MAKING THE SOCIAL IMPACTS OF ADAPTIVE REUSE PROJECTS IN COPENHAGEN VISIBLE

SUSTAINABLE CITIES MASTERS THESIS
AALBORG UNIVERSITY COPENHAGEN

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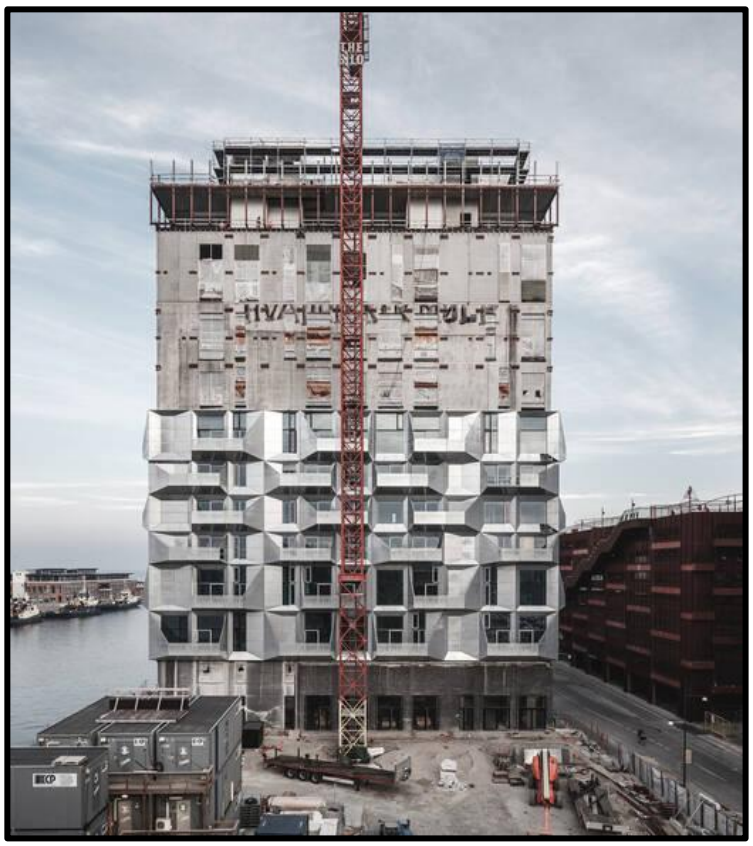

(COBE, 2020)

ABSTRACT

Adaptive reuse is a building practice which offers multiple sustainability benefits compared to new construction and is becoming increasingly popular. The social impacts of the practice are not as extensively discussed in the Copenhagen construction industry as the environmental and economic impacts, and there is minimal inclusion of them in the German Sustainable Building Council (DGNB) building assessment system. This report investigates different professionals in the industry to make visible their valuations of said social impacts. Based on these valuations and a literature review, recommendations are offered on how the impacts, specifically relating to heritage, identity and gentrification, can be better integrated into the Danish DGNB system. Through these recommendations, better social outcomes on adaptive reuse projects can be achieved and further adoption of the practice can be encouraged.

This report is grounded in Science, Technology & Society Studies theory relating to the creation of knowledge, and the impacts that the creator's subjectivities and methods have on this knowledge. Diverse professionals within the construction industry value the social impacts of adaptive reuse differently across a number of valuing registers: Monetary, Complexity, Narrative, Sense of Place and Visual valuing. Those most attuned to the social impacts were architects and planners, who mainly valued adaptive reuse in the Narrative, Sense of Place and Visual registers. Contractors and developers were mainly driven by Monetary and Complexity valuing and consulting engineers struck a balance between the registers. It was found that in order to make an effective compromise between registers, the social impacts of adaptive reuse needed to be made more communicable. The DGNB building sustainability assessment system is a means in which to achieve this. The following recommendations for the integration of the social impacts into the DGNB system were offered:

1. Include a criterion which awards points for the adaptive reuse of a building, with points being weighted so that preservation of material with heritage value is rewarded;

2. Offer points for the adoption of heritage conservation practices for the project building, and also for buildings in the vicinity;

3. Reward local economic development efforts, such as offering reduced rents to local businesses in commercial space;

4. Award points based on a certain percentage of residences in apartment buildings being classified as affordable housing;

5. Include a criterion for increasing residential density in an area;

6. Reward the inclusion of communities in the design process through the completion of a cultural resilience assessment or the creation of a cultural advisory group; and

7. Develop an adaptation of the DGNB system specifically for the reuse of buildings in order to simplify the certification process for adaptive reuse projects.

