project. Qualitative research generally tends towards systematic or non-probabilistic sampling. The sample (pool of interviewees) is not intended to be statistically representative, but instead are chosen because they possess certain characteristics. This is termed criterion-based, or purposive sampling (Rithcie *et al.,* 2003). "The purpose is not to establish a random or representative sample drawn from a population but rather to identify specific groups of people who either possess characteristics or live in circumstances relevant to the social phenomenon being studied" (Mays and Pope, 1995: 110).

Information on stakeholder interactions and value chains involved in building energy renovation was collected through 54 interviews carried out with individuals with experience in refurbishment projects in a variety of European countries. Semi-structured interviews using pre-formed open-ended questions were adopted as the most suitable method, given that interviewees came from across Europe and there would be only one opportunity to talk to each of them. The questions focused on four areas:

- Professional background of the interviewee and detail of a specific energy renovation project they had been involved in;
- Outline of the design process involved, including bottlenecks and integration with the district context;
- Stakeholder interactions in the project;
- Occupant and user participation in the design process.

Persons who took part in answering the questions in the interview process are referred to as interviewees. Interviews were generally carried out face to face. However, telephone interviews were carried out in three instances due to scheduling and travel difficulties. In preparing the interview questions, the researcher team adopted a 'realist' approach as outlined by Sunikka-Blank & Galvin (2015), rather than a purely grounded theory approach, as the latter would assume that the researcher will analyse the transcripts without any preconceived ideas as to what the content and emphasis might be – i.e. identifying these from the ground up. For the purposes of this task, the questions included were designed to elicit details of the stakeholders involved in the building refurbishment process; their interactions throughout the value chain;

their interests, drivers and motivations; and the engagement of occupants and users in such projects.

The questions were relatively short and simple, and jargon, unexplained acronyms, and complex industry or profession-specific terminology were avoided where possible. Some of the interviews did not follow the order of the set interview schedule, as the answers to a later question may have been forthcoming in an earlier one, or the conversation may have diverted from the format but remained relevant – in which case the interviewee was allowed to lead the conversation, and only steered back to the standard question format when it was deemed necessary by the interviewer. All face-to-face interviews were carried out at a location chosen by the interviewee, and recorded with their consent. Notes were taken, and full transcriptions (not summaries) were completed afterwards. Due to the participatory nature of this research, the communication, attitudes, and language of the interviewees is as relevant was the opinions they express in the interviews, and will be discussed in more detail in the second part of this chapter.

> "Participatory communication in research implies, at its most basic level, that researchers are not solely responsible for generating the research or communicating about it. Research participants, local citizens, or those traditionally referred to as 'the researched' are able to participate in creating and expressing their own knowledge and, in so doing, empower themselves to effect social, political, economic, and cultural change that is appropriate to them." (Cornish & Dunn 2009:666)

> "Participatory communication involves citizen-led approaches to both creating and expressing knowledge; within research, this means that researchers are not simply responsible for generating information and communicating about it, neither are they acting alone. From this perspective, the emphasis of participatory communication is on communicating rather than extracting or delivering information." (Cornish & Dunn: 674)

2.5 ANALYSIS OF TRANSCRIPTS

Interviews were coded using the 'template method' as described by Walker *et al.* (2014). This involves producing a template consisting of a list of codes representing themes identified in the textual data. A code in qualitative inquiry is 'most often a word or short phrase that symbolically assigns a summative, salient, essence - capturing, and/or evocative attribute for a portion of language-based or visual data' (Saldana, 2013). The initial list was developed from a combination of the key research questions reflected in the interview schedule, and themes identified through an initial reading of the transcripts. This coding template was subsequently refined and developed in the course of coding the transcripts - i.e. assigning segments of text to one or more of a set of thematic 'coding nodes'. The nodes used are shown in the following figures:

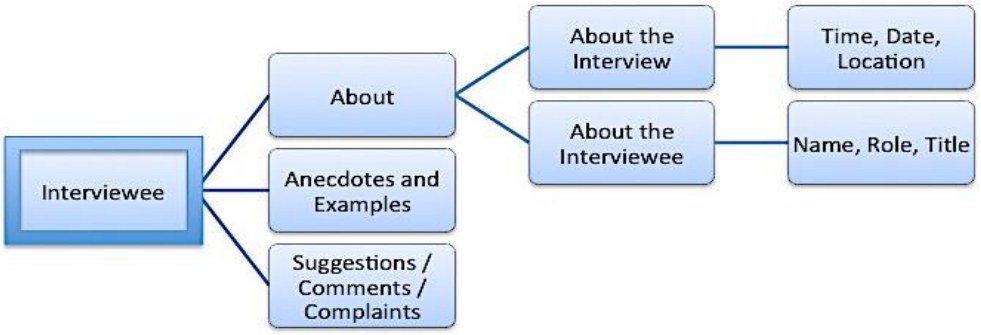

FIGURE 5 : INTERVIEWEE NODES & SUB-NODES

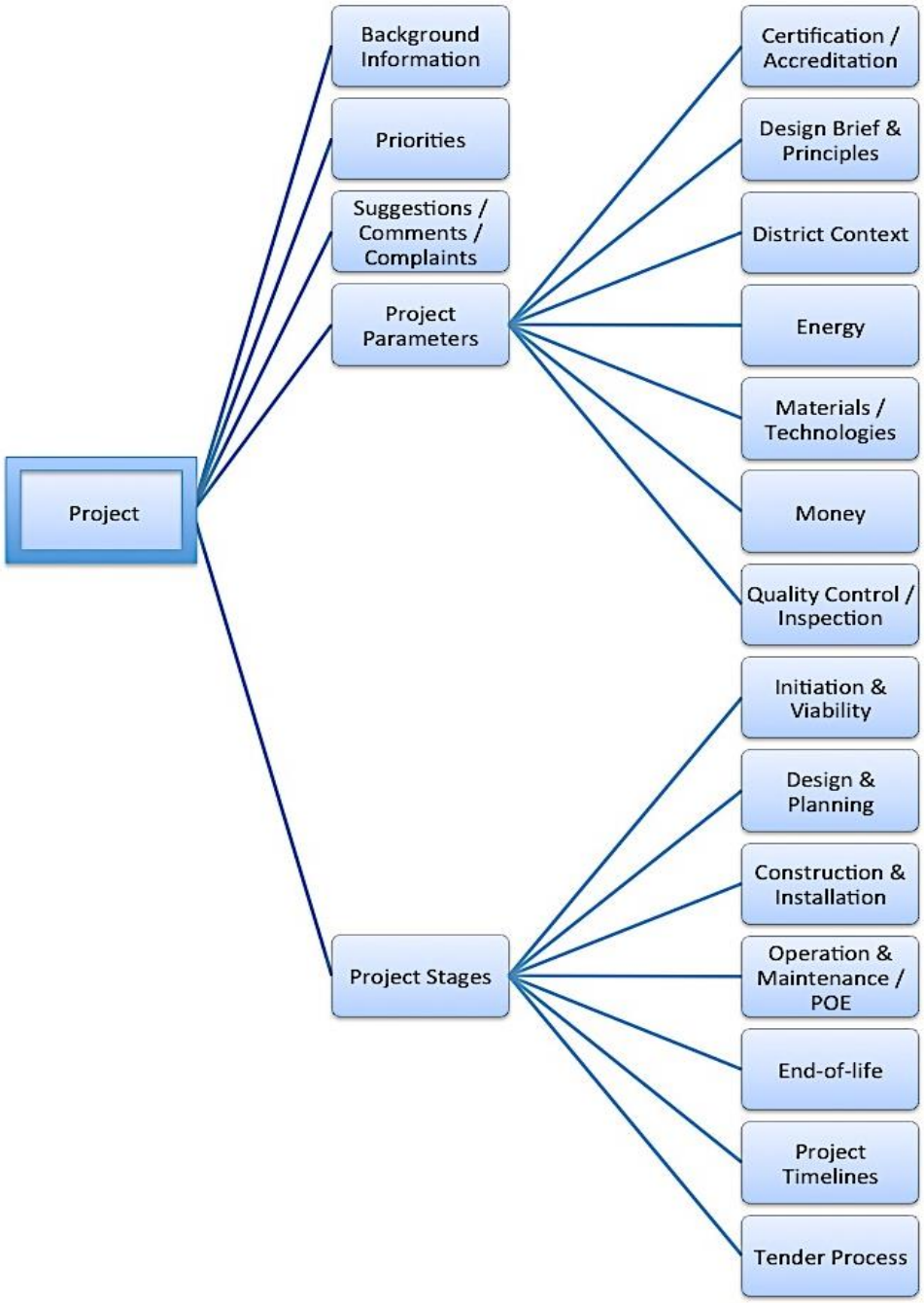

FIGURE 6 :PROJECT NODES & SUB-NODES

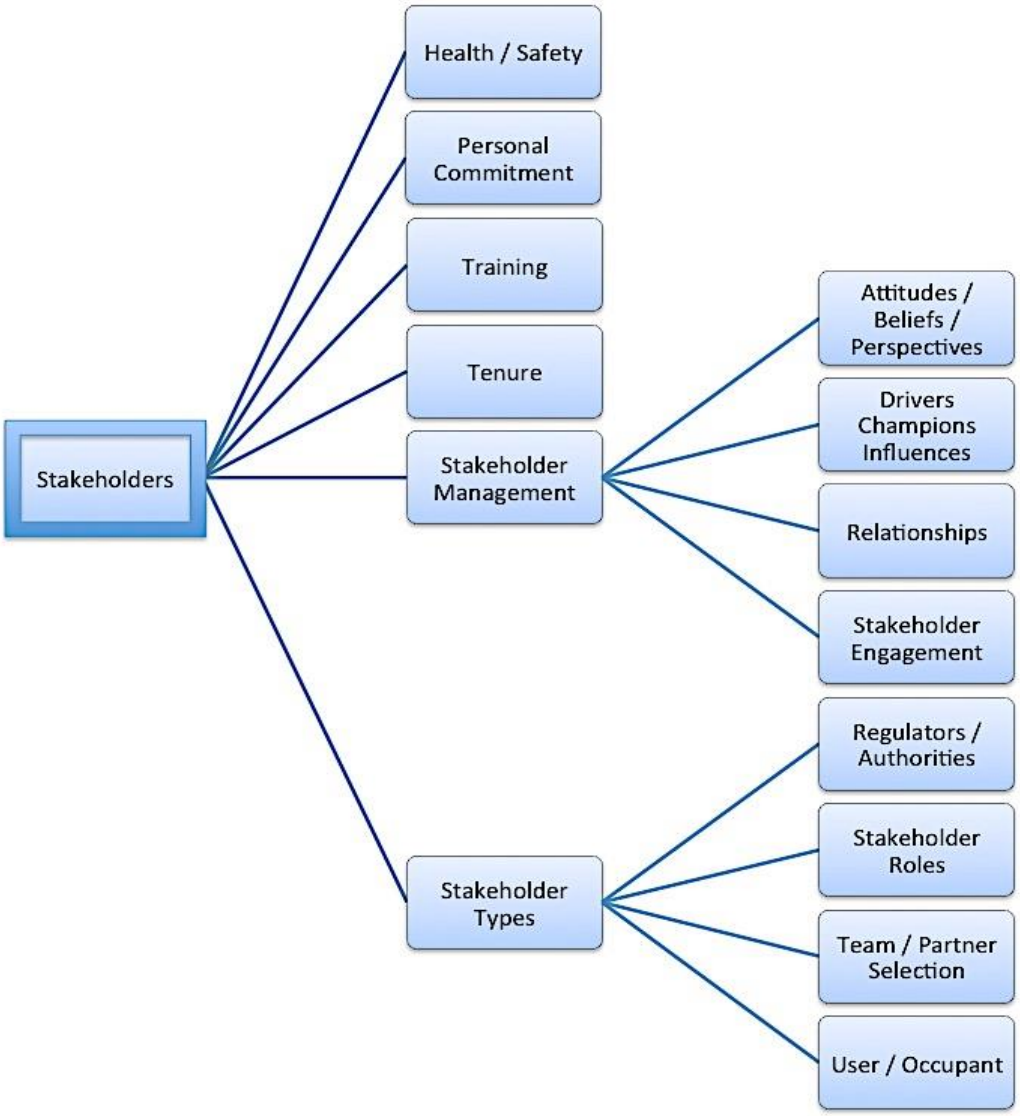

FIGURE 7 : STAKEHOLDER NODES & SUB-NODES

As coding advanced, relationships and hierarchies between the coding nodes became apparent (as evident in Figure 5, Figure 6 and Figure 7 above). When coding was completed, a summary of each coding node was written up, highlighting key points from the interviews, supported with quotes. The material was then organised under headings reflecting the task description. NVivo software was utilised for the interview analysis process. The software replaces the traditional methods of highlighting, underlining, and (literally) cutting, pasting, copying and categorising volumes of printed text. "Good qualitative research involves meticulous data sorting and organization and carefully using ideas generated by the data" (Séror, 2005:323). Nvivo facilitates

this by coding, organising, linking and cross-referencing of digital material such as photos, videos, audio files, and typed documents. NVivo supports both qualitative and mixed methods research, and is designed to help organise, analyse, and find insights in unstructured, or qualitative data like interviews, open-ended survey responses, articles, social media and web content (QSR, 2015). It should be noted that Nvivo is merely a tool for handling the data, a valuable tool, but a tool nonetheless; it does not do the analysis. The interpretation of the data, making sense of it i.e. the analysis is still very much in the hands of the researcher.

Analysis of transcripts is aided by handwritten notes taken during, and immediately after the interview in order to record non-verbal data, facial expressions, gestures and so on. Reading between the lines, what the interviewee does not say, or gesticulations and how they say something can be of significance to the overall analysis. It can indicate sarcasm, emotive issues, glaring omissions, deception, pride, exaggeration, boredom, confusion, pauses and other information that might not be gleaned from the interview text alone. Care has to be taken also with regards what parts of the interview transcript text is to be taken literally, and at face value, and what parts of the transcript text needs to be "decoded". This is somewhat problematic where interview transcripts have been translated from the interviewee's native language to English, where some of the nuances, and meaning may have become lost in translation, therefore verbatim translation is highly recommended. Finally, the results of the analysis were written up and a series of initial findings identified. The following section outlines the findings from the interview transcripts with regards to the topic areas of stakeholders and value, with a particular focus on the occupants and users of buildings also forming the narrative structure.

3 FINDINGS

This section outlines the key findings of the research under four headings derived from the project description, namely: identification and characterisation of stakeholders; mapping of stakeholder interactions and communication flows; interests, drivers and motivations of stakeholders; and occupant and user needs and interests. At its most basic level, this value chain characterisation allows project principals to identify key stakeholders and understand their positionality by preparing power - interest matrices as illustrated in Figures 8 & 9 below.

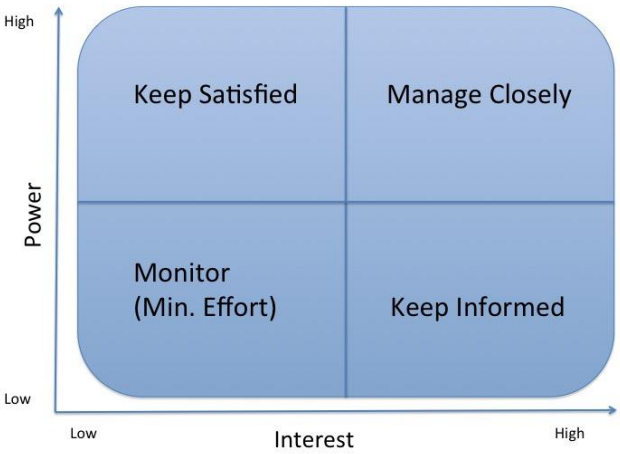

FIGURE 8 POWER/INTEREST MATRIX (PMI, 2008:249)

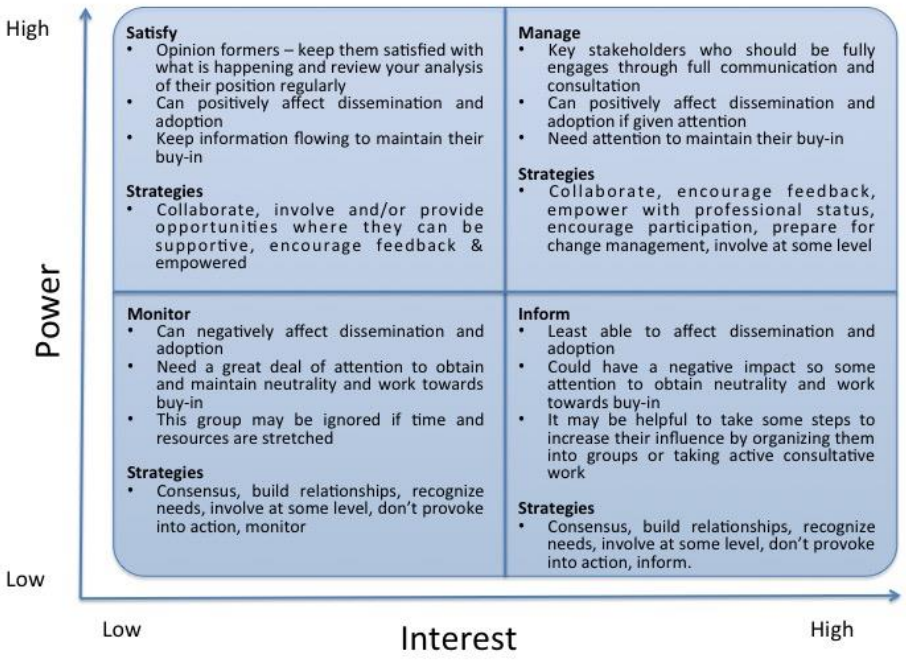

FIGURE 9 ANNOTATED POWER/INTEREST MATRIX (ADAPTED FROM BOON, 2012:6)

A key function of the value chain analysis reported in this document, was to develop an understanding of the value chain(s) associated with building renovation which could inform the development of the integrated design methodology being developed in Task 2.6. In addition, specific attention was paid to the role of inhabitants and users, so as develop an understanding how to involve them in the design of the refurbishment. In this respect, this research fed directly into Task 2.5 Occupants involvement in new design methodology and its associated output, a report detailing approach for occupant involvement in the design process. As these tasks were running concurrently the value chain analysis itself, the findings were fed into T2.5 & T2.6 through a variety of ways including: informal communications; an interim report produced in month 13; and not least through the involvement of the authors in these other tasks

3.1 IDENTIFICATION AND CHARACTERISATION OF STAKEHOLDERS

This sub-section of the report seeks to identify and characterise the stakeholders in energy retrofit projects. A building or district scale energy retrofit is a significant project which draws on the skills and resources of many different organisations and professionals, impacts on a range of people from building occupants and users to neighbouring residents, and may have implications for municipalities, planning authorities, heritage bodies and utilities. In order to develop a useful typology of stakeholder interactions, it is necessary to reduce the wide variety of possible stakeholders to a limited number of generic categories and order them hierarchically in terms of their relation to the project. Drawing on the results of the interviews, a literature review, and work previously done in UMBRELLA, dozens of possible stakeholders were identified and included in an initial list. These were then assigned to one or another of a limited number of categories of stakeholder, such as design team, client, statutory body or end user. There are five groups of stakeholders that fulfil various roles, in some cases more than one role, in a project. These are the occupants and users of buildings, the owners, the designers, the builders and all others. All of these are designated as stakeholders as per the definition ‘can affect or be affected’ (as described earlier in this document).

The stakeholders are also naturally divided into two groups: those who are centrally involved in the design and delivery of a project, and those other stakeholders who impact on or are impacted by the project in a variety of ways. To reflect this, a conceptual distinction was made between project roles and stakeholder categories.

3.1.1 PROJECT ROLES

Project Roles refer to a limited number of generic roles that are inseparable from the delivery of any building or district refurbishment project. Each of these roles will be present in any project, but can be filled by different types of stakeholder. For example, the client in a project might be the owner of a building, a development company, or local authority/municipality acting on behalf on multiple owners of different buildings. Ownership in turn can be complex, involving different types of stakeholders such as owner-occupiers, institutional investors, trustees, landlords, *etc.*

Client

Role: The client initiates a construction project and contracts with the designer and contractor to design and build it. They have either legal ownership or control of the building for the duration of the project. *Examples:* Owner occupiers, landlords, developers, municipalities, state agencies, housing associations, boards of universities, trustees, special purpose vehicles, cooperatives.

Design Team

Role: The design team includes all those involved in translating the requirements of the client into a finished design for the project, which takes into account the budget and the constrictions of the site as well as the needs of occupants, users, public authorities and the wider neighbourhood. The design team will usually include one partner who is the lead designer, producing an overall architectural vision for the development, and a range of specialists who contribute their own specialist expertise to the design of different aspects of the project. It may or may not include a client representative depending on how involved the client is in the design. *Examples*: Architect, architectural technician, engineer (civil, structural, mechanical, electrical, services), quantity surveyor, energy consultants/assessors, ESCOs, energy certification consultant, architectural specialists (landscape, conservation), interior designers, design specialists (multimedia, *etc.*), client representative.

Project Manager

Role: The project manager is responsible for the implementation of the building project according to the design. They will liaise between the client, the design team and the various contractors to ensure the work of construction is carried out efficiently and smoothly and in accordance with the wishes of the client. *Examples*: A variety of different stakeholders can

assume the role of project manager. It could be an architect, engineer, main contractor, or a representative of the client.

Building Contractor

Role: The building contractor is a construction company that has been contracted to carry out all or a portion of the construction work on site. The main contractor undertakes to carry out all the construction work; specialised tasks within this may then be subcontracted to companies or professionals with specific skills. *Examples:* Main contractor, sub-contractor, specialists, *etc.*

3.1.2 STAKEHOLDER CATEGORIES

Stakeholder categories are groups of stakeholders who do not have responsibility for the delivery of a project, but who impact or are impacted by it in various ways. For example, the category 'public and statutory bodies' includes all those who exercise a regulatory function over the design and implementation of the project, such as local authorities, planning bodies, environmental protection agencies, and health and safety authorities. Several such bodies may be engaged in different ways with the same project at different times over its lifecycle; they will not all fulfil an identical role, but there is sufficient similarity to allow them be placed in the same category.

Financiers and Associated Services

Role: External parties involved in providing finance for a project, whether in the form of investment funds, loans, grants or tax rebates; also in providing services which facilitate the provision of finance, such as assessing cost. *Examples*: Shareholders, investors, banks, national and local governments, public grant programmes, energy supplier schemes, solution-provider backed schemes, ESCOs, donors, charities; insurers, accountants, quantity surveyors.

Public and Statutory Bodies

Role: Public and statutory bodies include all those who exercise a regulatory function over the design and implementation of the project. As well as bodies charged with implementing legislation and regulation, this category all includes those public bodies that establish legislation and regulations. *Examples*: Local authority (including planning department, architect's office, traffic, roads and housing departments, heritage officers, mayor, chief executive and councillors), planning bodies (including planning appeals boards), environmental protection

agencies, health & safety agencies, fire services, EU, national and local legislators, standards bodies (ISO, CEN), green building certification schemes (BREEAM, LEED, Passivehaus, *etc.*)

End-Users

Role: End-users are all those who will use the building. A single project can incorporate many different categories of user, each of whom will have different needs that will have to be taken into account in the design process. The different categories of staff who may be employed in a building are also users of the facilities, who will be particularly important from the point of view of energy efficiency. *Examples*: Staff, tourists, students, service users, customers, occupants.

Occupants

Role: Occupants are a specific class of users who include all those who are resident in the building, whether on a short-term or long-term basis, before, during or after the retrofit. Occupants are therefore not a single category of users and as part of the design process specific consideration will need to be given to the different kinds of occupants who may inhabit a building over its lifetime and how their needs can be incorporated. In the case of a retrofit project a building will often already be occupied at the initiation of the project. Occupants will then need to be taken into account through every stage of the design and construction process, including through minimising disruption. *Examples*: Owner-occupiers, tenants (commercial and residential), subtenants, student residents, hotel guests, *etc.*

Building Management

Role: These are individuals professionally engaged in the on-going management of buildings and their energy systems after commissioning. They can include specialist individuals or entities such as maintenance staff, facility managers, ESCOs, *etc. Examples*: Facility managers', maintenance staff, ESCOs, *etc.*

Community and Civic Society

Role: These are parties who are not involved in the project, but impact or are impacted by it due either to physical contiguity (living in the surrounding neighbourhood) or some special interest (members of environmental or heritage NGOs). It is worth noting that in many cases (such as developments including retail or service functions) stakeholders in the surrounding community

may also be potential users of the facility. *Examples*: Residents in surrounding areas, businesses, neighbourhood and community associations, sporting and voluntary groups, local business groups, road users, NGOs, special interest and campaign groups, general public.

Consultants and Third Parties

Role: These are parties whose involvement in the project is limited to a consultative role involving a particular area of expertise, which is not directly related to design or construction. *Examples*: Planning consultant, auctioneer, media and marketing, property valuation, insurers, utilities, *etc.*

Materials, Solutions and Infrastructure Providers

Role: This category includes all those stakeholders engaged in the manufacture of building products and technical solutions, in research and development, the training and education of workers for the construction sector, or the provision of infrastructure such as roads, sewerage, telecommunications and electricity. Many of these stakeholders are engaged in 'upstream' activities and may have no direct contact with a particular building project. Others are engaged in 'downstream' activities to do with waste disposal and recycling. Both groups can be easily overlooked. However, without the input of manufacturers, researchers, utilities, waste disposal and educational institutions building projects could not go ahead. The livelihoods of these stakeholders will also be impacted by broader trends in the construction industry. *Examples*: Primary producers, material processors, manufacturers, standards bodies, R&D institutions, retailers and distributors, solution providers, logistics, education and training institutions, utilities, infrastructure providers, waste contractors, recycling firms.

Table 6 below gives an overview of project roles and stakeholder categories and the kinds of individual stakeholders who may fall under each.

Project Roles	Client	Owner occupier, landlord, commercial developer, municipality, state agency, housing association, charity, special purpose vehicle, cooperative
	Design team	Architect, architectural technician, engineer (civil, structural, mechanical, electrical, services), planning consultant, quantity surveyor, energy consultants/assessors, energy service companies, architectural specialists (*e.g.,* landscape, conservation), interior designers, design specialists (*e.g.,* digital multimedia, exhibition designers, *etc.*), client representative
	Project manager	Architect, engineer, main contractor, client representative
	Construction contractors	Main contractor, sub-contractors, specialist services
Stakeholder Categories	Occupants	Owner-occupiers, tenants, sub-tenants, student residents, hotel guests, hospital patients, prisoners, tenants' associations, residents' associations
	End-users	Occupants, staff, customers, students, patients, tourists
	Building management	Facility management, ESCO
	Community and civic society	Nearby residents, nearby businesses, residents' and community associations, voluntary groups, business associations, municipalities, elected representatives, NGOs, civil society organizations, public
	Financiers and associated services	Shareholders, investors (traditional and 'green' focussed'), banks and other traditional institutions, public grant programme, energy supplier schemes, solution-provider backed schemes, donors, ESCOs, charities, insurers, quantity surveyors
	Public and statutory bodies	Municipality (planning, building control, heritage, traffic), planning appeals board, building control, statutory regulators, environmental protection agencies, health and safety agencies, fire service, EU, national and local legislators, standards bodies, green building certification schemes, waste authorities, EPAs
	Materials, solution and infrastructure providers	Primary producers, material processors, manufacturers, standards bodies, R&D institutions, retailers and distributors, solution providers, logistics, education and training institutions, utilities, infrastructure providers, waste contractors, recycling firms
	Consultants and third parties	Legal advisors, property valuation, auctioneers, insurers, planning consultant, media and marketing, utilities

TABLE 6 : LIST OF STAKEHOLDER GROUPS IN CONSTRUCTION PROJECTS

3.2 MAPPING OF STAKEHOLDER INTERACTIONS AND COMMUNICATION FLOWS

This sub-section describes and maps the interactions of actors within the value chain, and in particular the pattern of communication flows, building on the identification and

characterisation of stakeholders in section 4.2. (Some of this work was carried out in conjunction with the development of use case scenarios within Task 1.3). The results of the interviews are drawn on to illuminate the nature and quality of interactions that take place in the value chain for building retrofit. The model of stakeholder salience developed by Mitchell *et al.* (1997) is also used to characterise the relationship of stakeholders to the project at each stage of its evolution. In this model, stakeholders are described as possessing power, legitimacy or urgency – or a combination of any two or three of these, as described earlier in Section 2.4.

3.2.1 Stakeholder Interactions at the Initiation & Viability Stage

This phase of activity is concerned with the definition and initiation of the project and demonstrating its viability. Depending on the size and scope of the project this stage may involve any or all of the following activities; the building owner consults the occupants, instigates a building condition survey, instigates a building energy audit, consults financiers, considers their options and draws up a design brief. The majority of activity taking place at this stage centres on the owners of the building, or proposed building. These are the definitive stakeholders from whom the initial idea to build or retrofit originates, who will consider the viability of the project, initiate the project, and secure the relevant finance. Therefore, they are indicated in the centre of Figure 10 below, which is based on Mitchell *et al.*'s (1997) Stakeholder Salience typology. The owner (also known as the client within the construction industry) will also hire the design team at this stage. There are a number of ways of doing this: the owner may handpick the design team, they may be assembled based on recommendation or reputation, or they may compete for their place on the team in an architectural competition or via a tender process.

On a new build the architect is traditionally the design team leader, however, on a retrofit it could be a building services engineer who fulfils this role, particularly where the design brief may be more focussed on building services, for example if there are renewable technologies such solar panels, heat recovery ventilation or similar involved. The owner may also provide a project manager, either from within their organisation, or from an external organisation, in order to oversee the project. Financiers are also consulted at this stage in order to assess access and availability of funding and project budget figures. If a building is occupied, the owner may consult the occupants regarding their views on the refurbishment – or the occupants themselves may be the ones requesting the works. While a formal permitting process with planning authorities may not begin at this stage, the owner will already need to consider what type of development

is allowed, information on local area land zoning, what type of permits might be required and so on.

It will be important at this stage to identify the stakeholders, determine their salience, and then assess their requirements. Figure 10 offers a generic model of stakeholder salience at the initiation and viability stage.

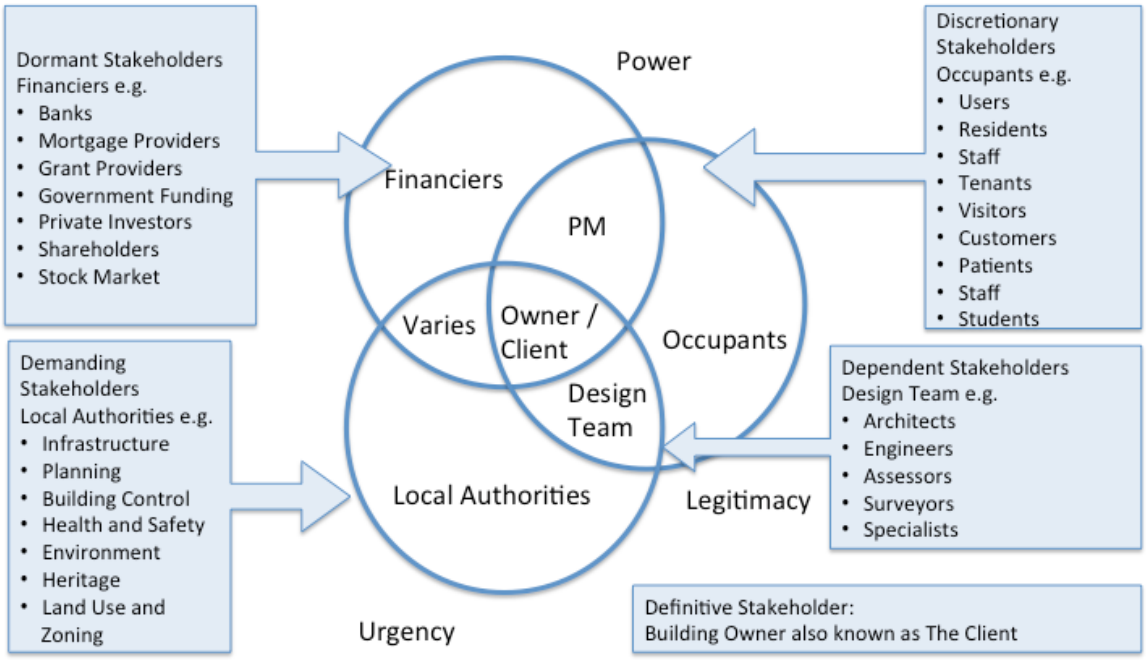

FIGURE 10 : **GENERIC STAKEHOLDER SALIENCE SCHEMATIC FOR PROJECT INITIATION & VIABILITY STAGE**

The design team are dependent stakeholders; they do not yet have any power. The financiers have the power to give the project the go ahead, or not. The project manager (where one is appointed) will have both power and legitimacy, and will become a dominant stakeholder at this stage. Local Authorities may be demanding stakeholders (depending on the particular circumstances) where the project within their jurisdiction – they will demand that it be safe, compliant with regulations and so on.

Figure 11 below offers a generic mapping of communication flows between stakeholders at the initiation and viability stage.

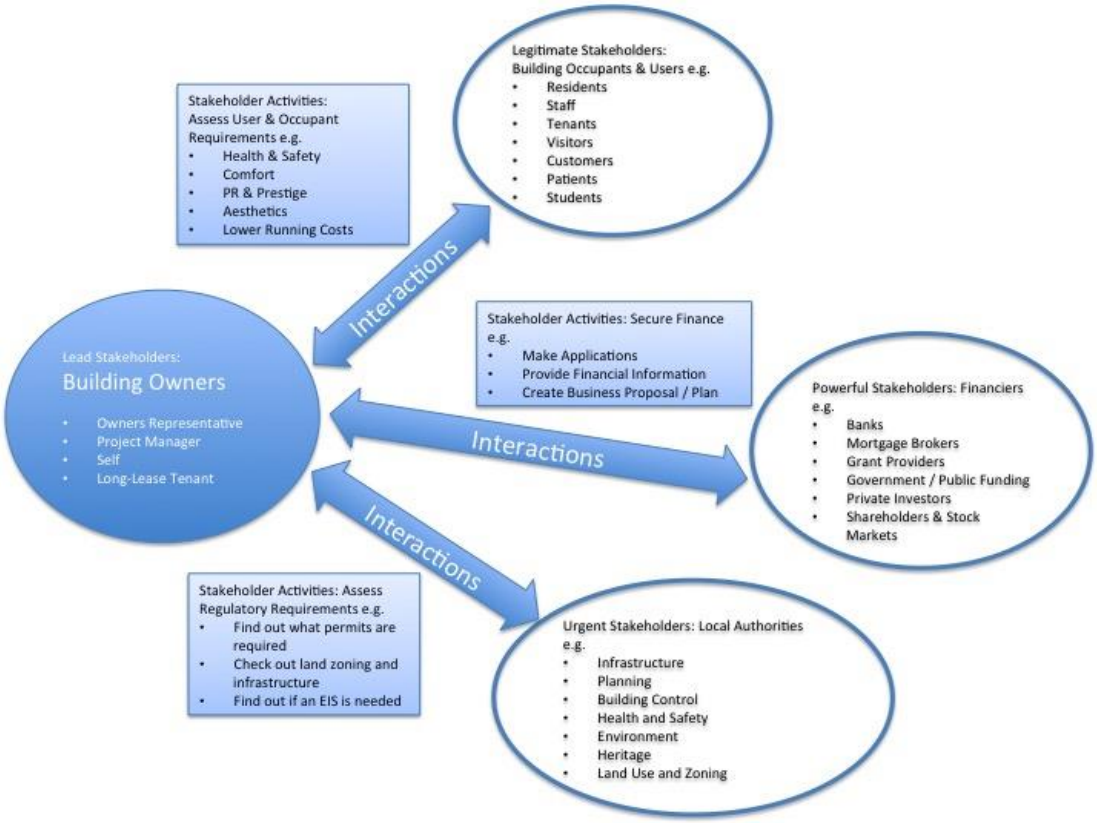

FIGURE 11 : BASIC INITIATION & VIABILITY COMMUNICATION MODEL

The building owner as the definitive stakeholder is the focal point of communications. Other stakeholders who will be central to the project may not even be involved yet. The owners make decisions based on interactions with the other secondary stakeholders, such as building occupants (or proposed occupants), financiers and the local authorities. In some cases the interactions include communication or consultations (be it one way or two way), and decision-making based on their (the owners') perceptions of the other stakeholders requirements and their previous interactions, publicly available knowledge (*e.g.,* planning guidelines, basic mortgage application criteria), stakeholders reputations and so on. For the most part, based on the literature and the interviews, while engagement with the occupants is viewed as beneficial, interaction mostly tends to be one way, with building owners making assumptions about the occupants' requirements. The value generated by this relationship could potentially be far greater if engagement was increased. The design team are often only involved at the very end of this stage, i.e. when they are appointed. Once this appointment has taken place the project moves on to the earliest stages of Design and Planning. Other stakeholders such as building

contractors are usually only peripheral at this point. The owner may be aware of, or interested in certain contractors, but there are usually no lines of communication open or any type of formal or informal interaction with them. The design and construction teams will add significant value to the project, as they will ultimately lead it to its conclusion.

The level of communication and engagement with building occupants and users varies greatly from project to project. However, in an ideal scenario, high levels of engagement, and early communication are viewed as crucial to the overall success of a project. Very often a retrofit of a building will mean that the future occupants of a building are unknown, and therefore it is not possible to involve them. However, where there are existing occupants – even if they will no longer be occupants after the retrofit – their input based on their lived experiences with the building can be a valuable asset. The project instigator or building owner may speak to them over the phone, via e-mail, post or social media, in a public meeting, workshops or via a survey for example. The occupants may also be in a position to provide financial information regarding the cost of utilities or rent, lease or mortgage agreements. They may also be required to facilitate access or assist the building condition survey team, or building energy audit team.

The stakeholders add value at this stage in the following forms:

- Financial (rental, leasing and sale agreements);
- Labour (carrying out surveys and audits);
- Physical artefacts (documents, survey drawings, reports, contracts and agreements *etc*.);
- Skills (work experience & training of surveyors *etc*.);
- Knowledge (lived experience of occupants, professional knowledge of surveyors, education and qualifications or stakeholders);
- Goodwill (*e.g.,* generated by consulting with and engaging the building occupants before making decisions that affect them with regards their home, place of work *etc.*).

Figure 12, to Figure 17 are communication diagrams for each of the main stakeholder groups (owners, occupants, designers and builders) at the Initiation & Viability stage.