These recommendations can result in better preservation of heritage & identity and reduce the negative impacts of gentrification from adaptive reuse projects.

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1.0 INTRODUCTION

In order to face the environmental, economic and social issues confronting society, cities of today need to adopt alternative models to work towards a more sustainable world. One area which is key in this is the building sector. Buildings play a fundamental role in the social and economic activities of a population; they define how citizens live, work and play. They are also responsible for a significant environmental impact. In the European Union, this sector accounts for approximately 50% of all extracted materials use, 50% of total energy consumption, 30% of water consumption and 30% of waste generation (European Commission, 2019). Buildings also have a large impact on the social fabric of communities. The design and planning of buildings impacts access to economic opportunity, sense of community, sense of security, and overall quality of life (United Kingdom Green Building Council, 2020).

The practices by which buildings are designed, constructed, used and deconstructed need to be reimagined to increase resource efficiency, lower greenhouse gas emissions and improve socio-economic outcomes. There are many different ways to approach this reimagining, all of which have varying social, environmental and economic impacts, both positive and negative. These approaches include but are by no means limited to: focusing purely on optimising operational efficiency; designing buildings to improve community connectivity; and utilising sustainable materials in the construction of a building. One practice which is consistently being utilised in modern building design is adaptive reuse. In simple terms, adaptive reuse involves the refurbishment of an old building to utilise the space for alternative uses. Traditionally, older buildings have been demolished due to economic perceptions that more value can be gained from new developments as well as the belief that buildings need to be demolished simply because they are old or inefficient (Bullen and Love, 2011; Shipley et al., 2006). Recently, however, there has been increased adoption of adaptive reuse in cities (Aigwi et al., 2018).

Adaptive reuse can have both benefits and drawbacks from environmental, economic and social perspectives. Through the use of materials embodied within the existing building, less material resources are required in construction, which can lead to significant resource savings and potential emissions savings (Langston, 2008). Compared to some other sustainable building measures such as operational efficiency improvements and design-for-disassembly, where new buildings are designed to allow for flexibility and ease of dismantling, adaptive reuse has more short-term environmental benefits. This is due to the fact that at the time of building conversion, there is an immediate saving in resource use and reduction of construction and demolition waste. Refurbished buildings can sometimes, however, lack the operational performance of new buildings.

Economically, adaptive reuse can result in cost savings as opposed to demolishing and building new (Bullen, 2007; Shipley et al., 2006), although there is some debate regarding this (Kohler and Yang, 2007). From a socio-economic perspective, the adaptive reuse of buildings can provide benefits through creating a community resource from an unutilised property, revitalising local communities, retaining visual amenity and cultural heritage, and maintaining a sense of place (Bullen, 2007). Some of these benefits can also be realised in new projects, and as such it is important to distinguish between impacts that occur specifically because of the choice of adaptive reuse as a building practice, rather than because of the revitalisation of a site. Negative social impacts can include issues with disabled access and gentrification (Kimberly Winson-Geideman et al., 2007; Langston, 2008). In the scientific literature, there have been numerous studies focusing on the success factors required for adaptive reuse (Bullen and Love, 2011; Langston, 2008; Yung et al., 2014), the environmental and economic benefits compared to demolishing and building new structures using a costing methodology (Itard and Klunder, 2007; Kohler and Yang, 2007; Shipley et al., 2006), and some which focus specifically on the social impacts (Kimberly Winson-Geideman et al., 2007; Oppio and Bottero, 2017).

In Copenhagen, adaptive reuse has been widely adopted (Dirckx, 2010). Numerous industrial areas along the harbour have been revitalised, and a large part of this revitalisation has been the adaptive reuse of older industrial buildings to create apartments, hotels, cultural spaces, and offices. Examples of this include the conversion of an old grain silo in Nordhavn into an apartment complex named The Silo, the conversion of an electrical transformer station into Hotel Herman K and numerous warehouse conversions into residential and office space in Holmen (Figure 1).