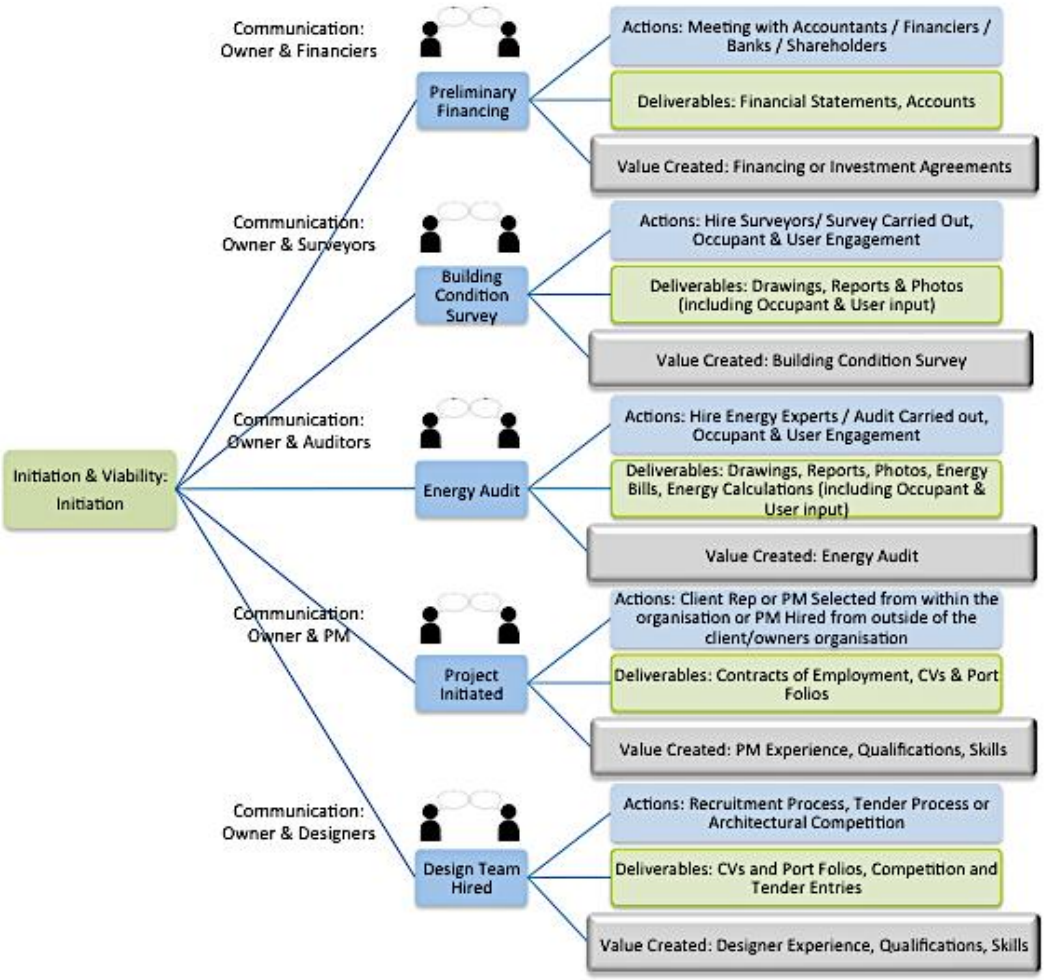

FIGURE 12 : **COMMUNICATION DIAGRAM FOR OWNER / CLIENT AT INITIATION & VIABILITY (INITIATION)**

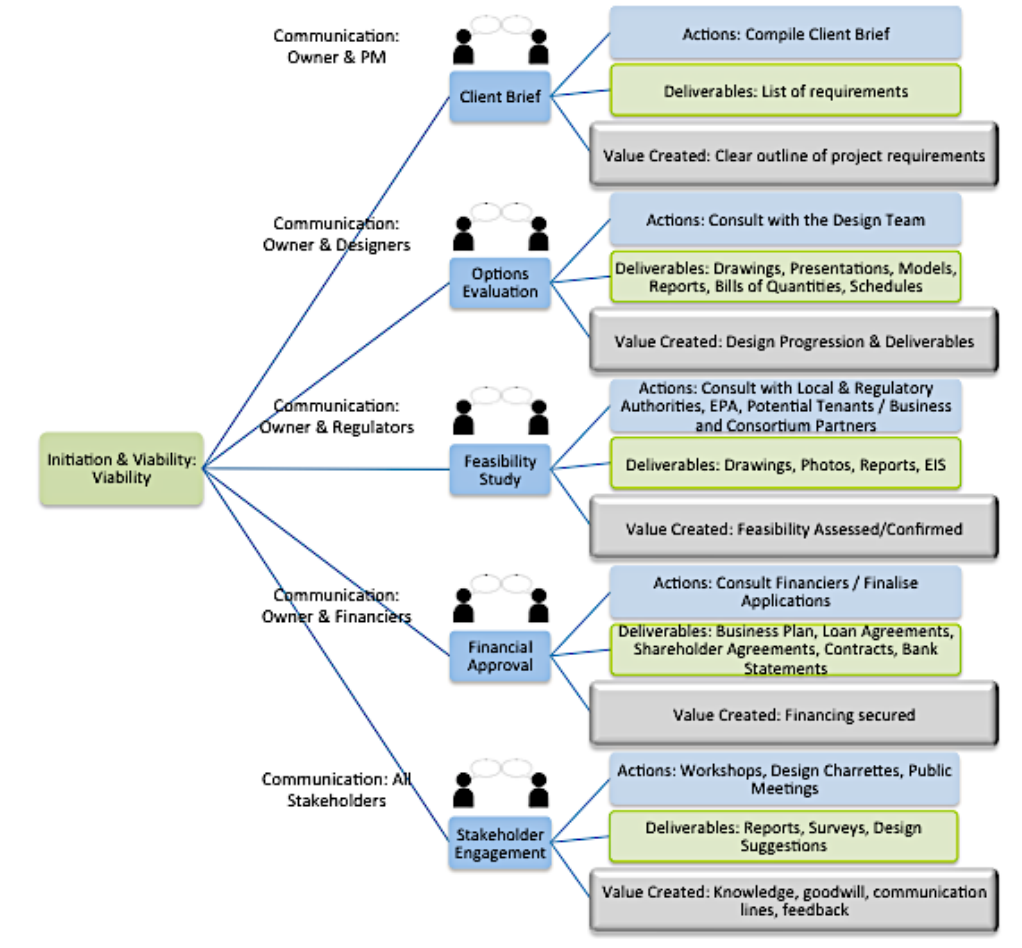

FIGURE 13 : **COMMUNICATION DIAGRAM FOR OWNER / CLIENT AT INITIATION & VIABILITY STAGE (FEASIBILITY)**

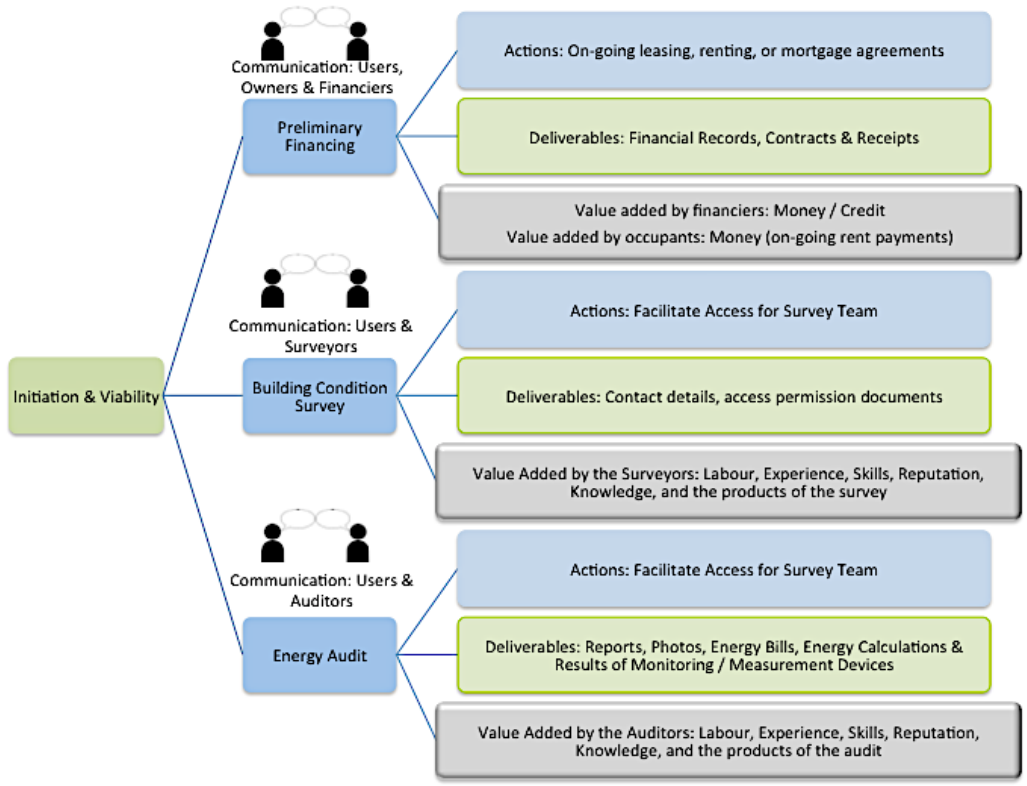

FIGURE 14 : **COMMUNICATION DIAGRAM FOR OCCUPANTS & USERS AT INITIATION & VIABILITY STAGE**

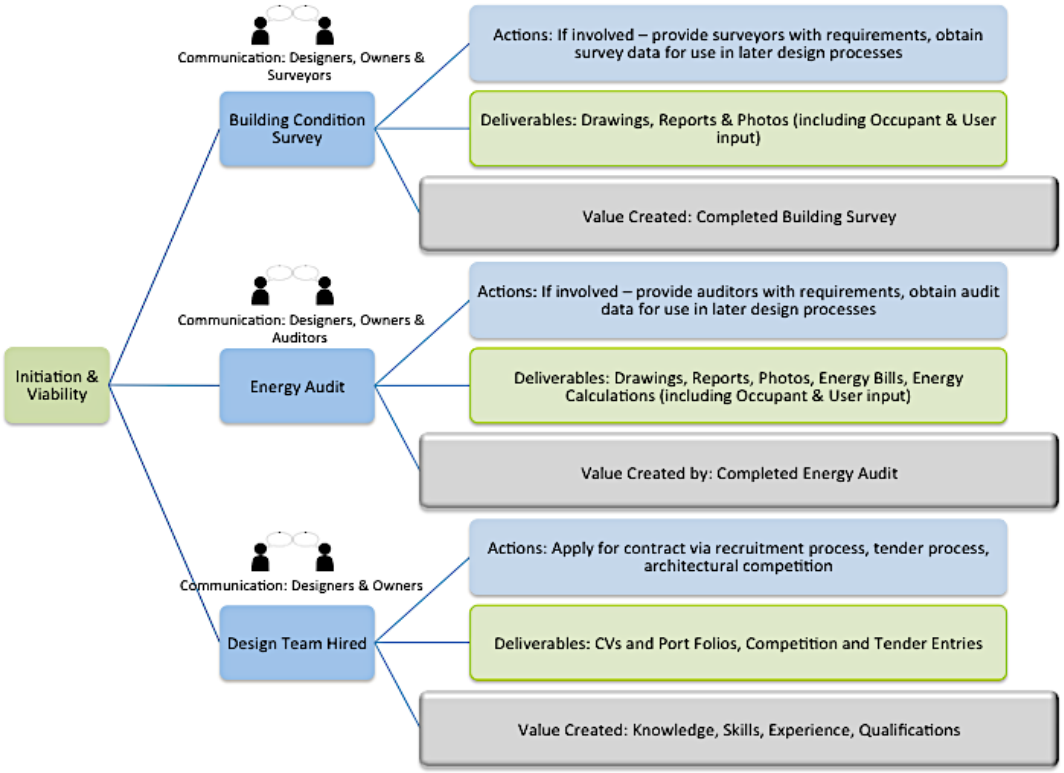

FIGURE 15 : **COMMUNICATION DIAGRAM FOR DESIGNERS AT INITIATION & VIABILITY STAGE**

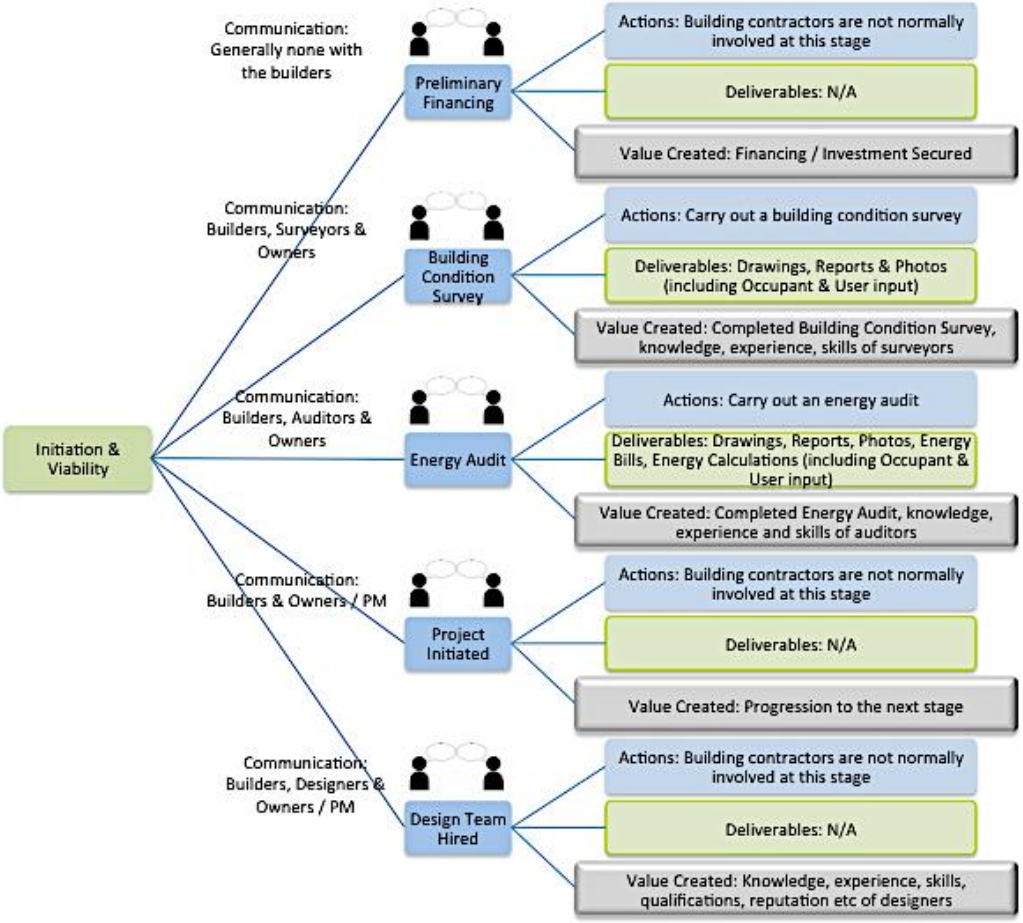

FIGURE 16 : COMMUNICATION DIAGRAM FOR BUILDERS AT INITIATION & VIABILITY STAGE

FIGURE 17 : GENERIC INITIATION & VIABILITY ACTIVITIES & OUTPUTS

3.2.2 *Stakeholder Interactions at the Design & Planning Stage*

Designers - who may be architects, engineers, or others on a multidisciplinary team - are the definitive stakeholders in this stage. Consequently, they are the focal point of communication, which centres on design and planning activities. The owner communicates their requirements to the designer via the design brief. The design team communicates their interpretations of this based on their own speciality (architecture, engineering *etc.*) with one another and then back to the owner for approval. The design team also interacts with the relevant authorities to ensure all necessary permits are applied for and approved. Ideally, though it is not always the case, there should also be interaction between the designers and the building occupants and users, as well as neighbours, in the form of stakeholder engagement (neighbours) and participatory design (occupants). The outcome of these activities will be the design of the new energy-efficient building or retrofit and any associated planning permits or other regulatory requirements. The value generated is the tangible representation of the owner's (client's) vision and requirements, which will ultimately enable their realisation by the building contractors. Planning authorities also play a very important role in this process and their level of involvement will depend on the nature of the project and the particular regulatory context. Other significant other influences on this hub of activity include the socio-political context; the nature and availability of finance; potential solutions; energy market forecasts, *etc.* Figure 18 offers a generic model of stakeholder salience at the design and planning stage.

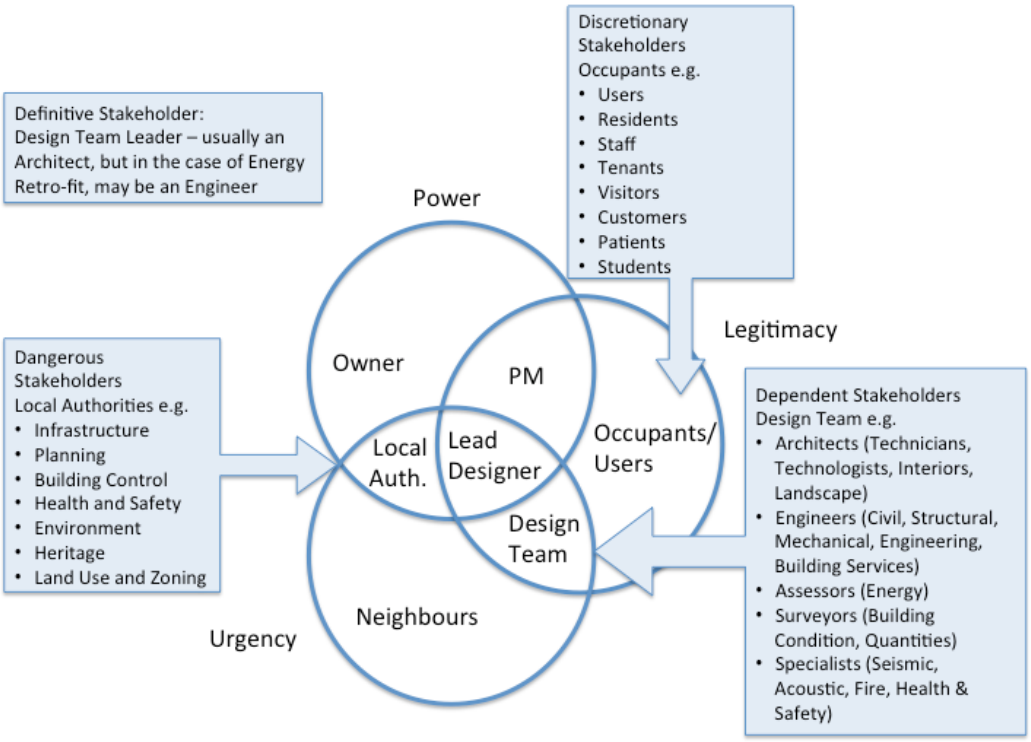

FIGURE 18 : **GENERIC STAKEHOLDER SALIENCE SCHEMATIC FOR DESIGN & PLANNING STAGE**

In this stage the owner takes a slight step back. They still retain power, but it is now the design team leader who is the definitive stakeholder. The occupants still possess legitimacy, but as they are discretionary stakeholders, their input to the design process varies from some to none at all. Neighbours may be demanding stakeholders, who insist the project will not obstruct their view, affect their livelihood, impact on their property value and so on. The local authorities may be a dangerous stakeholder, as they will have an urgent demand for information where building permits are required, and can exercise their power to refuse permission for the project to go ahead.

Figure 19 below offers a generic mapping of communication flows between stakeholders at the initiation and viability stage.

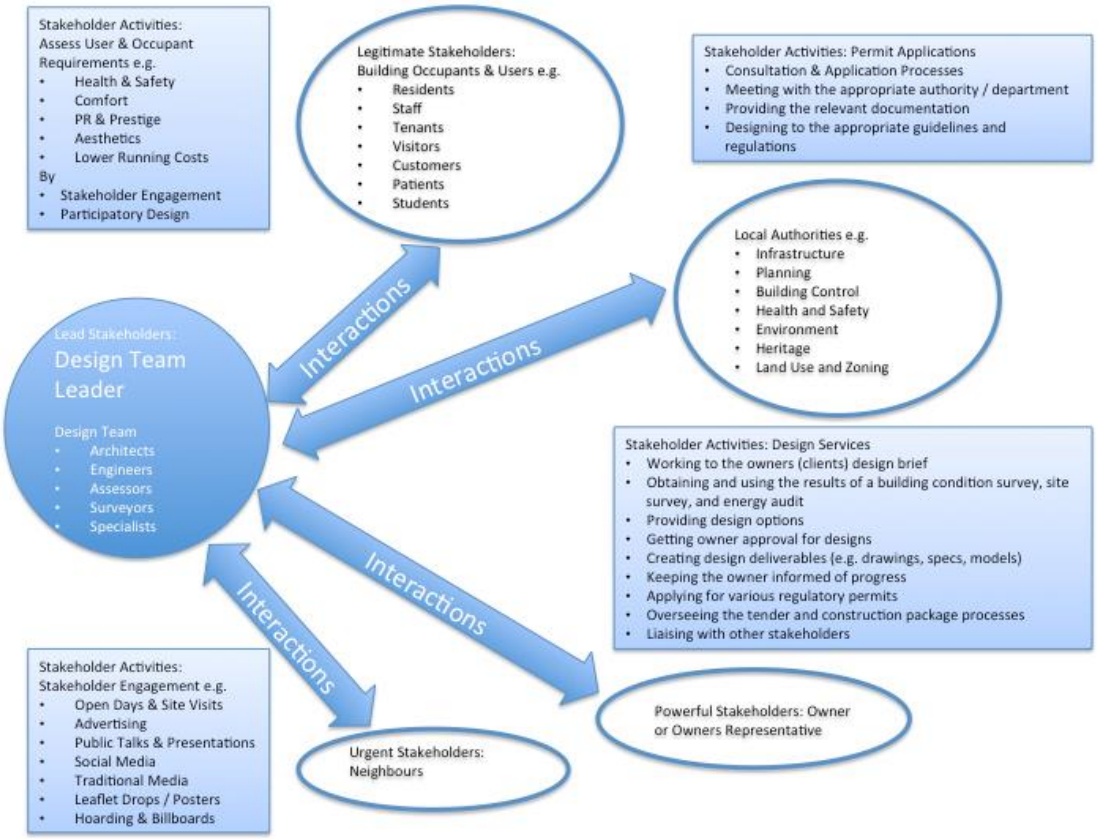

FIGURE 19 : BASIC DESIGN & PLANNING COMMUNICATION MODEL

During the various design stages, from preliminary sketching and development of options, to detailed technical construction design, the design team are the main focal point for all communication and activity. Relationships within the design team, despite their professional contractual nature, can often be informal, whereas relationships between the design team and "external" stakeholders tend to be more formal. Design and Planning comprises any or all of the following; preliminary concept design, general arrangement design, statutory and permit approval processes, detailed design, preparation of tender and construction packages. Depending on the designer's contract with the client there may also be a requirement for on-going post-occupation works; however, their obligations usually end once the building has been constructed and handed over to the client and the snagging is complete.

Communication with occupants at this stage may involve a detailed stakeholder engagement process, or alternatively take the form of occupants and users making official comments, submissions or objections on the design proposals through the various official channels such as

the planning authorities. Some of the interviewees mentioned that local communities, occupants, neighbours and the general public were engaged prior to the commencement of works through public meetings, community events, design charities, open-days and so on. The level of engagement varied greatly though, and did not exist at all in many cases.

Design is a creative activity by which the client's needs and objectives are collected, interpreted and expressed in three-dimensional physical solutions. The designer's duties are: "to interpret the Client's output specifications, functional requirements and constraints and to translate them into prescriptive information in sufficient detail that can be communicated to a contractor, who can then construct a particular facility" (DoF, 2009). The means by which the designers convey and communicate their activities in a project are the drawings and specifications that they produce. Different types of drawings must be produced for different purposes, and for different stakeholders, depending on what information is required to be communicated. The amount and type of information and detail given also varies.

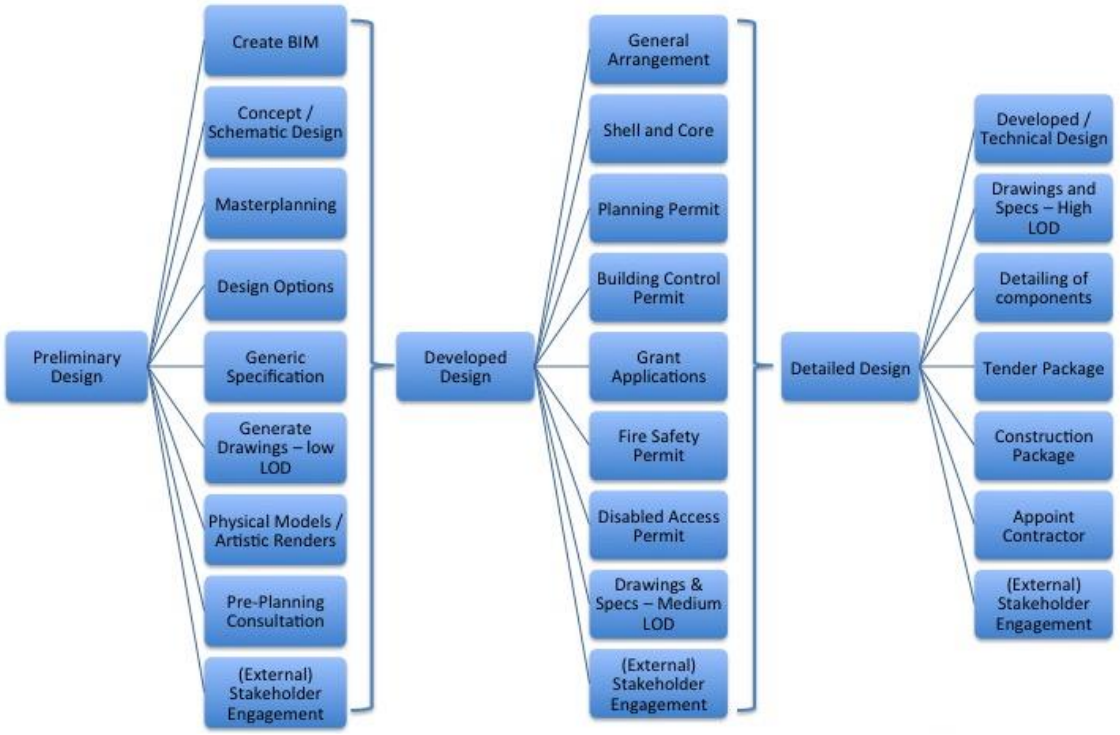

FIGURE 20 : GENERIC DESIGN & PLANNING ACTIVITIES AND OUTPUTS

The deliverables of the design process are primarily drawings, (electronic and printed), and documents such as spread sheets, specifications, reports and applications for permits and financing (grants, stage-payments *etc.*). Three-dimensional physical models are often created, especially for larger urban projects. Virtual models are now also commonplace due to the increased use of Building Information Modelling (BIM). The design and planning stages vary from project to project, depending on local regulatory requirements, the site, the design brief, and a great many other variables. It may be a very long process taking years, and going through several phases and iterations, and requiring a large design team.

In the preliminary concept stage of the overall design stage, the design is in its most primitive format. There may be several options available to choose from. The level of detail will be relatively low. In the case of a very large development, an overall master-planning exercise may be required. This is often undertaken by one design team, with separate teams appointed for each individual building. Deliverables may include three-dimensional artistic renders, and physical models, plans and elevations, indicating the overall massing of a building, the fenestration and materials to be used on the exterior building envelope *etc.* For example, a model may indicate that it is a 10-storey building with a triangular footprint and curtain walling glazed façade to the south, with retail on the lower floors and offices on the upper floors. The primary purpose of this stage is to agree on the basic design concept and best options from amongst those proposed. For larger developments, where there are a great number of persons or organisations with an interest or stake in the project, and an ability to affect or be affected by it, the proposals may be shared with the local authorities and the general public through press releases or public meetings, but on smaller projects there is generally little or no external stakeholder involvement at this point. Several of the interviewees commented on the usefulness of three dimensional physical models in order to get their design ideas across to the clients and the general public, who would not often be able to clearly read and comprehend architectural drawings and engineering schematics. Once the design concept has been formalised and a decision has been made to proceed on the basis of a specific strategic definition, or design brief, the designers move on to the development of the designs.

The purpose of developed design is not only to progress the ideas beyond the basic concept design, but also to act as an intermediate stage where there is a requirement to apply for a statutory permit, grant, or public finance. With retrofit projects that are not required to seek

such permits the design process may progress directly from the concept stage to the detailed design stage. The level of detail increases significantly for developed design, and drawings will be at a minimum scale of 1:100 for plans, sections and elevations, moving to a scale of 1:20 for partial sections. More accurate specification of materials is required, and for more elements. Specification of the entire build-up of a wall (*e.g.,* inner leaf, cavity, and outer leaf), floor or roof element will now be needed, as opposed to specification of only the externally visible materials. The design will need to conform to building regulations in order to obtain financing and statutory permits such as planning permission, fire safety certification, building warrants and so on. It will contain information such as the purpose of each room, which walls are load-bearing, the level of fire resistance of elements, the number of stairwells, lifts, doors, windows, the exact heights of elements, internal and external running dimensions and so on.

Regulatory processes such as pre-planning application can vary from relatively informal (depending on the people involved) to formal. In general, however, relationships between other stakeholders and local authorities or regulators, due to their nature as official bodies, tend to be formal, if not at times somewhat adversarial. The formality of regulatory processes has been described in the interviews as time consuming, but beneficial for larger developments, where large investments of time, money and risk are being made, due to the security provided by paper trails, and official and recorded communications. Several interviewees pointed to the long processes for obtaining permits as a factor in delaying projects, especially where heritage buildings are concerned. Many of the projects discussed in the interviews needed some form of warrant. The only ones where this was not the case were those which did not involve a significant change of use (i.e. office space to office space as opposed to residential to office space), and where the works did not affect historical features or the external façade. Numerous interviewees described how this limited their freedom in designing and implementing energy conservation measures.

Detailed design occurs in the latter stages of the design process and requires an even higher level of detail, with drawings of individual components and junctions such as window heads, foundations, door jambs and so on. These will be required at a scale of at least 1:10 and 1:5, indicating the exact location of fire stopping, draught proofing, waterproofing, building services, sanitary ware schedules, ironmongery schedules, floor finishes and fitted furniture layouts for example. The tender process can be intensive, lengthy, and, particularly for publicly funded

projects, it can also be restrictive. The cheapest contractor might not necessarily be the best to work with. They may have been awarded the job because they had scored the highest on cost – however, on private jobs, more weighting may be given to other criteria if the client and design team so wish, for example experience, moral values and ethos, previous relationships, sustainability criteria and so on. Interviewees pointed out that one of the disadvantages of public tendering processes is that the client is not freely able to choose design team/construction teams based on existing relationships, experience and so on, which are often relied upon when selecting designers or contractor for private projects.

The stakeholders add value at this stage in the following forms:

- Financial (on-going rent, lease, mortgage payments, on-going business activities);
- Labour (carrying out design-related tasks);
- Physical artefacts (documents, drawings, models, reports, planning permits *etc.*);
- Skills (work experience & training *etc.*);
- Knowledge (lived experience of occupants, personal and professional knowledge, education and qualifications or stakeholders);
- Goodwill (*e.g.,* generated by consulting with and engaging the building occupants on design decisions that affect them with regards their home, place of work. Can also be generated by the reputations of the stakeholders such as the design team)

Figure 21 to Figure 24 are communication diagrams for each of the main stakeholder groups (owners, occupants, designers and builders) at the design stage.

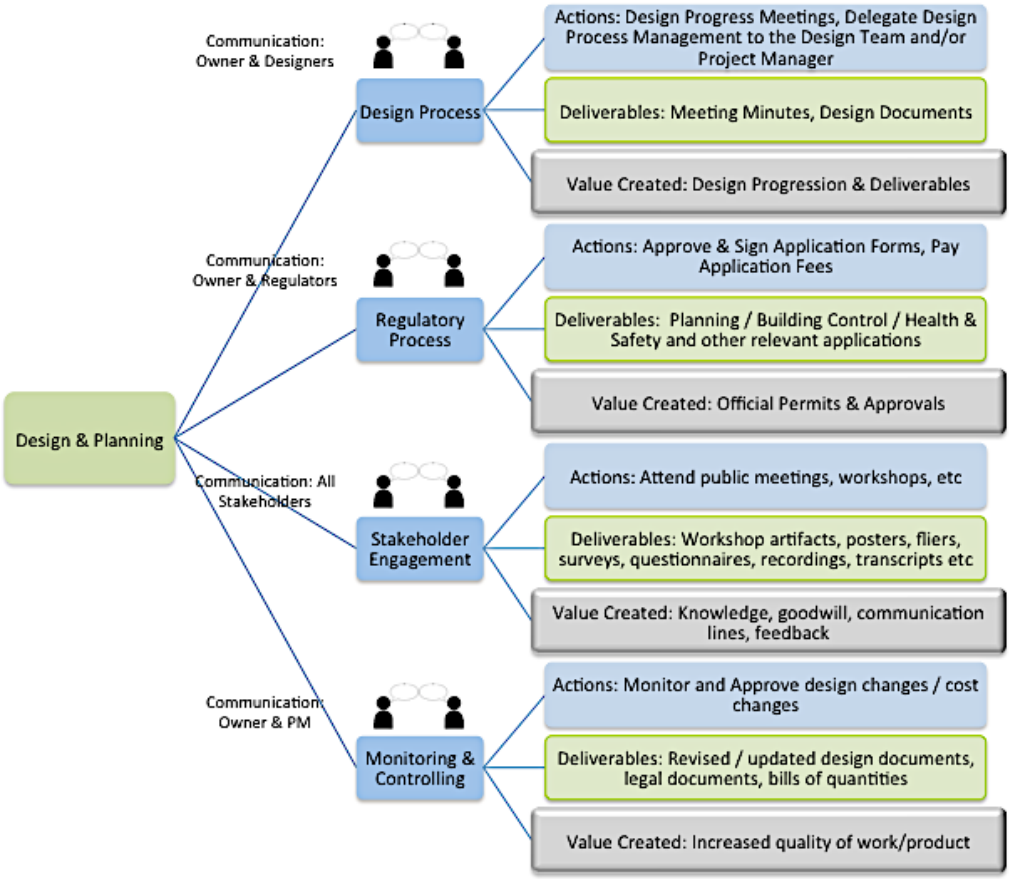

FIGURE 21 : **COMMUNICATION DIAGRAM FOR OWNER / CLIENT AT DESIGN STAGE**

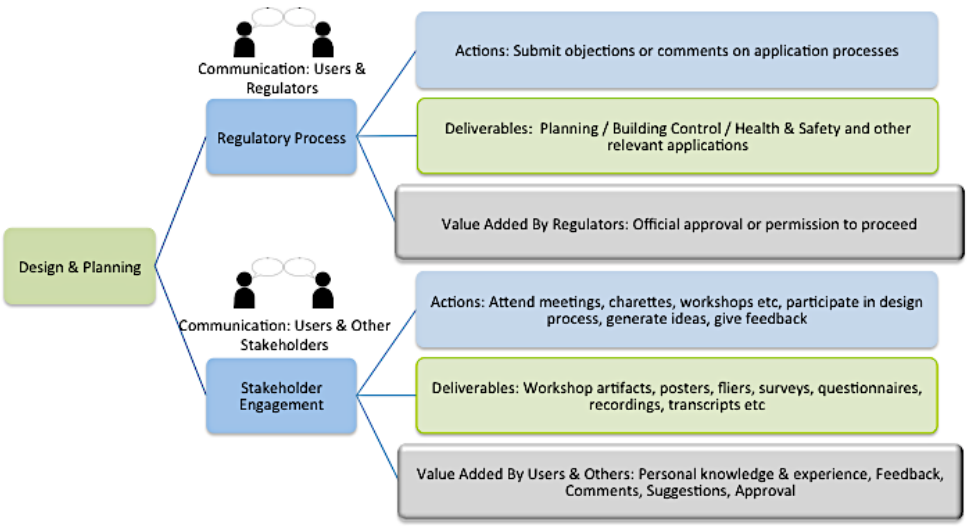

FIGURE 22 : **COMMUNICATION DIAGRAM FOR OCCUPANTS & USERS AT DESIGN STAGE**

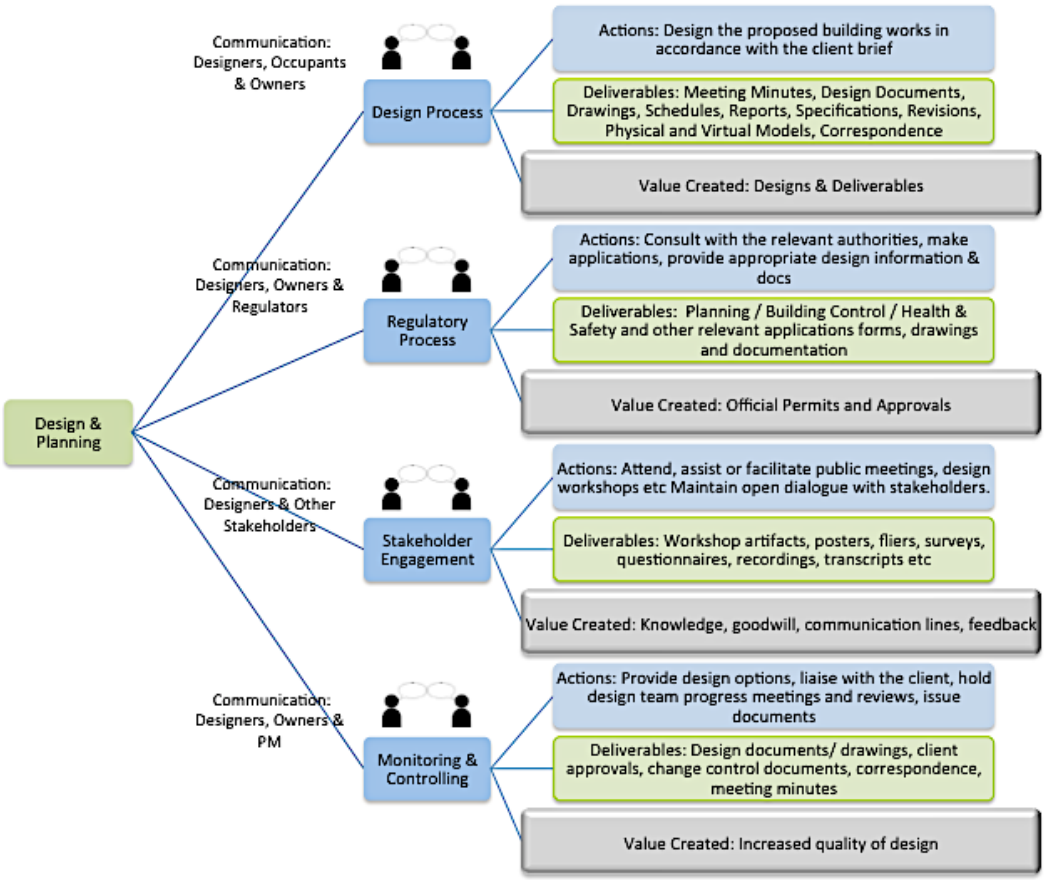

FIGURE 23 : **COMMUNICATION DIAGRAM FOR DESIGNERS AT DESIGN STAGES**

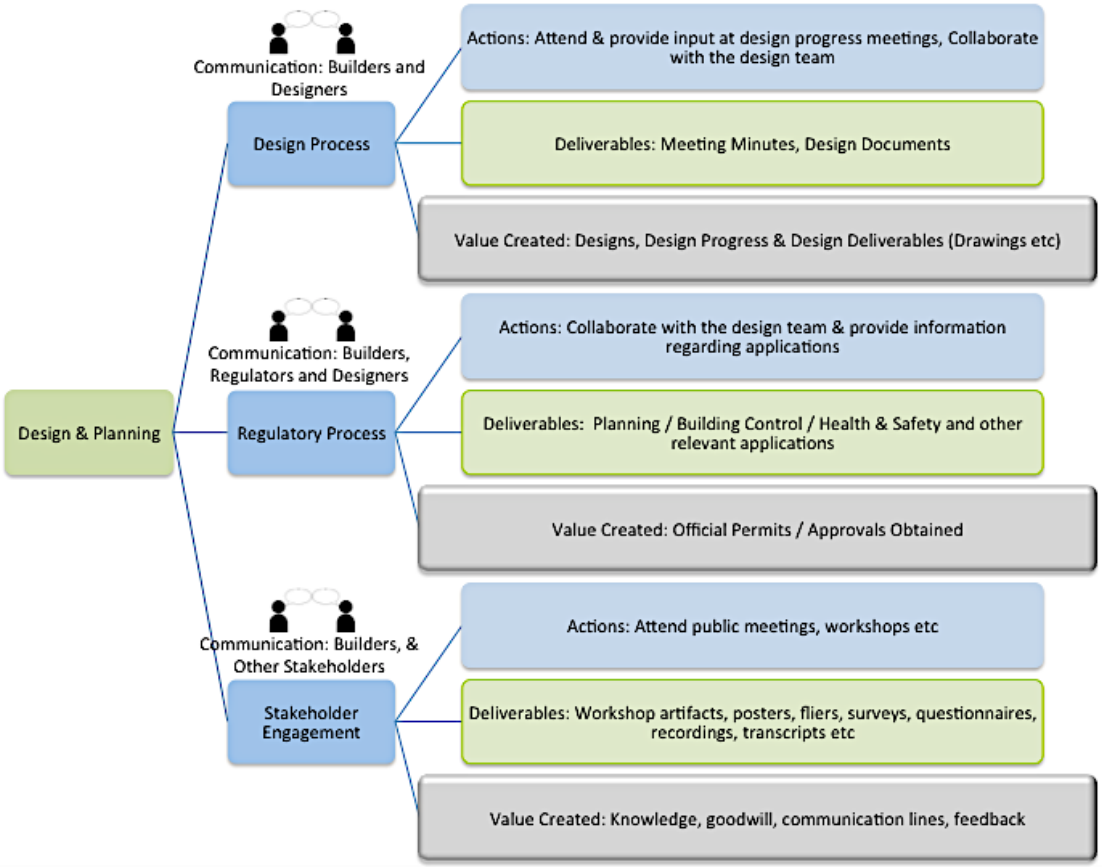

FIGURE 24 : **COMMUNICATION DIAGRAM FOR BUILDERS AT DESIGN & STAGE**

3.2.3 STAKEHOLDER INTERACTIONS AT THE CONSTRUCTION & INSTALLATION STAGE

The implementation of the project forms this phase of activity, in which the definitive stakeholder is the project manager, who depending on the project may be a dedicated project manager or else the architect, engineer, lead contractor or an employee of the client. Where there is no separate Project Manager to oversee the entire project, the Design Team Leader tends to continue managing all aspects of design in conjunction with the Construction Team Leader, generally the main contractor, who manages all aspects of the construction. The design process generally overlaps the construction process; especially on existing buildings where there may be a requirement for additional design as construction takes place due to unforeseen circumstances *e.g.,* construction work reveals rotting timbers, dampness or spalling concrete that requires a design intervention. There may also be a Project Supervisor appointed for the design and construction stages, who will be required to oversee all health and safety matters, and to liaise with both the design team and construction team leaders. In any case, the main stakeholder at this point is the Construction Team Leader (the builders of the project).

Unforeseen issues with existing buildings can arise on a daily basis during the construction stage – which means that the designers need to be present more often than on a new build. This is not always possible, since the designer's contract and the project budget usually only allows for them (or a representative) to be on site at intervals, and not every day. On most projects the contractor is appointed after all or most of the design is complete. However, a couple of interviewees discussed the benefits of having the contractor involved at the design stage based on their experiences. The contractor can provide valuable information on buildability, costs, material availability and lead-in times, stock and off-the-shelf sizes versus bespoke specials and so on.

Figure 25 below offers a generic model of stakeholder salience at the construction and installation stage.

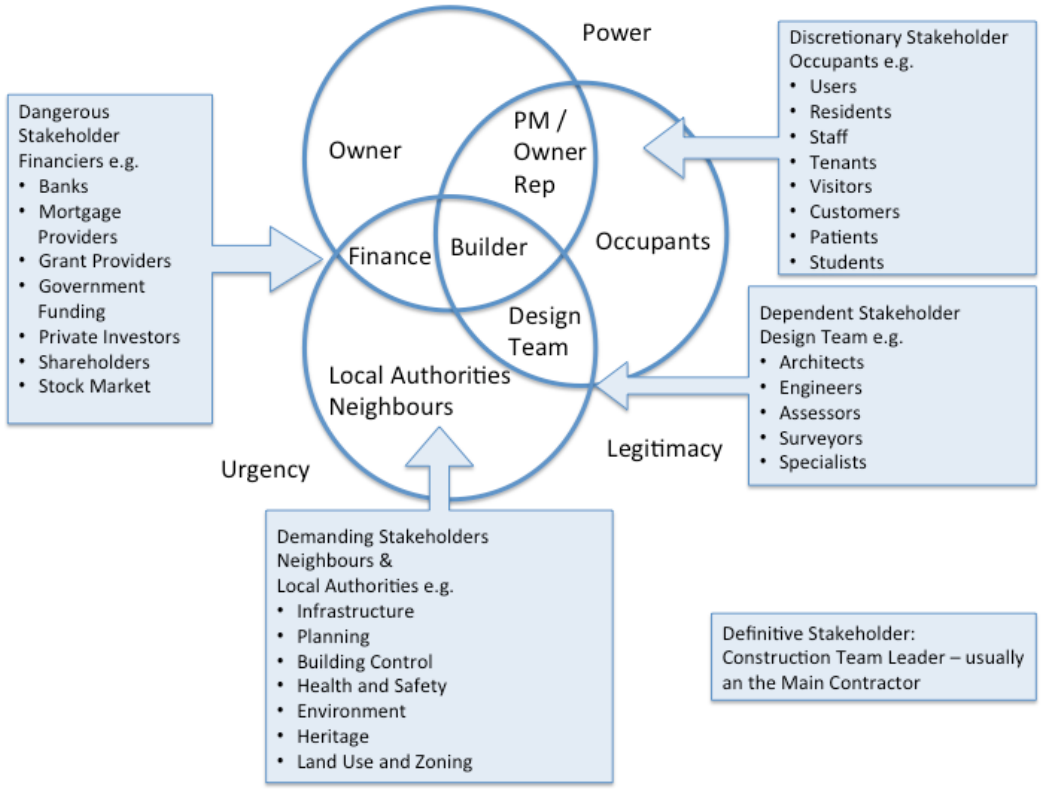

FIGURE 25 : **GENERIC STAKEHOLDER SALIENCE SCHEMATIC FOR CONSTRUCTION & INSTALLATION**

Outcomes of this stage include the completed building / retrofit and the environmental burden associated with the construction activities. There are also social outcomes such as construction jobs, improved (or damaged) reputations, and altered relationships – for example, locals may have been driven apart or drawn together by conflict and objection to, or support for the

development, or errors (in design or construction) may have led to litigation. Relationships between the building occupants and other stakeholders such as the contractors, and building owners may have been strained by noise, dust, site traffic, building access and area traffic restrictions as well as parking restrictions during the construction process. There may also have been economic repercussions. Lengthy construction and excessive site traffic may have altered local activities leading to loss of customers and revenue for neighbouring businesses.

Figure 26 below offers a generic mapping of communication flows between stakeholders at the construction and installation stage.

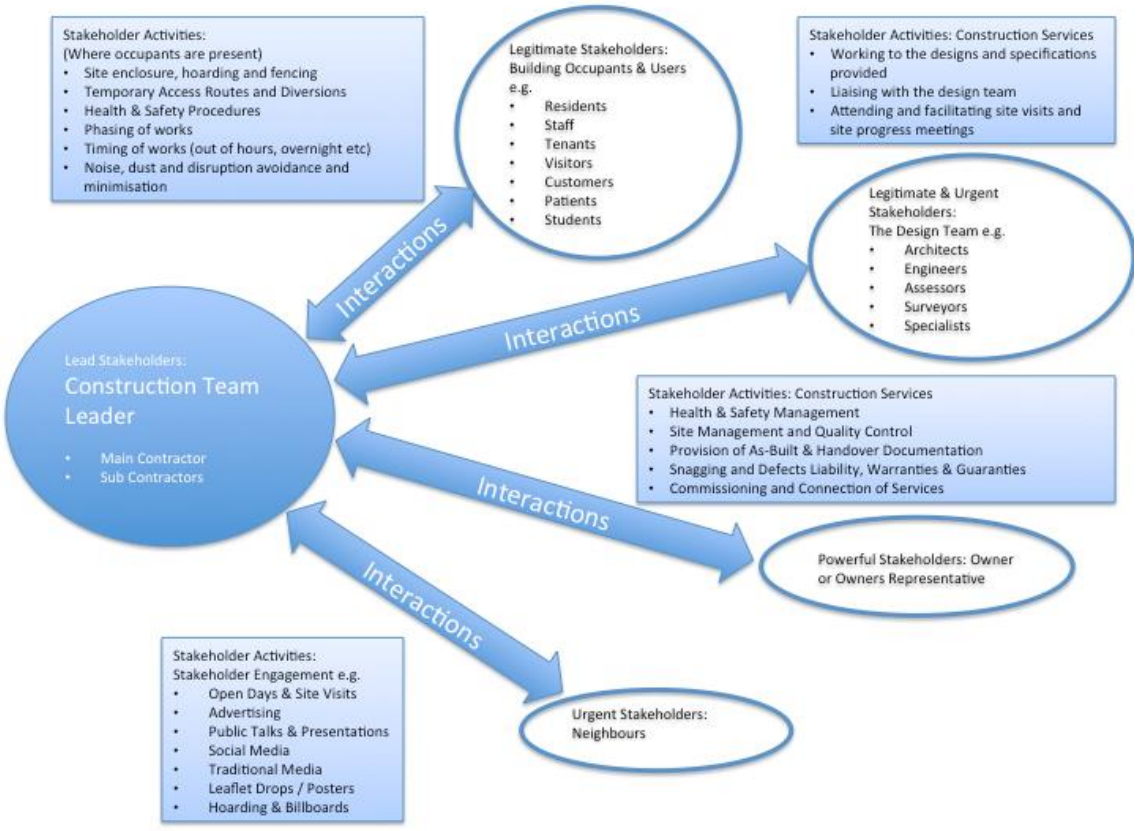

FIGURE 26 : BASIC CONSTRUCTION & INSTALLATION COMMUNICATION MODEL

The main stakeholder in the construction stages is usually the principal building contractor who is carrying out the construction or installation work. Most of the communication and activity is centred on the builders. The main lines of communication will be between the construction team and the design team. The building owner may attend some progress meetings and site visits;

however, that is very much dependent on how "hands-on" the owner is about the construction process. The occupants may remain on site, in which case, there will be a lot of communication between them and the builders in order to maintain a balance between the occupation and use of the building, and the on-going works, to minimise disruption and inconvenience for all parties, and to ensure the safety of all of those involved. The site will be cordoned off and vehicular and pedestrian traffic will be carefully managed. There may also be some communication with the local authorities regarding traffic restrictions and road closures, scaffolding and hoarding, site security and health and safety issues for example. Lines of communication will also be maintained with financiers. The quantity surveyor for the contractor will be working with the quantity surveyor for the owner (client) to provide the stage-payment documentation, in order to draw down agreed payments from the financial backers. This stage can be grouped into three sub-stages, arrival on site, construction works, and handover of the site, as indicated in Figure 27:

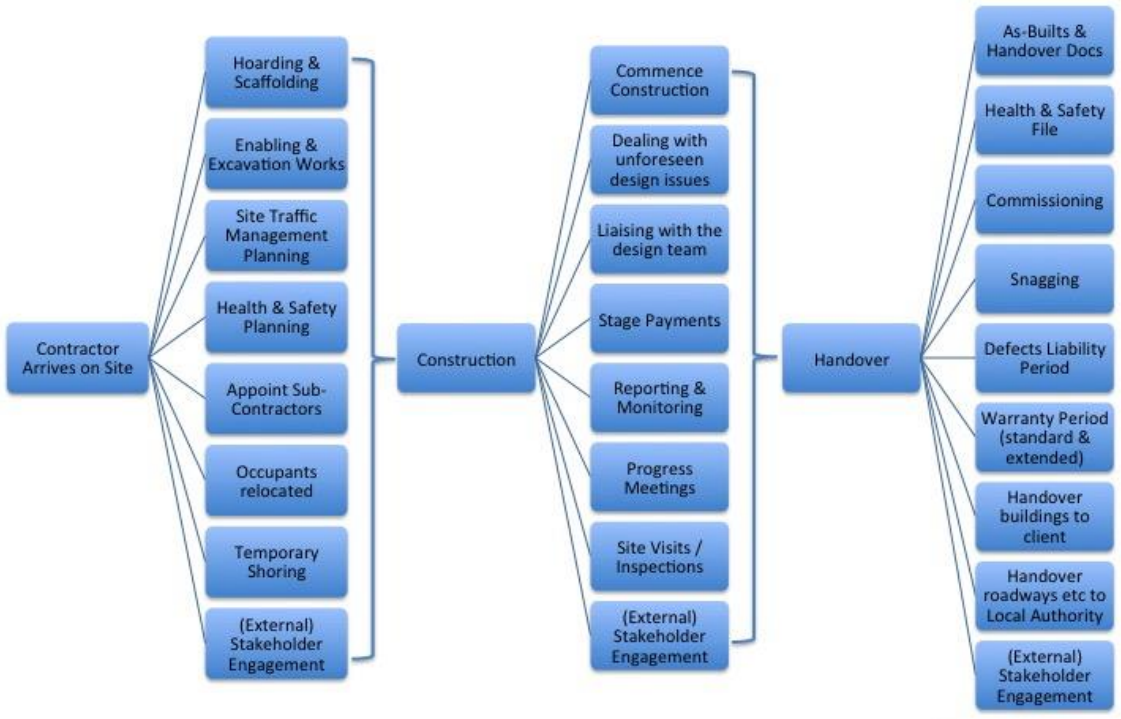

FIGURE 27 : GENERIC CONSTRUCTION & INSTALLATION ACTIVITIES AND OUTPUTS

The stakeholders add value at this stage in the following forms:

- Financial (on-going rental/leasing/mortgaging of building, on-going business activities, construction stage payments);
- Labour (building / installation works on-site);
- Physical artefacts (built / installed elements);
- Skills (work experience & training *etc.*);
- Knowledge (lived experience of occupants, personal and professional knowledge, education and qualifications or stakeholders);
- Goodwill (*e.g.,* generated by consulting with and engaging the building occupants on design decisions that affect them with regards their home, place of work. Can also be generated by the reputations of the stakeholders such as the construction team).