Figure 1 The Silo (COBE, 2020) Hotel Herman K (Byggematerialer DK, 2020) Torpedohallen in Holmen (DAC, 2020)

Adaptive reuse has been highlighted as an important technique to improve construction sustainability in Copenhagen in large part due to its short term environmental sustainability benefits (Dirckx, 2010; Rambøll, 2020). The social benefits of the practice can also assist in contributing to sustainable urban development. In its 2019 plan, two key goals relating to housing and city life for Copenhagen Municipality are to: use and make visible Copenhagen's cultural heritage as a basis for understanding and developing the city; and to actively maintain and create identity and quality in existing urban neighbourhoods (Københavns Kommune, 2019).

There are many adaptive reuse projects in progress at the moment in Copenhagen, and it can be expected that there will be more in the near future. Despite a general awareness of the benefits of the practice in the Copenhagen construction industry, discussions with the consultancy Rambøll indicate that there is not a large focus on the social impacts of these projects (Rambøll, 2020).

The construction process of buildings is dynamic and complex, and involves many actors with diverse professional backgrounds, such as architects, contractors, consulting engineers, planners, and developers. Each of these actors view adaptive reuse differently, and as such they also view its social impacts differently. The agendas, backgrounds and methods of individuals influence their valuation of the social impacts, and therefore some actors will be more aware of them. By investigating the field, it is possible to gain an insight into how the valuations of professionals in the construction industry differ and coincide. This provides a mapping of sorts in order to make visible the social impacts of the adaptive reuse practice. This investigation of these valuations will answer the first half of the research question of this report: how do professionals in the Copenhagen construction industry value the social impacts of adaptive reuse projects?

Given the merits of adaptive reuse in improving sustainability, it would be beneficial to encourage further adoption of the practice. One way to do this is by raising awareness and sharing knowledge among professionals of its social benefits. An effective way of facilitating this knowledge sharing and awareness raising is through integrating the social impacts into a tool, such as a building sustainability assessment system. At the same time, it should be ensured that the potential negative impacts of adaptive reuse are avoided. This can also be achieved through the integration of the impacts into the same system. In Denmark, buildings are assessed using an adaptation of the German Sustainable Building Council (DGNB) system. An investigation into sustainability assessment systems both in Denmark and internationally will answer the second half of the research question: how can the social impacts of adaptive reuse be integrated into the DGNB system to achieve better social outcomes on adaptive reuse projects and increase the practice's adoption?

Building sustainability assessment systems originated from a need to improve construction practices in order to reduce their significant environmental impact. Further development also led to the inclusion of economic and social impact, in order to balance the requirements of building owners, users and surrounding communities. The systems generally rate building performance using a range of criteria covering aspects such as energy use, ecology, air quality and indoor comfort. Points are accrued on a basis of meeting or exceeding standards across these indicators, and according to the total number of points a level of certification is awarded to the building. Building certification acts as a measure of progress for the industry to move towards sustainability and enhances the awareness of impacts of different building practices. By embedding these sustainable practices in the tool, they are disseminated and normalised in the industry (Ding, 2008). It structures information to give an objective assessment of building performance, and can have commercial benefit by lowering building operation costs, improving occupancy rates and increasing rent returns (Plebankiewicz et al., 2019). Different systems have been developed by both governmental and non-governmental organisations around the world, covering different contexts relating to building type, geography, and focus. One such example is the DGNB system, which is a sustainability rating tool for buildings and urban districts. It assesses sustainability through a building or district's entire lifecycle based on several key aspects of sustainable building: environmental, economic, sociocultural and functional aspects, and technology, process and site quality. The certification is done by a certified auditor working in collaboration with the contractor (DGNB, 2020).