Figure 28 to Figure 31 are communication diagrams for each of the main stakeholder groups (owners, occupants, designers and builders) at the construction and installation stage.

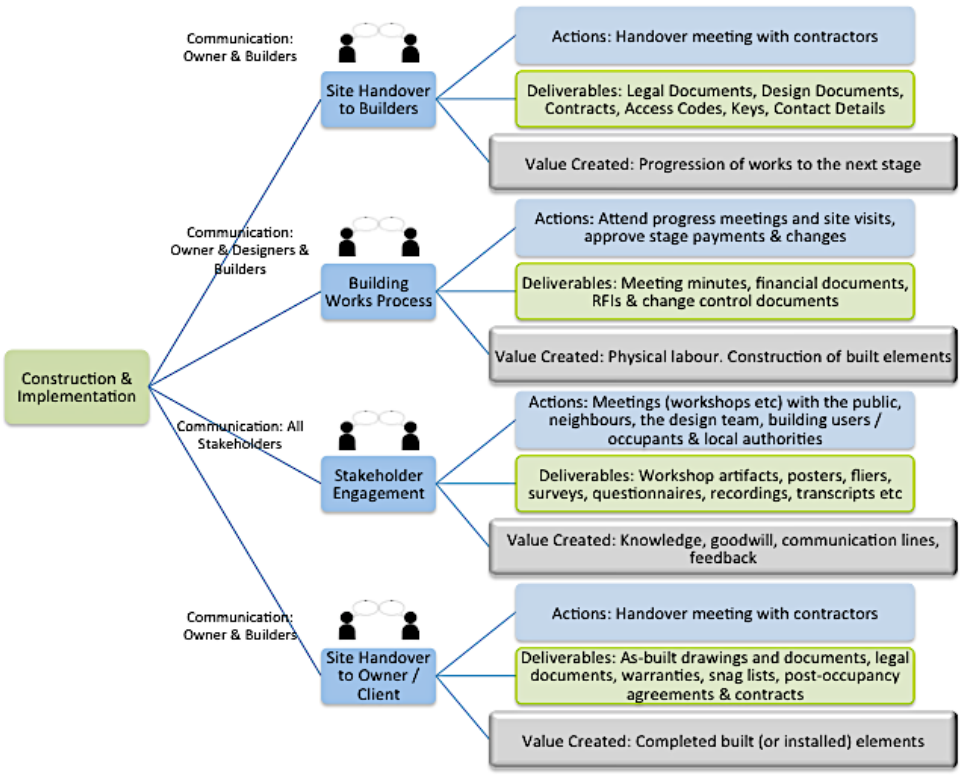

FIGURE 28 : **COMMUNICATION DIAGRAM FOR OWNER / CLIENT AT CONSTRUCTION STAGE**

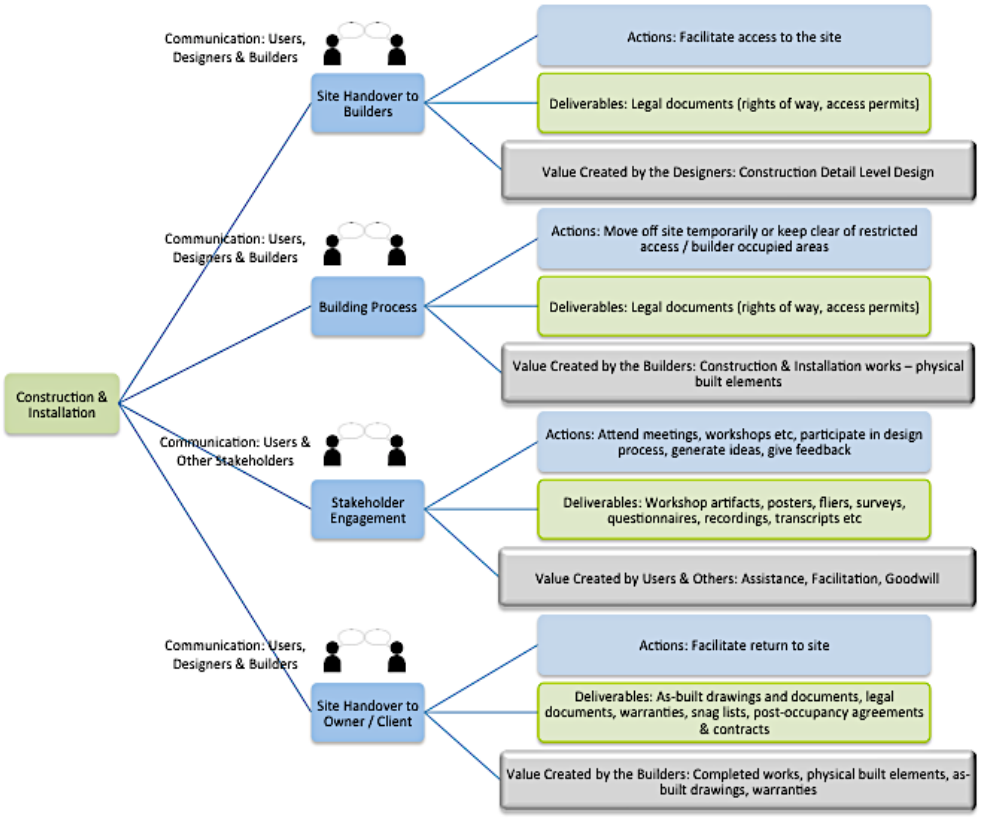

FIGURE 29 : **COMMUNICATION DIAGRAM FOR OCCUPANTS & USERS AT CONSTRUCTION STAGE**

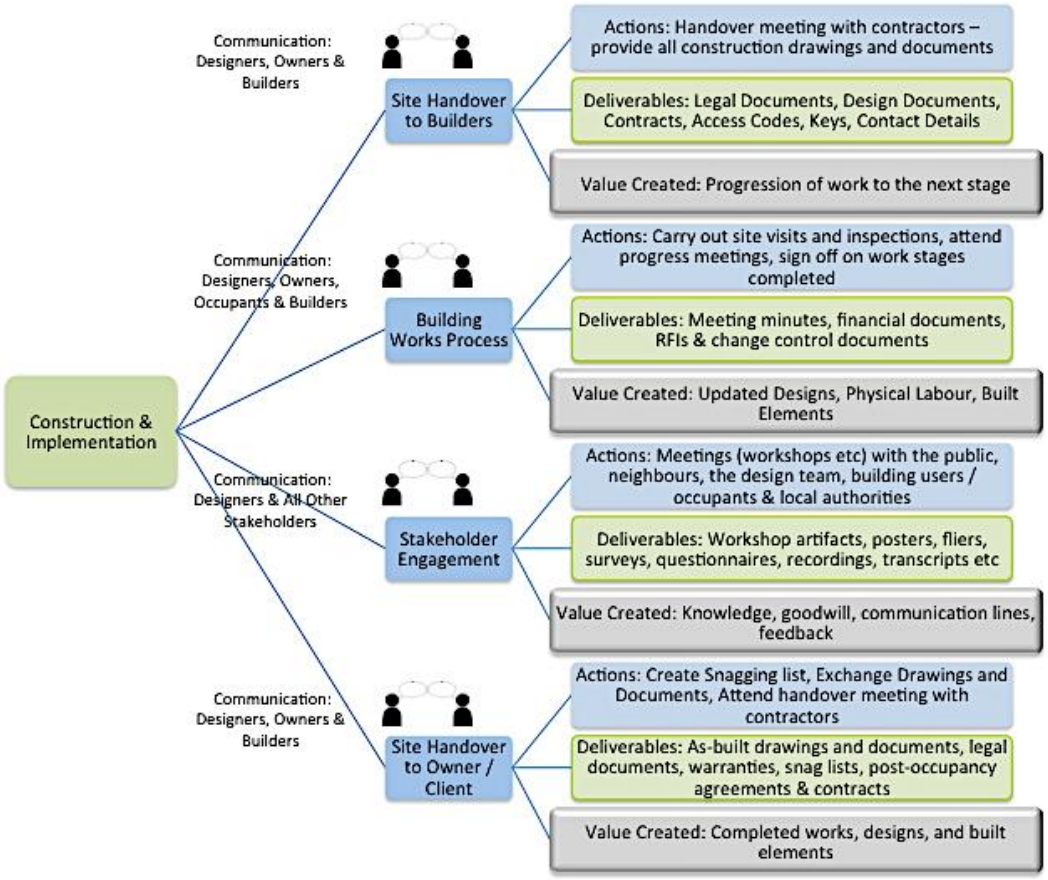

FIGURE 30 : **COMMUNICATION DIAGRAMS FOR DESIGNERS AT CONSTRUCTION STAGE**

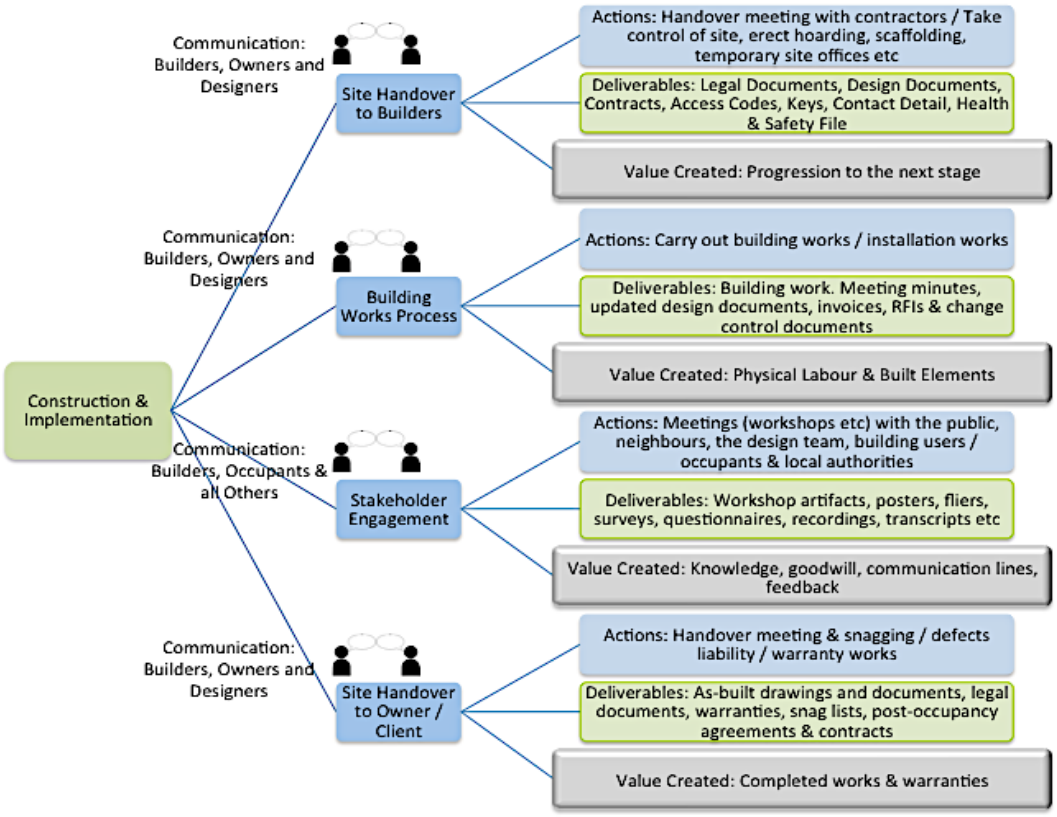

FIGURE 31 : **COMMUNICATION DIAGRAMS FOR BUILDERS AT CONSTRUCTION STAGE**

3.2.4 *Stakeholder Interactions at the Operation and Maintenance stage*

At the operational or in-use phase the occupants (i.e., inhabitants and users) play a leading role as the definitive stakeholders. The outcome of this stage determines the energy demand and the environmental burden associated with use of the building. Stephenson *et al.* (2010) note surprising variability in energy-related behaviour, even across households or companies with apparently similar characteristics. End-users are significant stakeholders in this regard, acting as multipliers and often as peer-to-peer 'experience' experts for the acceptance or disapproval of advanced energy concepts (Mlecnik *et al.* 2012). Increasingly, behaviour change is becoming a policy focus for decision-makers. Governments, non-government organisations and energy utilities have employed a range of behavioural strategies to curb demand (Strengers 2012). Other influences on performance within the use phase include maintenance and upkeep of the building, energy market, climatic conditions, economic context, *etc.*

Figure 32 below offers a generic model of stakeholder salience at the operation and maintenance stage.

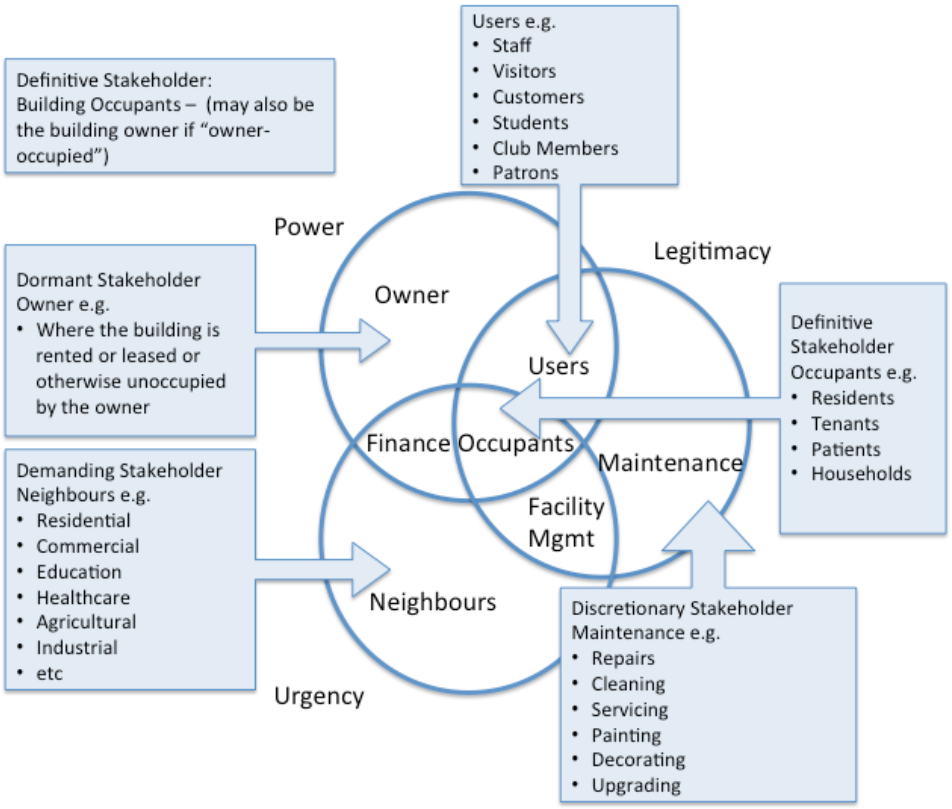

FIGURE 32 : **GENERIC STAKEHOLDER SALIENCE SCHEMATIC FOR THE OPERATION & MAINTENANCE STAGE**

Nearly all interviewees had something to say about the relationship between energy efficient building projects and the actual or potential occupants and users of the buildings. This is the only stage in the lifecycle of a building where the occupants are unequivocally designated as key stakeholders by practically all interviewees. How the building is operated and maintained will greatly influence its longevity, and its actual performance in line with its proposed theoretical performance. Much has been written in the literature about occupant behaviour, value-action gaps, performance gaps and how buildings often do not meet the design expectations. However, many of the projects discussed in the interviews were either incomplete, or had only been recently completed, and very little interaction had occurred between the design team and the occupants post-occupancy, therefore opportunities for valuable lessons were either being lost, or were simply not available yet.

Figure 33 below offers a generic mapping of communication flows between stakeholders at the operation and maintenance stage.

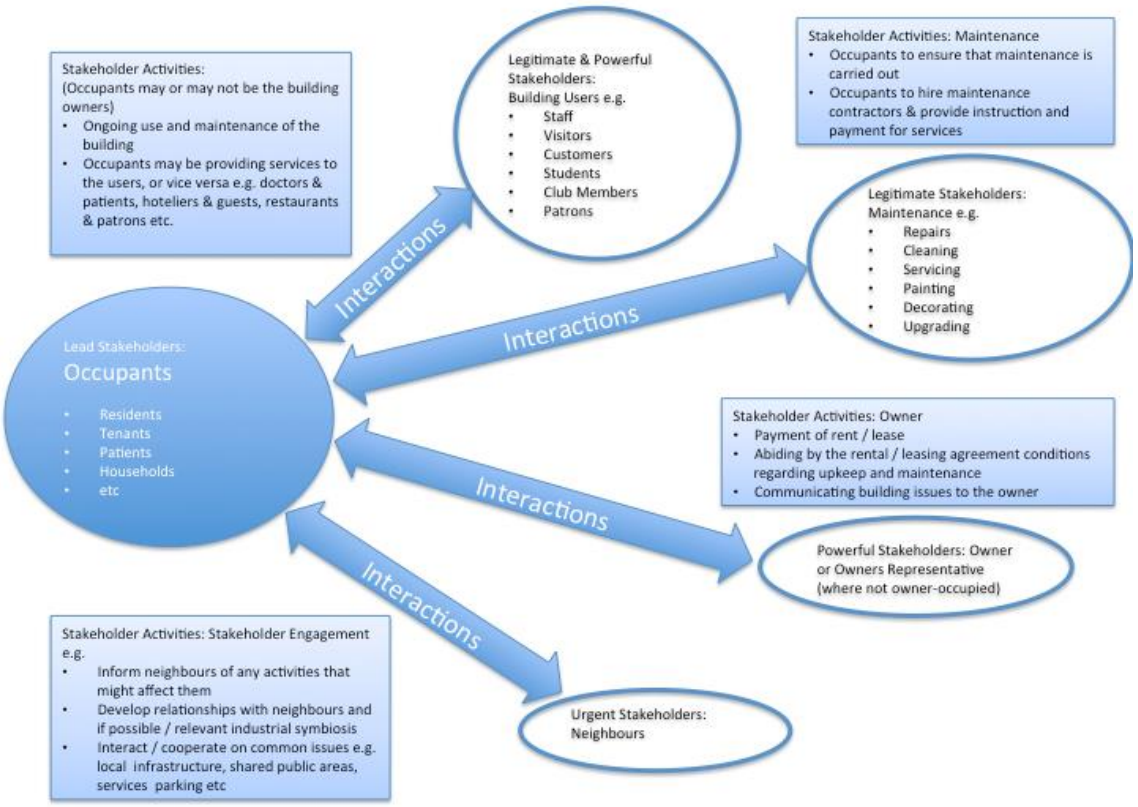

FIGURE 33: BASIC OPERATION & MAINTENANCE COMMUNICATION MODEL

At this stage the occupants are the main stakeholders, as they have most at stake in the day-to-day operation of the building. The design team, and for the most part the construction team, no longer have any contractual obligations to the building under most traditional contracting scenarios. The exception would be where a process such as Soft Landings (or Government Soft Landings) is in place. Soft Landings is a five-stage process developed in the UK where Stage 1 (inception and briefing), Stage 2 (design development and review) and Stage 3 (pre-handover) refer to the works that take place up to when the building is handed over to the client. Stage 4 is the Initial Aftercare, and Stage 5 consists of an Extended Aftercare period of 1-3 years incorporating Post-Occupancy Evaluation (POE). Based on the interviews, levels of inspection, monitoring, and feedback once the construction works are complete and the building has been

occupied or re-occupied seem to be almost non-existent. The main activities taking place are the operation and use of the building and its on-going maintenance. The main interactions are between the occupants, the owner and the various facility managers and maintenance contractors. Activities at this stage will vary depending on the type of building, whether it is residential, a business premises, retail outlet *etc.* The activities associated with value generation will be the on-going maintenance and upkeep of the building, intermittent painting and decorating, and the servicing, repairing and replacement of building elements.

The stakeholders add value at this stage in the following forms:

- Financial (on-going rental/leasing/mortgaging of building, on-going business activities);
- Labour (Maintenance and servicing works);
- Physical artefacts (built / installed elements, maintained and repaired elements, as-built drawings, reports);
- Skills (work experience & training *etc.*);
- Knowledge (lived experience of occupants, personal and professional knowledge, education and qualifications or stakeholders);
- Goodwill (*e.g.,* generated by consulting with and engaging the building occupants on design decisions that affect them with regards their home, place of work *etc.*).

Figure 34 to Figure 38 are communication diagrams for each of the main stakeholder groups (owners, occupants, designers and builders) at the operation and maintenance stage.

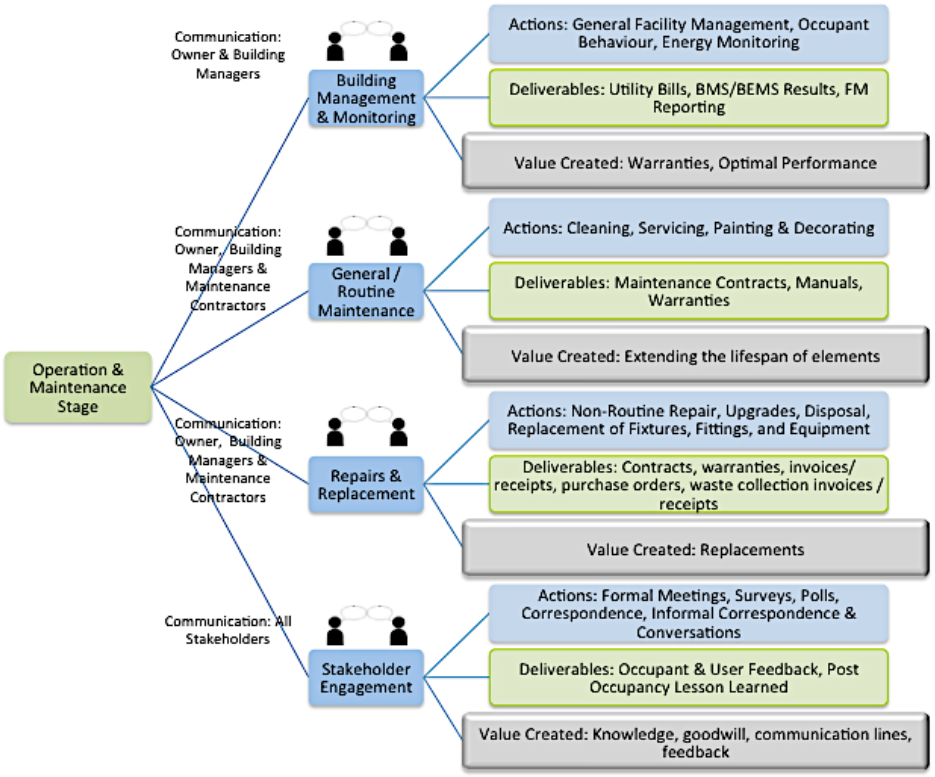

FIGURE 34 : **COMMUNICATION DIAGRAM FOR OWNER / CLIENT AT IN-USE STAGE**

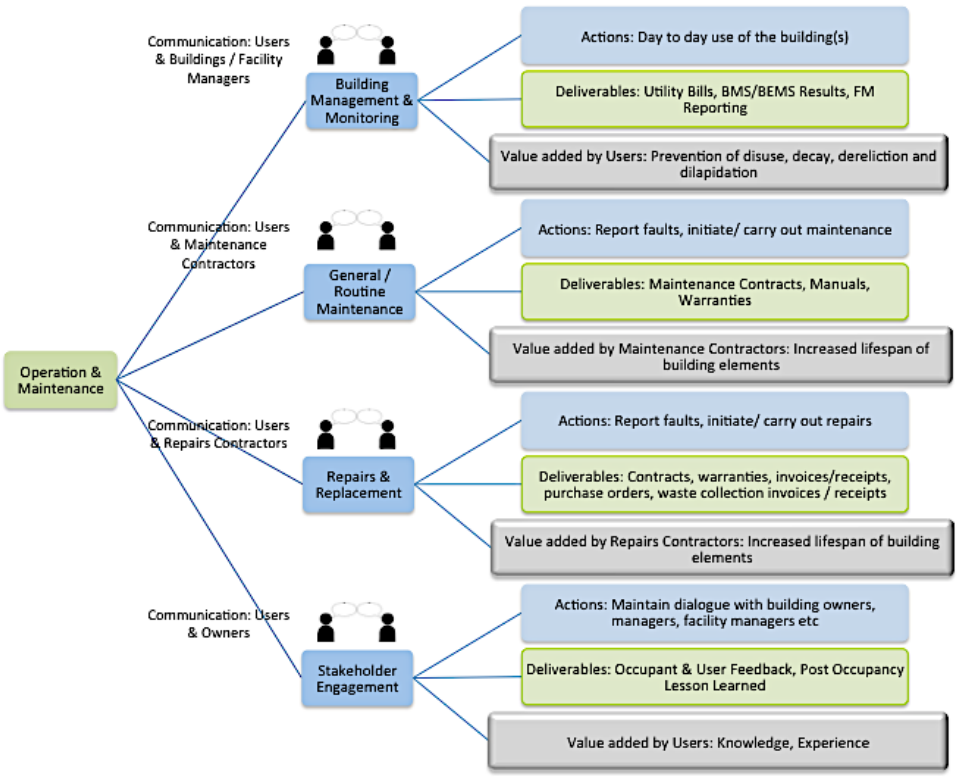

FIGURE 35 : **COMMUNICATION DIAGRAM FOR OCCUPANTS & USERS AT IN-USE STAGE**

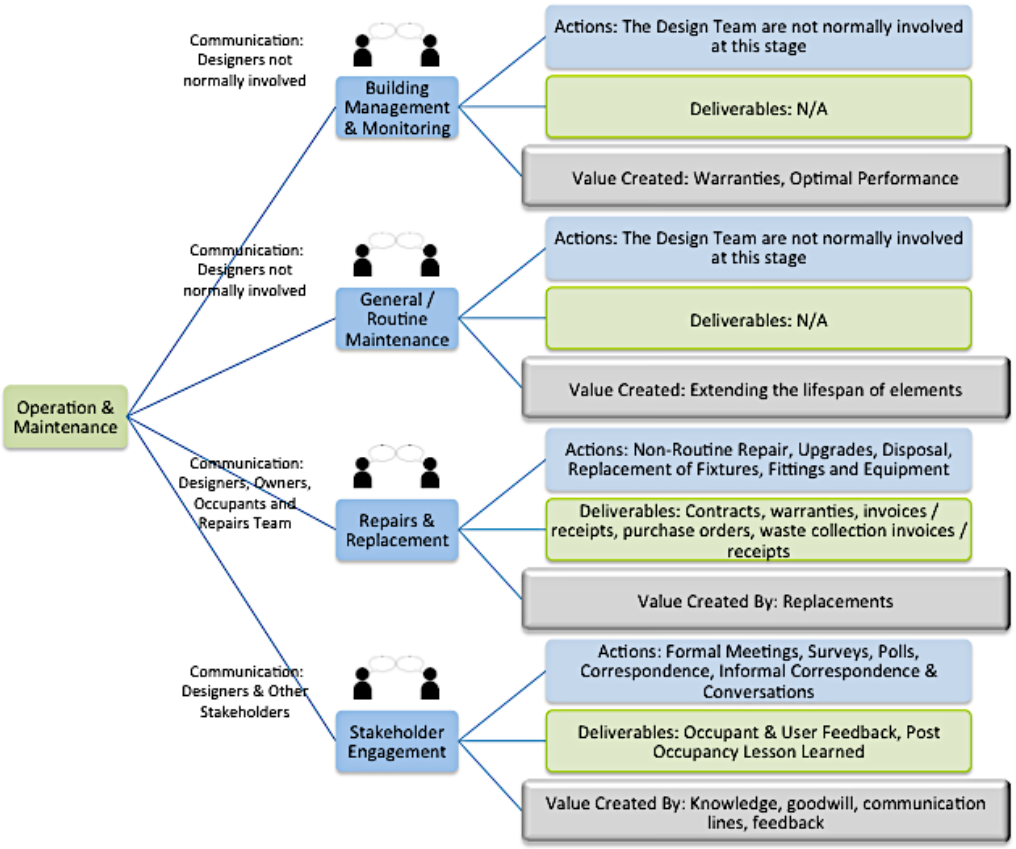

FIGURE 36 : **COMMUNICATION DIAGRAM FOR DESIGNERS AT IN-USE STAGE**

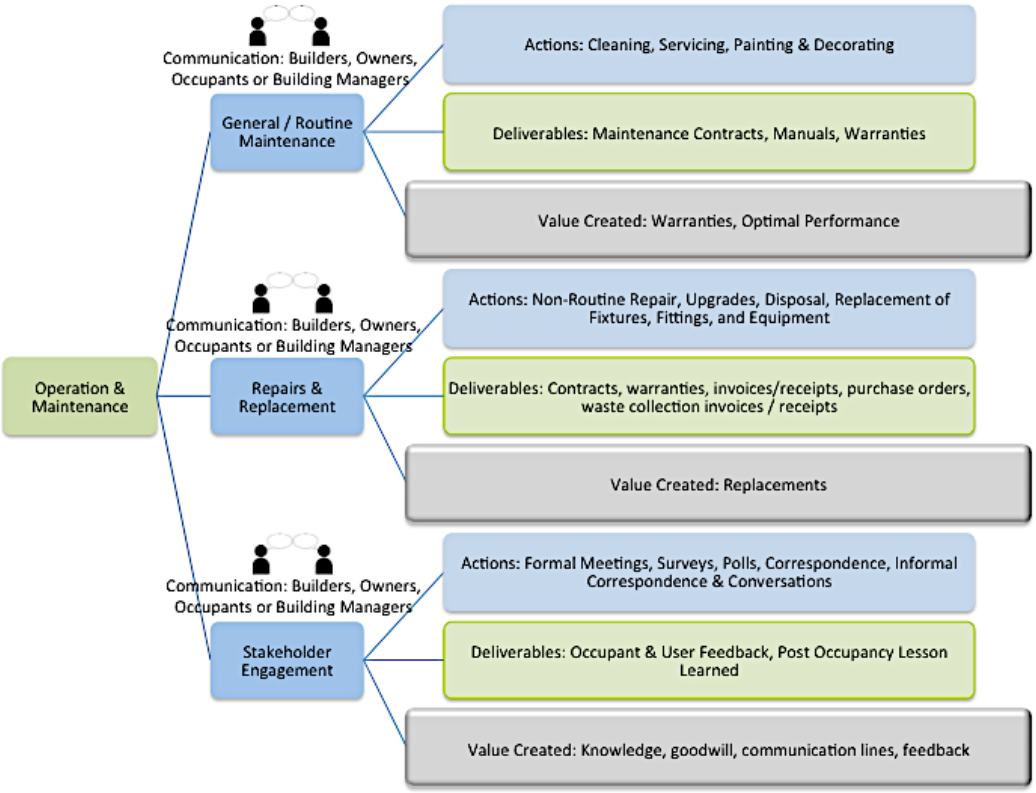

FIGURE 37 : **COMMUNICATION DIAGRAM FOR BUILDERS AT IN-USE STAGE**

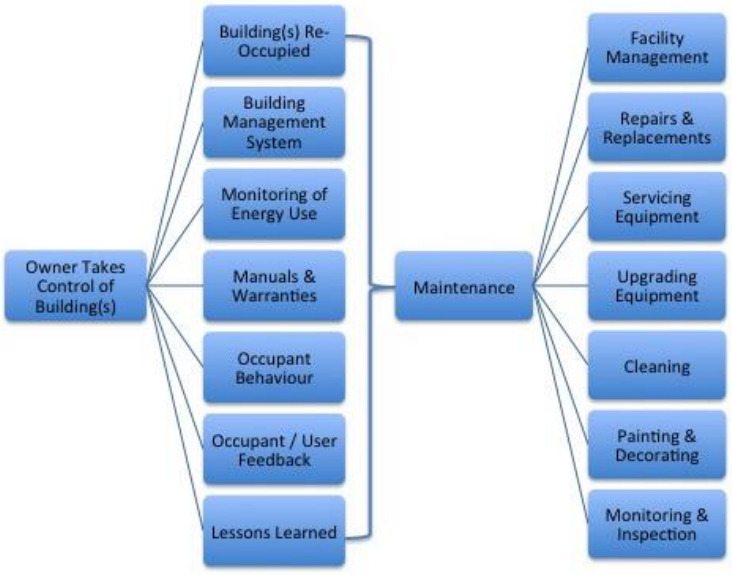

FIGURE 38 : **GENERIC OPERATION & MAINTENANCE ACTIVITIES AND OUTPUTS**

3.2.5 *Additional Findings from the Interview Process*

This sub-section of the report provides a thematic overview of a number of general issues relating to stakeholder interactions and communication that emerged from the interviews, in addition to those touched on in the various project stages above. Interviewees' names are not used, and are instead replaced with a code number in the form of NT16001, NT16002, NT16003 and so on. The text is broken up into sections based on the themes that emerged from the interview process.

Formal & Informal Communication

An important theme, which emerged from the interviews, is the respective benefits of formal and informal communication channels. Informal communication based on long-standing relationships was the most popular communications style amongst the interviewees (NT16041, NT16042, *etc.*). One interviewee described communication between members of the design team as informal; in this case, they had worked together many times before, and had built up strong relationships, having known each other for over 10 years. Their relationships had evolved beyond professional, and into friendships. This was seen as the main reason for their success. The relationships with others outside of the main design team, such as specialists brought in for specific issues, members of the client's organisation and so on was described as formal but communicative (NT16001). The value of informal communication was often mentioned in relation to one particular project where the levels of stakeholder engagement were high. One member of the design team mentioned how they took heed of "passing remarks" by the occupants, casual conversations with neighbours, and spontaneous design ideas in charrettes (NT16007).

The design team also had informal communication with a range of unusual stakeholders not directly connected to the project, that might have gone unidentified with another project team on-board that were not willing to "think out-side the box" as it were. They spoke to people involved in local tourist attractions, people involved in transport and shipping and so on. In general, there was much praise in the interviews for the development of relationships to the extent that communication could evolve from formal to informal; however, one interviewee cited the benefits of having more formalised communication with the authorities. While it was lamented that it was not now possible to work out issues over a coffee with the relevant authority personnel, and that the extra layers of bureaucracy can tend to slow down the process,

it was noted that the benefits include confirmation of discussions, requirements and agreements as well as an official paper trail should there by any chance of litigation in the future (NT16002).

NT16023 also mentioned that one particular American client took great interest in the project, travelling to Ireland once a month for meetings and bringing their own architectural and engineering consultants with them. This added extra layers to the hierarchy and formality of communication, however the additional input was welcomed, particularly as the client required the contractor to be involved very early on in the design stage. The aim, as the interviewee stated, was to have "all the brains at the one table" and achieve "better communication" from the outset. Interviewee NT16025 also discussed the great benefit of having early communication with, and involvement of the building contractor on construction projects.

Overall the common phrases or themes regarding communication that emerged as being most desired for success were:

- Diplomacy
- Trust, honesty and integrity
- Reliability and dependability
- Reputation
- Experience
- Professionalism
- Relationships and friendships
- Familiarity and informality

Relationships & Reputation

Another theme of the interviews was the importance of long-standing relationships and trust in facilitating collaboration and communication. Developing good professional and personal relationships with potential stakeholders, clients, and others in the industry, and above all gaining a good reputation was described as crucial to both the success of communications on a project and the success of the project overall. "Your reputation does really have an important influence on how people deal with you" (NT16002). Interviewees from design backgrounds pointed out that certain tender processes can have a negative effect on project relationships

and communication as you do not have any choice with regards who you will have to work with in order to complete the project (*e.g.,* NT16004) The winners of the tender for each particular role, architect, engineer, contractor and so on may never have worked together before, or may have done so, but not enjoyed the experience. It takes time for a relationship to develop, and as a consequence communication may suffer. Different companies have different organizational cultures, different methods, styles and so on. NT16024 concurred on this point saying that with public tenders it's the luck of the draw which contractor you end up with, and they may not be the one that you wanted, the one that you have a good working relationship with already.

NT16012 also discussed the merits of working with stakeholders of good repute, lauding the project team as "the most powerful team in the city, in the county", and the contractor as the "best in their field" and for their award-winning fenestration team. The positive nature of the relationships that had evolved was signalled by the fact the interviewee stated that they work with the same collaborators on almost all of their projects. They believe that familiarity with one another, with how each member operates and communicates, allows for the type of collaboration and flexibility that is required for project success.

Trust was mentioned as being a major factor in the success of relationships and communication between stakeholders (NT16022). NT16017 stated that had it not been for the involvement in the project of one particular person that he trusted, he would not himself have become involved.

Face-to-Face Communication

Face-to-face communication, as opposed to online engagement, seems to have been the most common and most successful form of communication with stakeholders used by the interviewees. At the same time, it is clear that online engagement is increasing. One instance where an anonymous, or online system would certainly be advantageous would be a comments and complaints facility. NT16036, a contractor, stated that they had a very successful complaints-logging system in place where the occupants could contact them via e-mail, and between them and the building manager they were able to monitor, control, and solve issues as they arose.

Regular planned meetings were cited by many of the interviewees as being part of the communication process, the most beneficial being ones that were held on-site. Meetings were often described as being divided up according to the topic and target audience. For example, a

weekly site meeting might be attended by the design and construction team to discuss the minutiae of technical details. Meanwhile a monthly meeting might be set aside for the project team and the client and/or occupants to discuss overall project progress and specific issues pertinent for those stakeholders, who would not want to be present for the agreement of a flashing detail or a concrete pour. Several different types of meetings were discussed in the interviews: board meetings, project team meetings, project progress meetings, design team meetings, site meetings, public meetings, town hall meetings, private meetings, and one-on-one interview-type meetings. The visual aspect of having meetings on site appears in itself to be of benefit, as was hinted by NT16025 when they stated that the "closeness" was useful to the occupants in order to see and understand how the building work was progressing.

3.3 INTERESTS, DRIVERS AND MOTIVATIONS OF STAKEHOLDERS

The interests, drivers and motivations of stakeholders in energy retrofit can vary widely. This chapter summarises the relevant material from the interview process undertaken by NewTREND. The interests, drivers and motivations identified are organised into four categories, namely, those which are the result of (1) market and financial factors; (2) public regulations and policy; (3) factors integral to specific buildings and technologies; and (4) socio-cultural values and attitudes.

3.3.1 MARKET AND FINANCIAL DRIVERS

Market and financial factors provide a crucial set of drivers for stakeholders in energy efficient building. This category incorporates a wide range of issues, including payback times, split incentives issues, and property values. Some of these operate to incentivise energy efficient building, a significant number impose barriers, while others are variable in their impact.

Payback Times/Return on Investment

The interviews indicate that payback time is a consideration in the selection of materials and technologies for energy retrofit, and in this regard the benefits of renewables are an issue of disagreement amongst the stakeholders in many countries (NT16006). Low payback was cited by NT16006 as a reason for not installing renewables, along with the impracticability of certain renewable technologies such as wind-turbines for urban use. Interviewee NT16023 likewise cited low rates of return on retrofit and a focus on the bottom line on the part of clients as a limiting factor in energy efficient building, but contrasted this with companies which were in a

position to take a longer view, where the benefits of energy efficient building became more apparent:

> "…some clients have zero interest, a lot of them it's just the bottom line for the build cost. Some clients you deal with are just a project manager within the company, and his only goal is to get the building built for as cheap as possible, and meet the current regulations, whereas some companies have a better philosophy where they take in how its built, how it's going to run for the next 30 years, and they do worry about maintenance costs, and running costs…" (NT16023)

This underlines the need for the integration of a lifecycle perspective into decision-making in order for the rate of return on energy retrofit to become attractive.

Impact on Property Value

The interviews show that increasing profitability and maximising the possible financial gain from every square metre is a priority for many clients (NT16007). Especially in the case of commercial office space, increasing the rental or resale value of the building prompts many refurbishment works. Moreover, improving the energy efficiency of a building can contribute significantly to the increase in value for both owner occupants and rented buildings, therefore energy retrofits are often part of refurbishment projects that seek to increase the monetary value of buildings. As one interviewee stated, offices that are comfortable to work in will keep their tenants and employees longer, and will attract a higher 'quality' tenant. Several interviews mentioned a 30-year building lifecycle as the basis for the costing of projects (NT16017, NT16023).

Split incentives

Split incentives emerged in the interviews as a significant disincentive to the energy retrofit of buildings. Maintenance and running costs are frequently not considered at the design stage, or are discounted because the stakeholder paying for the building work is not the one who will pay for the upkeep. It can also be the case that the stakeholder who gains from the installation of renewable energy sources (such as a commercial or residential tenant) is not the one who paid for the installation (private developer or public body). On the other hand, when occupants or users do not pay for the energy consumed by a building, they have little incentive to use it

efficiently. 'As I am not responsible for paying the energy bill I am not very interested in saving energy' (NT16035).

Funding Source (Public/Private)

In the interviews, the source of funding emerged as a critical factor in incentivising energy efficient building. Grants and public funding are vital to the market for energy retrofit, with more than half of projects covered by the interviews receiving public funding of some kind. On the other hand, this can create its own constraints. There were complaints that public clients may generate more levels of bureaucracy, and that grant-aided projects may require more paperwork. Lack of grant funding was mentioned as a difficulty by one interviewee (NT16006). Moreover, when private clients buy in to the idea of energy efficiency, they can be more open to new ideas and technologies than the public sector.

Fuel Poverty

It might be expected that a concern with fuel poverty would incentivise energy efficient building, since it offers the possibility of reducing fuel costs. However, in at least one case detailed in the interviews it had the opposite effect. A local authority was opposed to introducing a district heating scheme involving metering because they believed it could create a situation where vulnerable tenants might end up having to turn the heating off to save money (NT16013). Occupants living in fuel poverty are also unlikely to have the financial resources to pay for building refurbishment. That fuel poverty is not just a problem in cold climates is illustrated by interviewee NT16045:

> "The problems are not only on winter time, during the summer the walls became very hot from 9 a.m. until 9 p.m. Those who can afford it install a conditioner while all the others suffer the heat. Some of us are forced to sleep on the balcony. The situation is quite difficult especially for elderly people." (NT16045)

Information

Information deficits did not emerge as a significant theme in the interviews; probably because these were strongly focused on industry stakeholders who could be expected to be well informed about retrofit options, or occupants and users in buildings which had already been refurbished. However, enhancing the level and quality of information available to all

stakeholders in building refurbishment can only increase the incentives for energy-efficient building.

3.3.2 *Regulatory And Policy Drivers*

Regulatory and policy drivers play a central role in incentivising energy efficient building, as do building certification and assessment systems. On the other hand, building regulations can also place barriers in the way of energy retrofit: for example, heritage restrictions emerged from the interviews as limiting the scope of building refurbishments in many cases.

National and EU Policy

Two specific policy drivers mentioned in the interviews were feed-in tariffs and the planning system. Where feed-in tariffs have been introduced for renewable electricity, such as in Germany, this has provided a powerful incentive. However, feed-in tariffs are not the rule across the EU. For example, one Irish interviewee identified the absence of a feed-in tariff as a disincentive to investment in PV panels, as there was no means to recoup the investment (NT16013). The perception that the incorporation of a high degree of energy efficiency or of renewable energy sources will help a building gain planning permission can also act as an incentive. For instance, NT16002 viewed the integration of sustainability into urban design as a priority for the local authorities, so that sustainable building features would enhance the chances of gaining planning approval.

Assessment and Certification Schemes

Both mandatory and voluntary building assessment and certification schemes were found by the interviews to have a significant effect in incentivising energy efficient building. Since the introduction of the EU Directive on the Energy Performance of Buildings, it has become mandatory for member states to have a rating certification system in place for building energy use. The consensus among interviewees was that these requirements are a powerful driver of energy efficient building, especially among clients who may otherwise be indifferent to energy efficiency. The stronger the levels of regulation the better, as many stakeholders merely want to meet the minimum mandatory requirements (NT16023, NT16025).

The impact of building certification, however, can differ between sectors. For example, Irish interviewees suggested that private commercial tenants in office space did not pay quite as much attention to the BER (Building Energy Rating – the Irish certification system for energy

performance) as public tenants who are required to display their BER on their buildings and in general set a good example. Regulations also tend to apply more to new-build projects. Energy improvements to existing buildings tend to be voluntary, being implemented only where the opportunity arises and where they coincide with other objectives, such as increasing the rental value of a property.

In addition, adhesion to voluntary standards is now expected in some markets. For example, a London interviewee stated that the British Building Research Establishment's Energy Assessment Method (BREEAM) is now considered almost as standard (NT16002). LEED certification (Leadership in Energy Efficient Design, developed by the United States Green Building Council), is demanded by American and multi-national commercial clients setting up offices in Dublin. Passivehaus (Passive House), a German voluntary rating system, is gaining popularity across Europe, especially in the residential, and private one-off dwelling sector.

In summary, building energy rating systems were found to have a strong effect in incentivising energy efficient building. However, this effect can be differentiated according to market, sector (public/private), and type of project.

Heritage Restrictions

Restrictions due to the heritage value of buildings were frequently cited in the interviews as imposing strict limits on the degree to which their energy efficiency could be improved. Heritage buildings frequently cannot be covered with insulation or cut for ducting (NT16002 & NT16006). Replacing windows may not be an option depending on local planning and conservation laws, and their interpretation. Insulating the roof of a protected structure or listed building may also be difficult without removing and potentially damaging roof tiles, or disturbing delicate materials. 'We have to accept certain buildings as they are' (NT16007).

3.3.3 *Building and technology factors*

A range of factors intrinsic to individual buildings (or groups of buildings) and the specific technologies or materials that may be employed in a retrofitting project can act as drivers and motivations for stakeholders. The age, state or repair and condition of a building or a change of ownership may stimulate refurbishment; on the other hand, ownership structure or heritage value can act as disincentives to energy retrofit. The familiarity of a given technology, and the

ease with which it can be integrated into the wider socio-technical system of which a building is a part, can provide crucial incentives for its incorporation in a refurbishment project.