The DGNB system has been adopted in five different countries, including Denmark, by adapting and reviewing it to meet local standards, law and practice. So far, 83 buildings in Copenhagen have been DGNB certified (Green Building Council Denmark, 2020). When an adaptive reuse project seeks certification, there are already certain criteria within the system which relate to its impacts on the building performance over its lifetime. However, these predominantly relate to environmental concerns such as material savings. Within the entire tool, there are currently only two criteria which relate to the social impacts of adaptive reuse: SITE 1.2: The Image and Condition of the Area & Neighbourhood and SOC 3.3: Plan Allocation. This means there is currently little incentive in the construction industry to consider the social impacts of adaptive reuse when using the DGNB system. Integrating them into the tool can not only improve social outcomes on these types of projects, but can also encourage the use of the practice by providing incentive for building owners in the form of a higher DGNB rating, which may bring additional environmental and economic benefits.

With the above justification, there exists an opportunity to identify how the social impacts of adaptive reuse are valued differently by various professionals in the field, and to analyse how their perceptions relate to and inform each other. Through bringing together perceptions from across the construction industry, relevant actors can draw from a body of knowledge on the social impacts of adaptive reuse based on the knowledge of different professionals. The professional knowledge can also be used to analyse how these social impacts could be incorporated into the DGNB system in order to improve social outcomes on projects and encourage greater adoption of the practice.

This project therefore poses the following research question:

How do professionals in the Copenhagen construction industry value the social impacts of adaptive reuse projects? How can these impacts be integrated into the DGNB system to achieve better social outcomes on adaptive reuse projects and increase the practice's adoption?

This report aims to make the different valuations of the social impacts of adaptive reuse visible through an analysis of relevant data, and then recommend ways in which they can be integrated into the DGNB system. The analysis will consist of applying theoretical concepts to the construction industry in Copenhagen and is supported by a literature review concerning the origins and conceptualisation of adaptive reuse along with the impacts of the practice. The report will draw on theory from the field of Science, Technology and Society (STS) studies. This theory relates to how the creation of knowledge is influenced by the knowledge creator through both their subjectivities and the methods which they use. Applying it to the generated data in this report allows for the valuations of social impact in the construction industry to be investigated within an analytical framework. This will help in understanding not only what valuations the professionals in the industry hold, but also how they make those valuations. The theory will also describe the usefulness of inscription devices in making things visible, which can be applied to the potential of the DGNB system to render the social impacts of adaptive reuse visible. The next section describes these two theoretical concepts and how they will be applied, the epistemology that this report is grounded in, the research design of the report and the used methodology.

2.0 ANALYTICAL FRAMEWORK

This section first introduces the theory which will be used to investigate the research question. It then explains the epistemology of this report. Then, how the theory will be applied to the analysis will be described. Following this is the research design of the project, which sets out how the research question will be answered. Finally, the qualitative method used in this project is presented.

2.1 Theoretical Framework

In this subsection, the creation of knowledge from an STS perspective is considered in relation to how the subjectivities and methods of the creator affect their outputs. First, the role of inscription devices in the method of creating knowledge is described. Then, the connection between these concepts and the different valuations of things by individuals is presented.

Often, scientific knowledge is seen to represent true knowledge, describing the 'pure' reality of the world (Stehr, 2001). It is argued by numerous researchers (Cetina, 1999; Latour, 1999; Law, 2004) that methods used by practitioners and scientific researchers to construct knowledge are subjective and do not produce an absolute 'truth': as Latour (1999) states, "*the sciences do not speak of the world but, rather, construct representations*" (p. 30). These representations are influenced by the creator and their methods.

Knowledge creation relates to a question often posed in the philosophy of science: "*how do we pack the world into words?*" (Latour, 1999, p. 24). As described by Latour (2005), the creation of knowledge is a translation process, where methods are used in order to create statements which describe our world based on that which is 'out-there'. In the text 'Circulating Reference: Sampling Soil in the Amazon Forest', by Latour (1999), the translation process is described using an analysis of the methods used by researchers studying a section of forest. A group of researchers, including two pedologists (soil scientists), a botanist, a technician and Latour himself, wish to research whether an area of forest is expanding into a bordering area of savanna, or whether the savanna is encroaching on the forest. To do this, they take samples from the plants and soil in the area. Latour's focus in this process is on the methods which these scientists use to transform the reality of the forest into communicable statements written in a scientific paper at the end of the study.