Age, Repair and Condition of Building

The age, repair, and condition of a building can play an important role in the drivers and motivations of stakeholders in energy retrofit. For example, where the condition of a building creates a need for substantial upgrade or repair, this can provide an opportunity to improve its energy efficiency as part of the larger works. A change of use of the building requiring its modernization can open a similar window, as can the coincidence of energy retrofit with periodic maintenance. On the other hand, a limited upgrade of a building that does not incorporate deep retrofit can close down opportunities for achieving greater energy efficiency in the future (Allcott & Greenstone, 2012).

Ownership

According to the interviews, ownership structure and the tenure of buildings can have a variable impact on the incentives for energy efficient retrofit. A Hungarian respondent pointed out that district heating could be difficult to implement in buildings with complex ownership (NT160006). On the other hand, where buildings are privately owned, individual solutions such as thermal envelope improvements, and installation of solar panels, or PV panels are more common. In general, renewables tended to be more common with privately owned (or at least long-term leased) and owner occupied buildings.

Familiarity of Technologies/Materials

It is clear from the interviews that technologies and materials that are familiar, established, and of proven effectiveness are more readily deployed than newer or less familiar technologies. In the projects discussed insulation (in all applications, *e.g.,* internal, roofs, external wrap) was the most common approach adopted for energy retrofit. Upgrading windows or glazing (and to a lesser extent doors) was also common, as was the renovation of heating systems and boilers. Among renewable energy technologies, solar panels, both thermal and PV, were the most widely used among the interviewees. Condensing boilers, energy efficient lighting, water recycling, heat recovery, and combined heat and power were also mentioned. Geothermal and wind energy were far less common in the projects discussed. With a few exceptions, the picture is of a

relatively narrow range of familiar, tried-and-trusted materials and technologies being deployed in the energy retrofit of buildings.

Integration with other Technologies

Energy efficient or renewable energy technologies cannot be considered on their own; their feasibility is often determined by their relation to the other heating, cooling and energy-generating technologies in a building and its surrounding district, as well as the wider socio-technical context. For example, one residential project installed solar PV panels for electricity generation, but because there was no method of storage, and no feedback tariff, the electricity simply went back to the grid while the occupants were out at work and school during the day (NT16013). The same interviewee noted, in relation to a district heating project they had been involved in, that increased air tightness and insulation standards in building regulations is now reaching levels where heating requirements are very low for new buildings. As existing buildings are retrofitted, the heating requirement overall in districts is reduced, as is the incentive to invest in district heating systems (NT16013).

3.3.4 *VALUES AND ATTITUDES*

The values and attitudes of stakeholders decisively shape their interests, drivers and motivations. They influence whether the priority in a project is given to the financial bottom line or environmental sustainability, occupant comfort or reduced energy use, aesthetics or utility. While the values and attitudes of clients can be of decisive importance, those of designers, contractors, local authorities and occupants and users are also important. The interaction between them and the decisions reached by stakeholders as a result can have a decisive impact of the future direction of the market for energy-efficient building.

Occupant and User Considerations

Depending on the value and priorities of building occupants and users, these can act as either incentives or barriers to energy efficient building. Energy efficiency and sustainability may also compete with different values such as utility, aesthetics, heritage, *etc.*

The ambiguity is reflected in the interviews. NT16013, a representative of a local authority, indicated that energy is not top of their tenants' lists of concerns. 'Safety is top of their list of concerns – is it safe to come to your front door, will you find people shooting up on the stairs, can people come and knock on your window – people on the ground floor.' While fuel poverty is an issue, with flats that are very hard to heat, tenants 'don't seem to focus on it, they don't seem to bring it up. In Dolphin House where they were very poorly heated and that was leading to the mould, it was the mould they were worried about, but none of them were really complaining about the cost of the heat. They're used to it' (NT16013).

Autonomy and control over energy use are widely desired by both commercial and residential tenants. For example, NT16011 states of commercial tenants in buildings let out on a floor-by-floor basis that they want to be sure 'there is no risk of me paying for the guy downstairs who has his heating on all the time'. This can have a variable impact on the incentives for energy efficient building. Sophisticated modern smart metering techniques can enable individual tenants attain a high degree of autonomy and control in their energy use. On the other hand, where metering is not introduced (for example due to opposition from tenants or concerns about exacerbating fuel poverty), the desire for autonomy and control can be a barrier to the use of district or building scale heating technologies.

Pro-environmental Values

It is clear from the interviews that the values of the client and the design team, in particular their attitude towards the environment and sustainability, can have an important impact on incentivising energy efficient building. As one interviewee stated, 'it's really down to the company philosophy, and what they want, if it's just to get it done, or if it's actually to do it right' (NT16023). Unsurprisingly given the focus of the research, energy efficiency and sustainability more generally were identified as key design principles in many of the interviews (NT16002, NT16003, NT16005, NT16012, NT16013, NT16015, NT16017, NT16020, NT16022, NT16025, NT16027). However, the interview process appears to confirm the findings in the literature that energy improvements are seldom the principal factor motivating a building renovation project. Instead, energy is often one of several coinciding needs, such as comfort levels, repairs, and modernisation, which stimulate a refurbishment project (Steskens *et al.,* 2015). There were also some interviewees for whom energy efficiency was not a priority – for example, because heritage considerations meant they were not subject to the regulatory standards (NT16003).

Environmental sustainability was not mentioned as a driver by many interviewees, with the exception of NT16023. Energy efficiency was cited by several, but usually for pragmatic reasons to do with public relations or finance, or in order to meet building regulations or market demands, rather than a concern with sustainability or environment. On the other hand, an increasing number of companies desire to project a 'green' or 'sustainable' image, and want their buildings to be energy efficient and incorporate renewable energy technologies. Likewise, public bodies are under pressure to demonstrate leadership in the area of energy efficiency, including through their buildings. Cultural shifts in both public and private sectors, therefore, are already playing a role in incentivising energy efficient building and are likely to intensify.

Project Champions

The interviews also make clear the importance of particular individuals who initiate, drive forward and sustain major building projects, particularly where they are ambitious or innovative. The influence of 'project champions' is hard to quantify but nonetheless undeniable. NT16006 discussed how the local Mayor was a great champion for the project. As an architect as well as Mayor, he had both the professional knowledge and personal interest to invest a lot of time and energy. A similar comment was made by NT16017. The personal commitment to a project of one or more team members was also mentioned in NT16010 as being a major ingredient of success. Innovative energy retrofit projects on the scale of multiple buildings or urban districts, in particular, are unlikely to succeed without strong and influential project champions behind them. Interviewee NT16006 states: 'Much depends on the leading man, who ties it all together…There must be one person with appropriate decision-making competence and organizational skills who holds the whole thing together.'

Table 7 below integrates the results of the interview process with the literature review in Section 2.6 to provide a comprehensive overview of incentives and barriers to energy retrofit:

Category of Driver	Incentives	Disincentives	Variable Impact
Market and financial factors	Impact on property value & rental	High upfront costs, Long payback times, Project risks, Split incentives, Fossil fuel externalities	Rate of return on investment, Funding source, Ownership structure, Fuel poverty, Information

Regulation and policy	National and EU regulations, Financial and non-financial incentives, Feed-in tariffs, Planning system, Assessment and certification schemes	Heritage restrictions	
Buildings and technology	Change of ownership/use, Coincidence with other works/maintenance, Modernization/repairs, Familiarity of technologies/materials		Integration with other technologies
Values and attitudes	Occupant requirements (comfort, utility, health & safety, *etc.*), Pro-environmental values, Project champions, Public relations and peer pressure	Non-financial costs	Autonomy and control

TABLE 7 : **INCENTIVES & DISINCENTIVES**

3.3.5 *INTERESTS, DRIVERS AND MOTIVATIONS BY STAKEHOLDER GROUP*

The table below breaks down the interests, drivers and motivations identified according to the stakeholder group to which they are most relevant:

Stakeholder group	**Drivers and motivations**
Client	Payback times/return on investment Upfront costs Project risks Externalisation of energy costs Impact on property value Split incentives Funding source Information National and EU policy and regulations Assessment and certification Heritage restrictions Age, repair and condition of building Ownership Occupant and user considerations Pro-environmental values
Design team	Upfront costs Project risks Split incentives Information

Stakeholder group	Drivers and motivations
	National and EU policy and regulations Assessment and certification Heritage restrictions Familiarity of materials/technologies Integration with other technologies Age, repair and condition of building Occupant and user considerations Pro-environmental values Project champions
Project Manager	Project risks Upfront costs Split incentives Information National and EU policy and regulations Heritage restrictions Familiarity of materials/technologies Integration with other technologies Occupant and user considerations Project champions
Building contractor	Upfront costs Project risks Split incentives Information Heritage restrictions Familiarity of materials/technologies Integration with other technologies Project champions
Building occupants	Project risks Externalisation of energy costs Split incentives Fuel poverty Assessment and certification Age, repair and condition of building Ownership Occupant and user considerations Pro-environmental values
End users	Project risks Externalisation of energy costs Split incentives Assessment and certification

Stakeholder group	Drivers and motivations
	Age, repair and condition of building Ownership Occupant and user considerations Pro-environmental values
Public authorities and statutory bodies	Fuel poverty National and EU policy and regulations Familiarity of materials/technology Pro-environmental values
Building management	Project risks Externalisation of energy costs Information Familiarity of materials/technology Occupant and user considerations Pro-environmental values Project champions
Financiers and associated services	Payback times/return on investment Upfront costs Project risks Externalisation of energy costs Impact on property values
Consultants and third parties	Familiarity of materials/technologies
Community and civic society	

TABLE 8 : **INCENTIVES BY STAKEHOLDER GROUP**

Clearly, the client is frequently the most influential stakeholder in setting the goals of a project. As one writer states, 'the influence of project owners is greater due to their position as key decision makers. Hence, the issues concerning incentives for green building projects are largely focused on project owners' (Olumunmi 2016: 1612). This is reflected in the interviews, where over and again interviewees state that they measure the success of a project through the satisfaction of the client (NT16038, NT16039, NT16041). What is striking about the answers is not that they mentioned client satisfaction, but that it was frequently the sole measure of success, and factors such as exceeding the criteria for energy certification, coming in on budget and on time, saving energy, *etc.* were not referenced. Likewise, only one interviewee mentioned user satisfaction as a critical measure of success (NT16001).

Clients are impacted in their decision-making by almost the entire range of interests, drivers and motivations identified: market and financial, policy and regulatory, building and technology-related factors, attitudes and values. In particular, as the stakeholder responsible for the cost of the retrofit, financial factors play a massive role in their decision. Their individual or corporate values are also crucially important.

In the case of the design team, a wide array of factors again come into play, since they will need to take into account not just the desires of the client, but what can feasibly be implemented in the project, the requirements of public and statutory bodies, and the needs of occupants and users of the building. The drivers operating on project managers and contractors are more limited, since they will be more narrowly focused on the delivery of the project. Consequently, the upfront costs of specific materials or technologies, the immediate impact of regulations or heritage restrictions on the project, or day-to-day relations with building occupants and users may be more important than longer-term strategic perspectives.

For building occupants and users, financial drivers are likely to be important; however, their perspective on these may be different to that of the building owners (unless these categories of stakeholder overlap). For example, project risks will concern them less as a source of potential financial loss than in terms of their potential impact on their quality of life, while reduced energy costs may benefit tenants more than building owners. Their attitudes and values are likely to impact on the effectiveness of a retrofit through the efficient use of new technologies or otherwise, rather than the decision to refurbish a building in the first place.

Other stakeholders may be responsive to a more limited set of drivers and motivations. Public authorities and statutory bodies will be driven largely by the policy and regulatory framework – although this can incorporate a range of objectives with differential impacts on energy retrofit. Financiers and associated services, on the other hand, will be focused largely on financial issues such as return on investment, upfront costs and payback times.

3.3.6 CONCLUSION

The interests, drivers and motivations of stakeholders can be divided into those that provide *incentives* for energy efficient building; those which provide *disincentives*; and those which are variable, capable of acting as either incentives or disincentives depending on the circumstances.

- *Incentives* for energy efficient building are strongly driven by public policy (building regulations, certification schemes, feed-in tariffs, the planning system) and its impact on the market. The values and attitudes of key stakeholders are also important (pro-environmental values, comfort, the role of project champions). The familiarity and established character of technologies and materials is also a factor.
- *Disincentives* for energy efficient building are dominated by market and financial factors (low return on investment, high upfront costs, information deficits, split incentives, long payback times), while public policy also plays a role in the form of regulations protecting heritage buildings.
- A significant number of factors can play the role of either *incentives or disincentives* depending on the context. These include market and financial factors (funding sources, ownership structure, return on investment), as well as the relationship of energy efficient technologies to the wider socio-technical system.

Consequently, stakeholder interests and drivers do not divide simply and cleanly into those which incentivise or disincentivise energy efficient building. Instead we need to understand them in the context of the wider socio-technical system, in which public policy and regulation, market forces, financial opportunities or pressures, technological development, and socio-cultural values and attitudes come together to create the environment in which decisions about building energy retrofit are made. Based on the interview material, it appears that public policy and personal and corporate values/attitudes are key drivers of energy efficient building. These in turn have the potential to shift the structure of market incentives in favour of energy retrofit, as well as helping new technologies move from niches to mainstream.

A further distinction is between *intrinsic* and *extrinsic* drivers and motivations. Extrinsic drivers can be defined as drivers that are mainly set by external parties to the project, such as governments or the European Union (Darko *et al.,* 2017:37). They include incentives such as tax breaks for energy retrofit or energy certification schemes, as well as factors like heritage regulations that may restrict the scope for energy retrofit. Intrinsic drivers are factors integral to the project, such as the different kinds of value (monetary or non-monetary) generated by an

energy retrofit, which motivate the stakeholders. 'Situations where people are poised to act out of sense of volition, personal endorsement and feeling of choice, are regarded as intrinsic motivation. Unlike external incentives, which are forced choice, internal incentives arise from a person's feelings or connection about the activity' (Olumnunmi *et al.,* 2016: 1615). At present, energy retrofit is strongly dependent on extrinsic drivers derived from public policy, as well as intrinsic motivations such as pro-environmental values on the part of project champions and occupant and user considerations such as comfort or health and safety.

3.4 Occupant and User Needs and Interests

Consideration of occupants and user needs and interests are central to NewTREND, since they can directly impact the performance of a retrofitted building. The two main factors that affect the use of energy in buildings are the physical characteristic of the buildings, and the behaviour of the occupants and users. The former can, and has been altered through legislation and various incentives to promote more energy efficient buildings, the latter however; occupant and user behaviour is not so easily changed by external means (Guerra-Santin, 2013). Occupant behaviours can be divided into two areas, the adaptation of the building or of adaptation of the person. The first may be through window opening, light switching, thermostat adjustment and so on, and the second is the adaptation of personal behaviour, adding or removing layers of clothing or altering levels of physical activity for example.

Consequently, the type of occupants and type of occupancy or tenure is an important factor for consideration (Rafsanjani *et al.,* 2015:11012). Are the occupants permanent or temporary, are they in-situ long-term, newly occupied, unknown as yet? Are they living in, working in or using the building? Do they own or rent, or are they there as employees, guests, patients, or prisoners? Do the occupants have a positive or negative relationship with the owners or with one another? What about demographics; are they mostly young, old, male, female, employed, unemployed and so on? And, of course, a very important question; who pays the energy bills? All of this information about the occupants can be very helpful in ascertaining their need and interests. Information which will in turn, if put to good use, will help to reduce the likelihood of a performance gap – where the building does not perform at the levels predicted in terms of energy consumption, comfort, indoor air quality levels and so on. The literature cites several examples where buildings underperform (*e.g.,* Bordass, 2001 & 2004, in Brown & Cole, 2009, Azizi *et al.,* 2014, Brown & Gorgolewski, 2014). Studies also show that the way people use

heating and ventilation systems is determined more by personal factors such as experience, attitude, origin, perception, gender and ownership rather than by external conditions (Guerra-Santin & Itard, 2010:319).

It is long recognised that the occupant should no longer be considered to be a passive recipient of a set of indoor conditions, but rather viewed as inhabitants who play an active role in the maintenance and performance of their buildings (Cole *et al.,* 2008 in Brown & Cole, 2009:229). The American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) state that "people are not passive receptors of their environment rather, they interact continuously with it" (ASHRAE, 2012 in Brown & Gorgolewski, 2014:494).

The needs and interests of occupants and users can be incorporated in a building retrofit through a number of routes. A generic picture of the typical future user of a building can be constructed, and their needs hypothesised on this basis. In cases where the occupant or user of a building is also the owner, they will usually be in a position to have their needs taken account of in the design brief. Alternatively, a structured approach to involving occupants and users in the design process may be adopted by the design team. This can have the advantage of systematically eliciting important information about occupants' and users' needs. It can also improve the design of new energy measures incorporated in the building, tailoring them to the occupants' and users' needs and increasing the likelihood of the measures being used appropriately and effectively when the refurbishment is complete. However, structured involvement of occupants and users in building design may not always be possible or desirable. Much will depend on the characteristics of the individual project and its stakeholders.

This section of the report draws on the interview material to present a picture of the ways in which occupants and users' needs and interests are currently taken into account in energy retrofit. It therefore complements NewTREND deliverables D2.5 and D2.6, which offer suggestions for an improved participatory design process engaging building occupants and users. The figure below illustrates an overview of proposed approaches to occupant and user Involvement In the design developed within NewTREND deliverables D2.5 and D2.6.

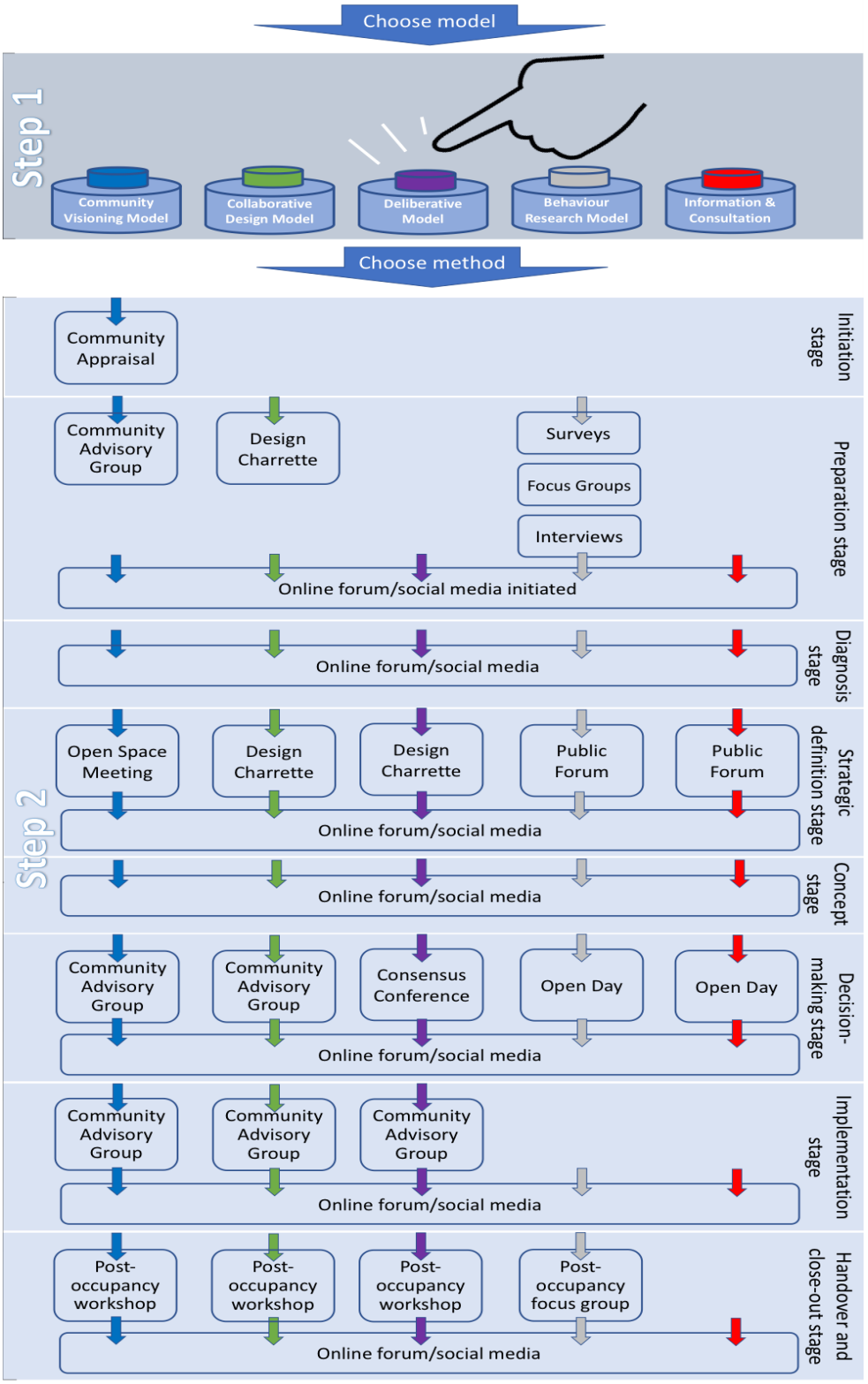

FIGURE 39 : OVERVIEW OF NEWTREND APPROACHES TO OCCUPANT & USER INVOVLEMENT

3.4.1 Occupants and Users at the Initiation & Viability Stage

In the majority of interviews, the occupants and users were not heavily involved in the initiation and viability stage. In some cases, they were never fully engaged at any point in the project, while in others, there was significant stakeholder engagement, but it was perceived to be of more value in the design stage, once the project manager, project team, owner or client deemed it a suitable time to involve the occupants and users. Interviewees spoke of following protocols with regards who to communicate with and when, and avoiding premature communication with occupants, including over-promising at the Initiation & Viability Stage.

> "At the moment, we are still in a preliminary stage of this process, and at policy level, the involvement of end-users is still quite premature." NT16046

> "We used to be very bad at the consultation, (name omitted) in general, when it was (name omitted), we used to just do stuff. I remember, when I started here, 30 years ago, we didn't do much of that. We kind of didn't need to – we were building in places where people weren't living yet. And then there was a phase where one manager in particular, he kind of got it, let's go and consult people, but he thought it meant doing whatever they say. So, he'd go to meetings and he'd promise anything, he'd promise things that weren't possible to do, just because one person in a meeting had shouted about it. So, that's not a very good way of doing it either. So, there's been organizational learning. I think Housing are the best department at it because they deal directly with people." NT16013

It can be difficult to decide when the time is right to begin consultation. However, several of the interviewees interviews indicated that engagement with the occupants occurred far too late in the project when construction works on site were already underway, so that their capacity to influence the project was consequently minimal (*e.g.,* NT16043 & NT16049).

> "The building occupants were asked about their needs by stopping the work in the yard for a certain time. During this stop, the requirements of the future inhabitants were investigated, in order to customize some aspects of the final product." NT16043

> "Of course, theirs should be among the first feedback that the designer should take into account, because it consists to design the spaces where many people will work, with different tasks. It seems to me illogical to not engage them and to not take into account

> their needs, because it leads to a disaffection of the workplace and to a lower user productivity." NT16049

> "We have been informed almost afterwards." NT16049

In many instances the future occupants and users of a building are unknown, making it more difficult to judge their needs, especially at the Initiation & Viability Stage.