Initially, to find their site, the group must consult a map of the Amazon. This is an example of 'standing on the shoulders of giants', in a sense: they are only able to perform their own science because of the work of many other scientists in other disciplines, such as geographers, whose work has facilitated the mapping of the region. In any field, the process of knowledge creation is always enabled by a body of interrelated knowledge which has already created a representation of the world. Once at the site, in order to study the phenomena, the scientists must take samples. By taking this information from the field it is possible to isolate what is relevant to the goal of the

scientists. It allows for categorisation, and then comparison. The data, represented by the botanist's leaf samples in this example, is "*detached, separated, preserved, classified and tagged"* (p. 39). The data is then reassembled, reunited and redistributed according to new principles decided by the researcher and their own discipline. The researcher and the data are both transformed accordingly by this process of disassembly and reassembly. The issue is then that there can be too much data to use practically; the scientist can be "*drowning in a sea of data"* (Latour, 1999, p. 39). As such, a second device is needed to inscribe the collected data. From that data, the researcher may need a third device to suit their needs, and then a fourth, and so on. The process of these translations by what can be termed inscription devices is the movement from which knowledge is derived.

Inscription devices make the world a laboratory. Through them, scientists facilitate their research. Latour posits that there is a large abyss separating what is 'out-there' in the world and the words used to describe those 'out-theres'. This abyss is bridged by small steps of translations from device to device. In his example, a mapping of the forest of sorts was performed to create a coordinate system. Using this coordinate system, soil was collected into a pedocomparator, a soil comparison tool which translates the 3-dimensional soil into a 2-dimensional grid based on the aforementioned coordinate system. The drive behind this is practicality: it allows the soil samples to be easily compared and transported. From this collected soil, the data was transformed into a diagram, which is in turn much more practical for transportation and dissemination than a suitcase full of soil samples. This diagram was then interpolated to create a statement in a scientific text, which is the created knowledge on what is 'out-there' in the forest.

This journey from the Amazon forest to the scientific report, wherein it can be said the world was packed into words, consisted of a series of translations carried out using inscription devices, each which overcame the limitations of the previous device. The final link in the chain, in this case the scientific report, does not exactly resemble the real, external world. In each translation, each bridging of a gap, there is a rupture, which ignores part of the context of the previous link. In each rupture, something is gained, and something is lost. What is lost is the locality, particularity, materiality, multiplicity and continuity of the previous link. For example, in representing soil samples with a colour code, the volume and the texture of the sample is lost. But this loss is deemed worthy for what is gained: compatibility, standardisation, textualisation, calculation and circulation. The colour code mentioned above can more easily be compared and graphed than the physical soil samples. In this sense each step of the translation chain is a both a reduction and an amplification, facilitated by the inscription device and leading to the statements which are not a resemblance of the world, but rather a representation. The translation process described above is not just confined to researching scientists. Professionals operating in any field also use inscription devices such as writing, measuring and graphing in order to create statements about the world.

These actors wish to take these statements 'out of the laboratory'; to use them to stimulate change in the world. Translations and the inscription devices used to facilitate them can be used to convince other groups of the validity of the created statements and to align actors on a course of action (Callon, 1997). Even though there is something lost through them, the importance of inscription devices is clear: thanks to them, *"we are able to oversee and control a situation in which we are submerged"* (Latour, 1999, p. 65). They are able to make visible certain representations of realities which may otherwise remain hidden. Other researchers support Latour's writings. Law (2004) adds that the value of a theoretical statement is partly dependent on the inscription process, and Cetina (1999) acknowledges that while the inscription process affects the knowledge created, through it *"truth effects can be derived, technologies can be put into effect, and universes can be 'understood'"* (p. 249).