> "(Interviewer) So when you were designing it, you didn't really know who was going to be using it in the end? (Interviewee) no we didn't but that is quite common in a way." NT16001

However, designers still need to take these into account, so a wholly generic 'user' is constructed. They may do so by looking at demographics, or using design 'rules of thumb'. One interviewee outlined the various rule-of-thumb methods used to take account of future users in the design of office space:

> ".....typically we base it on what we call a 60-60 split. So, if there is 100 people, instead of going 50 men and 50 women, we design to 60 men and 60 women…so for toilet numbers, wheelchair numbers, changing areas, you just have a slight bit more than the minimum so that you can take discrepancies" (NT16023).

In larger buildings, creating multi-purpose spaces is a way of both future-proofing buildings, and dealing with design scenarios where the end-user is not known at design stage, or where the end-user is not clear on what their requirements are. Basic information on the activities that will be taking place in a room is also an essential consideration in terms of energy use (NT16005). Another interviewee stated they used social survey data on the number of single parent families in an area, how many people were in social housing, *etc.*, to determine what sort of services might be needed in the refurbished buildings (NT16010).

3.4.2 Occupants and Users at the Design & Planning Stage

The extent, format, timing, and character of occupant involvement with design differed markedly between the projects included in the interviews. Many projects had no engagement with occupants and users, either because they were dealing with an empty building or because it was not a priority for the client and design team. Others engaged in various levels of

consultation, while for some occupant and end-user participation in the design process was a priority.

In many of the projects discussed in the interviews, occupants and users were given little or no voice in the design process. One interviewee stated 'there were residential forums, where the plans were presented to them, but no actual communication happened. The residents were not involved in the design process' and again 'it was just a plan/design presentation, not a consultation. And this was definitely bad' (NT16017). Another interviewee stated: 'We didn't involve occupants in the concept and detail design' (NT16020). For other design team stakeholders, users and occupants are viewed primarily as sources of data who can tell designers what indoor temperatures are like, how much electricity they consume, how often they use their appliances, turn on their heating *etc.* When asked to name the stakeholders in an energy retrofit project, some respondents failed to mention building occupants at all (NT16005).

> "There were residential forums, where the plans were presented to them, but no actual communication happened. The residents were not involved in the design process." NT16017
>
> "We could have count ourselves lucky if 20-40 out of 170 residents turned up at residential forums. Many people are just not interested and the negative attitude of the most influential people who come, made things difficult." NT16017
>
> "We didn't involve occupants in the concept and detail design,…." NT16020
>
> "No one participatory process has been done with users. I only know that the perspectives of occupants and users are only marginally considered." NT16027
>
> "We were not involved in any planning meetings. We even were not informed on the details of the retrofitting works." NT16035
>
> "No, we didn't involve the tenants in the process." NT16033

The next level of engagement is consultation, where users, occupants and neighbours are provided with information on the building plans and given the opportunity to voice their opinions. Usually this takes place when the plans are at or close to finalisation, so the scope to influence the design is limited to the possibility of having some particularly objectionable feature amended or removed. Several of the interviewees discussed how local communities, occupants,

neighbours and the general public were engaged prior to the commencement of the work. In some cases, it was noted, that people were just glad to see the buildings being refurbished and reused rather than being allowed to remain unused and falling into disrepair. Simply being allowed into the process, and made aware of the proposals was seen as a positive (NT16007, NT160014). Other interviewees tended to view the occupants as rather passive: 'they have just taken our plans, and accepted them' (NT16010). On the other hand, interviewee NT16023 discussed how neighbours of the building project, in an affluent urban area, were extremely pro-active and attentive to any building works in their neighbourhood. Getting them involved in the process was seen as vital to the success of the project, and having a 'better friendship' with them led to a 'better end product'. In Ireland, one project held several open days on site for neighbouring residents to view the proposed plans (in drawing and three-dimensional model format) and meet with the client and design team to discuss the proposals. Attendance was in the hundreds at these events (16007 & 160014).

As multiple authors have argued, actual participation rather than consultation means that residents and other end-users are given a real voice in the design process (Arnstein, 1969; Cross, 1993; Robertson & Simonsen, 2012). At minimum, this requires that they be involved at an early stage in the preparation of the design. A variety of tools and techniques may also be required to ensure stakeholders who are not design professionals are empowered to make their voices heard. In one project, public meetings, design charrettes and open days were held (NT16007), while in another occupants and local residents participated in brainstorming sessions with the design team (NT16013, NT16024). Interviewee NT16013 discussed how the residents of an urban redevelopment project availed of the services of their own architect in order to liaise with the local authorities (who were the developers in this case). The architect, who was paid by the local authority, acted as a translator of sorts, a go-between who would help ensure the residents' voices were heard in the design process (NT16013).

> "In terms of the design process we've been very much involved with a design group, a local community group set up by local residents. So, at each stage, pre-planning, and even during the tender stage, we had regular meetings with them, explaining what we were doing, taking on board their comments and that. They also employed their own architect, (name omitted), a private architect to explain some of the more technical details to them." NT16024

Interviewee NT16007 described 'just listening' as being very important to the design process, and discussed the use of physical scale-models and three dimensional drawings that can be easily understood by people outside of the construction industry (tools also mentioned by NT16024). NT16007 also discussed taking note of occupant remarks. This can be an important signifier of potential occupant behaviour. For example, if occupants remark on how much they like the smell of freshly cut grass or the sound of birdsong, this may show a tendency towards window opening behaviour. Conversely, they may express exasperation at the noise generated by nearby traffic, which would indicate that the windows would probably remain shut all the time even in warm weather. Heating and ventilation design strategies should take this type of information into account. Such tools can make design proposals accessible and legible to occupants and users: 'people who were coming in looking at the planning application could actually see what it looked like in 3D, and that is very helpful' (NT16003). NT16009 described a project where engagement with the locals included a neighbourhood dinner at the local parish hall attended by officials such as the local mayor.

3.4.3 Occupants and Users at the Construction & Installation Stage

The needs of occupants and users must also be taken account of when planning the construction phase of a project. Noise and inconvenience during the building works were cited as the main occupant and user consideration during the construction phase in several interviews (*e.g.,* NT16011, NT16006, NT16026). In the case of commercial office buildings, interviewee NT16011 described how it could be necessary to carry out the works on a piecemeal basis in order to retain sitting tenants. Tenants may be moved from floor to floor, or building to building, while refurbishment works are carried out in stages. This type of project requires very careful coordination, stakeholder management and occupant consideration. Minimising disruption and inconvenience are paramount. Working outside of normal office hours may also be required in order to facilitate commercial or public tenants of buildings (NT16011, NT16012, NT16024).

> "It was the most important thing to finish the project in time but not to disturb the workflow of the people. Of course there were some noise and people saw the workers on the scaffolding, but these are inevitable. We had to agree on when to empty a whole floor to take out the windows on Thursday- Friday and Saturday. But right after we took out the old ones, we have put in the new windows, then the team came to restore the damages. This is the most important task in organization." NT16012

In the project described by interviewee NT16025, refurbishment works on a cluster of university buildings took place while they were in use by staff and students. An online survey was conducted on the university website while the work was in progress to measure any disruption, and weekly meetings were held between representatives of the building users and the construction and design team. Interviewee NT16013 notes that on one project in a residential area roads and driveways had to be dug up, causing disruption to road users and residents, while in another residents refused to allow their garden walls, which abutted on the site, be demolished and rebuilt. Meeting and talking with residents one-on-one was the favoured way of defusing such potential conflicts. A lot of this work was devolved to the contractor, as the partner on site, with provisions in the contract to this effect.

3.4.4 *Occupants and Users in the Operation & Maintenance Stage*

It has been well established in the literature that post-occupancy evaluation provides valuable feedback on occupant satisfaction and behaviour, chronic problems, and repeated mistakes (Brown & Gorgolewski, 2014) as well as building energy performance. However, in practice it is not often carried out. A notable feature of the interviews is that few of those spoken to routinely measured building energy use post-occupancy to gauge the effectiveness of energy efficiency measures.

> "There's a contract with them and I'm administering the contract, I'm called the employer's representative. I meet them every two weeks. I go as well in between times. We have an inspector who goes every day – but that's for technical matters." NT16013

On the other hand, getting feedback from the users or occupants of a building once it has been occupied can be very difficult. In some cases, this may be due to issues of security and privacy – such as the protection of intellectual property in an office building for example (NT16002). But in most cases, this is because once the building-works are complete, and handed over to the client, all ties with the design team are severed. There are no further contractual obligations. Therefore, in many cases, there is no feedback from the occupants to the designers and builders in order that lessons may be learned for future projects, nor is there feedback for the occupants with regards to the actual energy savings as compared to the energy savings proposed in the design.

> "The building is used by the government office itself. We are no longer in business relations, though from time to time we talk on the phone." NT16026

> "What kind of relationship do you have with them? (the occupants) [Interviewee]: I cannot answer to the question because I don't have any information about, I don't have any type of relationship with the current occupants of the buildings. I haven't any type of feedback from that." NT16008

Feedback techniques can provide occupants with their energy use information. Feedback can also be tailored to individuals. Individual occupants have their own strategies and intentions - known as personal behavioural strategies – to change their energy saving behaviour (Rafsanjani *et al*, 2015:11015).

There are suggestions in the interviews also that energy retrofits may not perform as promised, in part due to the behaviour of users and occupants. One interviewee mentioned an office building that was designed to Passivhaus standard, but was not meeting its targets. The designed energy use was based on a 21-degree indoor air temperature, but the occupants preferred to maintain the building at 23 degrees Celsius (NT16013). This may be linked to what is commonly referred to as The Rebound Effect, where there is often an increased consumption of energy after energy efficiency improvement works are carried out. When this occurs the energy savings are far lower than expected, perhaps even offsetting the benefit of the retrofit works entirely. According to Rafsanjani, (2015) failure to address occupant behaviour undermines investment into building envelopes and appliances. Therefore, as occupant behaviour is influenced by the occupant's beliefs, attitudes, social environment, their peer groups, and more directly their needs and interests; failure to address this issue can also negate the benefits of building retrofit works.

Studies show that the type of temperature and ventilation control influences occupant behaviour, and should be given careful consideration. For example, the presence of a more advanced heating control system does not automatically lead to energy savings, nor does the presence of a mechanical ventilation system automatically lead to increased energy consumption (Guerra-Santin, 2013). Window opening behaviours, thermostat control modification and pre-set overrides are all features of occupant behaviour that can be difficult to control and quantify. There are also energy consuming occupant behaviours, which are more easily quantified, such as leaving machinery and appliances on standby. Rafsanjani *et al.*, (2015) states that in commercial buildings in the US less than half of buildings appliances are turned off

after work, and because there are more non-work hours than work hours in a day, the energy consumption of these appliances after hours is very significant.

Sick building syndrome is also of particular concern to the building occupants and users. One interviewee discussed a project that actually went so far as to link the physical condition of the buildings with the physical condition of the occupants in order to make a better assessment of their needs and to design the retrofit works accordingly.

> "And with these indicators we did a simulation about the functioning of the energy of this house. And then with the nurses we did tests about health…Because they found out that when they had the data coming from the sensors they found that maybe the temperature in the indoor at night was 13/14c with high humidity. So, you can imagine what does it mean to live there with this conditions, it affects the health and the project wanted to know how heat affect the health and what could be the situation after the retrofitting just to know how the relationship between the health and the indoor conditions of the house." NT16031

Peers in their built environment significantly influence occupant behaviours, and word-of-mouth is considered to be a very influential medium of communication between occupants (Rafsanjani *et al*, 2015). Some technologies may not work because building occupants or users dislike them, for example metering. One interviewee said they tried it in the past with residents in their buildings but had met with strong hostility (NT16013). Consequently, their organisation had ruled out using metering again. Robustness of design can help to mitigate the effects of unexpected occupant behaviour, for example, the use of thermal mass, fixed shading and avoidance of over-glazing in order to make buildings less sensitive to the actions of the occupants (Buso *et al.*, 2015). The literature suggests that although it is not a sufficient design strategy on its own, occupants do need to be given a certain amount of control over their environment in order to feel satisfied (Brown & Gorgolewski, 2014). However, in some cases discussed in the interviews, the requirement for energy efficiency led to designers taking steps to limit the control occupants and users had over the building systems. In the case of NT16013 this involved fully enclosing the building and putting in ventilation systems rather than grids. NT16015, an Italian interviewee, was explicit about this managerial approach and the reasons for it:

"Mechanical ventilation systems were foreseen in the project and camera bodies were placed in the habitable roof-space, in order to avoid that users could access to it to change the air circulation, because they are not educated about the operation of the systems technology" (NT16015).

3.4.5 *Communications with Occupants and Users*

One method of generating more positive communication between the project team and wider groups of stakeholders like occupants, users and neighbours was for the project team to go to the people and not make people come to them - to be visible, accessible and available. Interviewees talked about going door-to-door making house visits (NT16013), having personnel at "the coal-face", NT16002), "on the ground" (NT16012), or hiring the services of an architect to work on site during the construction process in order to maintain a permanently open channel of communications between the occupants and contractors on site and the architects and other design consultants off site (NT16014).

Where the occupants were the same before and after works, but were not involved in the process, the lack of communication was cited as having caused stress and anger towards those that carried out the project. (NT16035) In another project where there appears to have been a communication breakdown between the project managers and the building users, the building contractors and design team were at the receiving end of abuse and complaints, according to NT16012, which made their jobs difficult at times. NT16017 stated that they lost all motivation for the project because of the bad relationship with the occupants and users. On the opposite end of the scale, where public events were held, and occupants, neighbours and the general public were invited to participate in the process the events "generated a lot of goodwill towards the project" (NT16007).

The language used by some of the interviewees is an interesting insight into their attitudes. One interviewee for example was happy that the project was progressing with little "interference" from the occupants. At another point in the interview they were described as "you people". This use of language suggests an attitude towards the occupants as persons to be talked down to and provided with information to educate or cure them of their poor knowledge and/or bad behaviour, so they will not misuse the designers' buildings. It implies an information deficit model of communication and participation. NT16007 on the other hand states that having the occupants attend design charrettes and express their opinions gave them a certain ownership

of the project as well as providing valuable input into the overall design process where a casual comment might be teased out into a legitimate element of the design brief because the project team seemed to be always open to new ideas from any, even unexpected sources.

Another interviewee (NT16013) who was involved in several projects where there was significant stakeholder engagement and communication with occupant and user groups warned against opening lines of communication too soon, and without adequate preparation. Of the occupants and users it was said 'they know we are working on something but we haven't started to tell them yet' and also "we've a protocol about who you tell first". They advised careful preparation and initiating communication with various parties in a particular order, and with specific types of communication for specific groups. Diplomacy was viewed as being very important, for example, communicating with politicians who were not actually connected to the project, but had the power to influence stakeholder who were connected to the project. The whole process was described as an informal, evolving and adaptable communication protocol. This tiered approach to communication is not uncommon. NT16017 describes how the project team would approach representatives with ideas first, rather than entire groups of occupants and users, as the representatives would be able to tell them which ideas they thought the "community would accept, and what they would not". There was also another comment in the interview that "we never make a planning application that we are not going to get", which meant the interviewee would not proceed to that stage without having had very in-depth communication with all the stakeholders to resolve any potential issues beforehand.

The lived experience, the reality of the buildings, not just the professional and theoretical opinions on how the buildings function and perform, is very important information that can really only be gleaned from the occupants and users. Listening to their needs even in matters that are not crucial to the design brief can help foster better relationships. In one project, elderly residents had expressed concern for their health and safety and so the project team installed an "innovative surveillance service" for the elderly residents who lived alone, and a "telemedicine service for people suffering from complex diseases to assure immediate assistance" as part of the retrofit project (NT16046).

The use of food was mentioned in two interviews, from two different countries, as having been employed in stakeholder engagement, and, as hinted by one interview, as being beneficial to the positive reception of the project communication. Showing photos of similar projects, or even

taking stakeholders to visit similar buildings was also seen as a positive method of communicating design intent (NT16011). One project team hired the services of a PR company to design and distribute flyers, organise public information events and so on (NT16014).

Making information, legible, accessible and appropriate (and public-friendly as suggested by NT16007), was mentioned in several interviews. For example, NT16003 discussed how (in Ireland) the general public might comment on a proposal once it has gone in to planning, by which time a lot of time and money has already been spent on the project. At this point the general public only have a short space of time to form an opinion, and sometimes the type and amount of documentation involved is simply too much or too technical for lay persons not associated with the building industry to comprehend sufficiently in order to make comments or objections. NT16012 discussed a project where the occupants and users had their own architect to represent their interests and act as a go-between for them with the project developers.

There was a sentimentality and sense of history about certain buildings that made them more than the sum of their parts, not mere bricks and mortar, but living parts of the community. NT16007 encapsulated this feeling perfectly when describing their involvement in the project as preserving a legacy, and simply being another chapter in the history of the building, which has gone on for many years, and which will go on for many more in the future.

3.4.6 *Conclusion*

The occupant and user engagement described by most interviewees would be placed towards the bottom or middle of Arnstein's (1969) 'ladder of participation', which provides a typology of levels of participation (see below). In many cases occupant and user considerations were addressed without the participation of actual occupants and users, with designers seeking to take account of the needs of generic or hypothetical future building users. When there was engagement, it usually involved informing or consultation. In only a small minority of projects did it ascend towards the top of the ladder, involving partnership or even some level of delegated power. Where this was the case, it was frequently the case that the occupants were either themselves the building owners, or were numerous and well-organised with their own representative bodies.

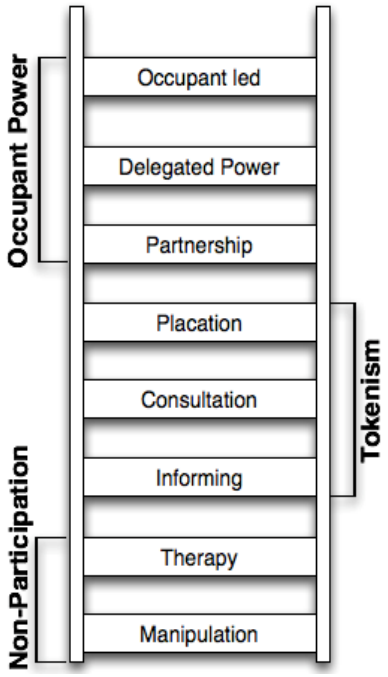

FIGURE 40 : LADDER OF PARTICIPATION, ADAPTED FROM ARNSTEIN (1969) BY FERRANO *ET AL.* (2016).

Where occupants and users were involved it was usually towards the end of the design process, through consultation on a more-or-less finished design. However, in those cases where occupants were involved near the beginning (*e.g.,* NT16007, NT16013, NT16024) the level of participation achieved was much greater. In general, the results show an awareness among building industry stakeholders of the need to take occupant and user considerations into account, combined with a frequently technocratic and managerial attitude towards them ('the design team know best') and an absence of effective mechanisms for occupant and end-user participation early on in design. Structured methods of incorporating occupant and user perspectives from early on in the design process could play an important role in proving both the design of building retrofits and the efficiency of their subsequent operation.

4 CONCLUSIONS & RECOMMENDATIONS

A wide variety of stakeholders can potentially be involved in building and district scale refurbishment projects. However, it is possible to categorise these according to a limited number of project roles and stakeholder categories for the purpose of analysing their relationship to the project, interactions within the value chain, and interests, drivers and motivations. Project roles refer to those stakeholders who are centrally involved in the design and delivery of a project. These include Client; Design Team; Project Manager; Construction Contractors. Stakeholder categories include those other stakeholders who impact on or are impacted by the project in a variety of ways. These include: Occupants, End-users; Building Management; Community and Civil Society; Financiers and Associated Services; Public and Statutory Bodies; Materials, Solution and Infrastructure Providers; Consultants and Third Parties.

Stakeholders differ significantly in power, legitimacy, and urgency. Moreover, their position in regard to each of these can alter from stage to stage of a project. At the initiation and viability stage the building owner is the 'definitive stakeholder' characterised by both power, legitimacy and urgency. Accordingly, they are at the centre of communications and stakeholder interactions. At the design and planning stage, the role of definitive stakeholder is taken over by the designers, and the design team leader becomes the central figure in communications. At the construction and installation stage, in most projects these roles are taken over respectively by the principal contractor and the construction team leader. Finally, at the operation and maintenance stage, the definitive stakeholders are the building occupants and most communications around the building will include them in one way or another.

In terms of communication styles, the interviews suggested that many stakeholders have a preference for informal communications, working with partners with whom they have long-standing relationships, and communicating face-to-face, as it was felt these were most strongly associated with effective working relationships and the achievement of project outcomes.

The interests, drivers and motivations of stakeholders in energy retrofit can be viewed as falling into four categories, namely, those which are the result of (1) market and financial factors; (2) public regulations and policy; (3) factors integral to specific buildings and technologies; and (4) socio-cultural values and attitudes. Market and financial factors comprise a mixture of incentives and barriers to energy efficient building. Public regulations and policy generally act as an incentive, although some regulations can impose barriers. Factors integral to specific buildings

and technologies have a mixed impact. Finally, socio-cultural values and attitudes can often play a key role in incentivising investment in EeB, even though energy efficiency and environmental sustainability are frequently not the main drivers behind an energy retrofit.

Building occupants and users can have a substantial impact on building energy use. Despite this, they are not always recognised as legitimate stakeholders in a project, if they are not the building owner. The needs and interests of occupants and users can be incorporated in building design in many different ways. At one extreme, a generic picture of the typical future user of a building may be constructed, and their needs hypothesised, without engaging any actual occupants or users. At the other, a painstaking and highly structured approach to involving occupants and users in the design process may be adopted by the design team. At the initiation and viability stage, in particular, there is very little evidence of occupant and user involvement. At the design and planning stage also, there is frequently little or no engagement with occupants and users; in other cases there is a structured consultation process; and in a minority of instances, a more significant degree of occupant participation in design. At the construction and installation stage, occupant and user engagement tends to centre on minimising noise and inconvenience from the building works. Finally, at the operation and maintenance stage of a project, there was little evidence of post-occupancy evaluation involving building users.

In general, therefore, engagement with occupants and users is usually limited to consultation when the design is already complete, although there were some projects that adopted a more participatory approach. In some cases, a strongly techno-centric and top-down attitude was detected, with designers deliberately restricting occupants' control over building systems such as ventilation in the interests of energy efficiency.

Occupant and user participation is most effective when they are offered a structured input into the design process, when this occurs from early on, and when they are provided with the appropriate tools and supports to facilitate participation. It is important that an engagement process leads to demonstrable results, rather than simply being a talking shop, if the interest and motivation of participants is to be maintained. Energy efficiency is not usually at the top of occupant and user concerns. Consequently, in order to be successful, any engagement process will need be open to the full range of occupant and user concerns, including issues of aesthetics, convenience, heritage, and utility, rather than focusing solely on energy issues. Post-occupancy

evaluation and measurement is vital and, despite the challenges involved, should be recognised as an integral stage of the design process.

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ACKNOWLEDGEMENTS

The research leading to these results has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 680474.

We would also like to acknowledge the assistance of all those who participated in interviews or in the focus groups which contributed to this report.