While some translations are based on quantitative devices such as measurement, other translations are less easy to code. In Latour's example, the pedologists also use an inscription device where they judge the physical texture of the soil to make an assessment on its material properties. In doing this, they must rely on their experience as professionals. Thus, the results of this translation are dependent on the individual researcher and their background, and also by the politics of language, race and gender (the group speaks in both French and Portugese, contains different nationalities and both women and men). Aligning with this, there is a general consensus that created knowledge is affected by the subjectivities, social settings and the culture of the inscriber, which could be a scientific researcher or a professional working in the practical world (Cetina, 1999; Latour, 1999). Cetina (1999) posits that different traditions have *"different practices of creating and warranting knowledge"* (p. 246). Therefore, different actors will produce different knowledge relating to a topic as they are all steeped in different traditions and have been informed by different factors such as their education, their agenda and their culture.

The different traditions of knowledge creators also have an effect on how they value things. Valuations of things are influenced by evaluative practices, namely: technologies of evaluation, criteria of evaluation, conventions of a specific field, self-concepts of evaluators and the role of non-humans and instruments of valuation (Lamont, 2012). Valuation studies is concerned with the value which individuals and groups attribute to objects and concepts. Exploring the tensions, determinants, contexts and effects of valuation aids in "*the understanding of how our world is constructed, transformed or fractured*" (Valuation Studies Journal, 2020, para. 2). It is not just about evaluation (determining if something is valuable or not), but also about valorising, which is the activity of making something more valuable. Valuation is therefore not only about what makes something better, but also about how one makes something better. This act of making something more valuable is supported by the use of inscription devices, linking it to the STS field. In the

valuation field, there are many studies on how the monetary value of things is established, but values are also tied up to other contexts, as discussed by Heuts and Mol (2013).

In their paper "What Is a Good Tomato? A Case of Valuing in Practice" Heuts and Mol (2013) discuss how different experts value tomatoes. These so-called experts are a wide range of actors who may not have a particularly specialised insight but are simply experts in relation to the practices which they undertake relating to a tomato. As such they consist of growers, sellers, processors, cooks and consumers. The text explores different ways of valuing according to their different practices. All of these informants have some involvement with tomatoes, and different opinions on what makes a good tomato. They discuss not only what is a good tomato, but how they make a tomato good with their own activities.

Heuts and Mol begin by dividing their informants' valuing of tomatoes into different categories, which they name registers. The first is a monetary register. Most of the informants deal with tomatoes in a market context: they buy or sell tomatoes, or engage in processes with them which require financing. Without money, growers cannot facilitate their growing, and processors cannot can their tomatoes. The monetary value is crucial: consumers want their tomatoes to be cheap, and growers, sellers and processors wish to make money from their efforts. The second register relates to how the tomatoes are handled. The value of different ways of handling a tomato depends on the informant. Tomato sellers wish to receive firm tomatoes from the grower, as they are not spoiled or crushed in transportation. But even better than this is tinning them, preserving them from rotting. To a cook, however, the valuation is different. They may not wish to use canned tomatoes in their higher end culinary creations. Their value also depends on the context. For example, a juicy, soft tomato is good for salads, but not for sandwiches. Therefore, the positive value in a good varies depending on both its end use and its user. The third register is historical time. To a consumer, tomatoes they ate when they were younger may taste better to them, recalling a sense of nostalgia. Within the same informant group, however, some consumers preferred the larger variety on offer today. From the growers and processors, there is also pride in breaking from the past and being innovative. Older tomatoes varieties may have spoiled more easily or were not as large. Different informants place 'good' tomatoes on a timeline, where the present is differentiated from the past. The fourth register is naturalness. This comes from the perception that things are more valuable if they have not been interfered with. In the public, the natural is celebrated; an example of this is people wanting their tomatoes to be organically grown. A grower, on the other hand, believes that through using 'unnatural' products such as potassium in their growing process, the tomato can taste better. The fifth and final register is the sensual value of the tomato: what makes it compelling visually, taste-wise or texturally. There can be clashes between different factors within this register: a tomato may look pleasing to the eye but can be tasteless. The ideal is for the tomato to be pleasurable to all senses.

Different registers can together add to the value of something, but they can also push and pull in opposite directions. In these cases, one register may be prioritised by an informant, or compromises may be made. For example, in the paper it was found that the most conspicuous tension between registers was between monetary and sensual valuing. As a grower noted, "*people say they want quality but what are they willing to pay?"* (Heuts and Mol, 2013, p. 134). Both consumers and growers have to make a compromise: they find a balance between cost and taste. But there is also a difference in choice of register based on circumstances. For tomatoes used in a pasta sauce, consumers identified they would choose cheap ones, whereas in a salad they would choose more expensive ones. Sometimes, depending on context, one value overrules the other.

The registers single out a particular concern of the informants in their valuation, but what is perceived as valuable within this concern depends on the expert, and varies between circumstances. Different registers can clash, but there can also be clashes within each of them. One value may overrule another, or there may be a compromise. These compromises are not found by the informants, but crafted: *"they depend on the practical possibilities of attuning one's work to different kinds of good at the same time"* (Heuts and Mol, 2013, p. 138). This kind of compromise can be applied to sustainability. How much is it worth spending on features which improve environmental performance? Or on architecture which increases the visual pleasure a community receives from a building?

In essence, what has been identified by assigning the informants' opinions on the value of a tomato to registers is that the qualities of a good are not fixed characteristics. They depend on the active contribution of the informants, who each have their own social settings, subjectivities and cultures. As the informants interact with the tomatoes, they seek to make them good through their own activities, not just evaluate them. The informants who discussed tomatoes were not simply judging them from a distance; there is an element of performativity, where they all played a part in activities which give value to a tomato. These activities, performed by the informants, are not just based on the informant themself but also on the methods which they use; their inscription devices which create statements on their value of an object or idea in the world.

This section has presented theory on how scientific knowledge is a representation, rather than a resemblance, of the world, and how the creator of this knowledge is influenced by their background, context, and the inscription devices used to translate the world into communicable statements and value objects and concepts. Section 2.3 discusses why this theory is relevant to this project, and how these concepts will be used to answer the research question. The next subsection describes the epistemology that this report is based on and is linked to STS studies, which is the field which the presented theory originates.

2.2 Epistemology

This report is grounded in STS studies. STS studies involve investigating how culture, politics and society influence technology and scientific inquiry, and vice versa. This discipline argues that *"science is a set of practices that are shaped by their historical, organisational and social context"* (Law, 2004, p. 8). It is argued that scientific knowledge is created within those practices; that scientific knowledge and technology do not exist in a vacuum. They participate in the social world and in doing so are *"being shaped by it, and simultaneously shaping it"*(Law, 2004, p. 12). This understanding differs from common conceptualisations on the nature of scientific inquiry, mentioned briefly earlier, which posit that scientific knowledge is a reflection of a reality which exists independently to humans' perceptions. Researchers within the field of STS studies argue that this is not true, and that scientific knowledge is "*not necessarily independent, anterior, definite and singular"*(Law, 2004, p.38). In his book 'After Method', Law (2004) argues that there are certain stable things in the world which can be made clear and definite: income distributions, greenhouse gas emissions and the borders of countries for example. He posits, however, that there are many other phenomena in the world which the scientific method cannot capture without distortion, such as *"pains and pleasures, hopes and horrors, intuitions and apprehensions, losses and redemptions, mundanities and visions"*(Law, 2004, p. 2). STS studies is then about better capturing some of these textures, as he refers to them, which are rendered invisible by normal scientific methods. This relates to the discussion of inscription devices and translations presented by Latour, who is a notable contributor to the STS field. In STS studies it is argued that the world can be better understood through employing analysis approaches such as Actor-Network Theory (ANT), developed by Latour, Law and other STS scholars. ANT posits that knowledge is the end product of heterogeneous materials from social, technical, conceptual and textual groups all fitting together in a network which translates them into scientific products. It is argued that this is true for science, but also all social fields: families, economies, organisations etc. Therefore, everything is the outcome of patterned networks of materials, which consist of everything from people to machines, texts and concepts. ANT is then interested in exploring how these networks are patterned in order to generate effects such as scientific knowledge (Law, 1992). This project is related to ANT as it is looking at specific materials, such as building practices, the professionals in the Copenhagen construction industry, research on adaptive reuse, building assessment systems etc. and exploring how they are related in order to create knowledge on the valuations of the social impacts of adaptive reuse. The project also looks at how to alter this network through the integration of these impacts into the DGNB system. As such, the project is also grounded in ANT.

This report draws on theory that is based on STS epistemology, acknowledging that the subjectivities and methods of the creator influence created scientific knowledge, and that this knowledge is a representation, not a reflection of an independent reality. The report is a qualitative investigation of how the social impacts of adaptive reuse are valued within the industry, and offers

recommendations to better integrate these impacts into the DGNB system. In performing this investigation, scientific and practical knowledge is translated through inscription devices to make the social world visible (Latour, 2005). The subjectivities and methods of the author influence the knowledge being presented in this report. The employment of translations and inscription devices means that the report can be considered interpretivist, as through them the author plays an active role in making these knowledge objects visible. Interpretivists are *"concerned with understanding the social world people have produced and which they reproduce through their continuing activities"* (Blaikie, 2000, p. 115).

In presenting literature relating to adaptive reuse, the author acknowledges that it is being interpreted according to the author's method, social settings, subjectivities and cultures (Latour, 2005). Similarly, in conducting interviews to collect empirical data, the author actively interprets the knowledge constructed by architects, consulting engineers, and contractors which has in turn been influenced by said actors' methods, social settings, subjectivities and cultures (Latour, 2005). The analysis of this data according to the author's preconceptions means that the resulting knowledge cannot be separated from the author. When using online materials from companies and organisations, it is acknowledged that these materials are created by these bodies in order to support their purposes and as such are based on a particular agenda, which has influenced their creation. The analysis which uses this data is also inherently interpretivist in that this research is being used to construct a knowledge object relating to the social impacts of adaptive reuse in Copenhagen. The next section will discuss how the introduced STS-grounded theory will be applied to answer the research question.

2.3 Application of Theoretical Framework

This first phase of this project looks at the valuations of the social impacts of adaptive reuse within the construction industry in Copenhagen, and how they differ between different actors. As established in section 2.1, knowledge creation is affected by the creator, namely by their social settings, subjectivities and cultures as well as the methods they use. This is applied to the construction industry: architects, planners, consulting engineers, developers and contractors all have differing educational and professional backgrounds, world views, agendas and methods. Therefore, the knowledge and values which they create regarding the social impacts of adaptive reuse is affected by these factors as well as by the tools and methods which they use in their profession. This links to the concept of valuation discussed by Heuts and Mol (2013). Instead of focusing on informants valuing tomatoes, this report investigates professionals valuing adaptive reuse. Valuing tomatoes is different from valuing adaptive reuse, but the concepts within the paper can be adapted to suit the purposes of this report. The five registers of valuation identified by Heuts and Mol can be used as a departure point to identify a new set of registers which said professionals use in their own valuations. The monetary, handling, historical time, naturalness and

sensual registers are modified in this project to categorise the different values which the informants assign to adaptive reuse, especially its social impacts. By doing this, clashes between different registers, and also within registers, can be identified. This offers the opportunity to explore why these values are similar or different between informants, giving an insight into how methods and subjectivities affect the social impacts of adaptive reuse in the Copenhagen construction industry. From this insight, focus can then be turned to how to integrate these impacts into an inscription device which makes them visible. By doing this, there is a greater chance that social impacts are considered. This can lead to more balanced compromises between values, enabling actors within the industry to attune their work to "*different kinds of good at the same time*" (Heuts and Mol, 2013, p. 138). The case inscription device in this report is the DGNB system.

The DGNB system is a method used in the construction industry to make visible the sustainability of a building. In the text 'Circulating Reference: Sampling Soil in the Amazon Forest' (Latour, 1999), the importance of the methods used to create scientific statements is highlighted. Each step in the method of the scientists for transitioning from the forest to the scientific paper was a translation, facilitated by an inscription device. The DGNB system can also be seen as being composed of many different translations which bridge the abyss from the reality of the construction of a building to the communicable statement on how sustainable that building is. The DGNB system is an inscription device itself, but it also consists of many other inscription devices, such as the measurement of building water use, Life Cycle Assessments (LCAs), Life Cycle Costs (LCCs) and indoor comfort assessments. These inscription devices have allowed for the creation of a statement which can be easily disseminated and compared, but they have also resulted in the loss of context, and the ignorance of other factors which play a part in the sustainability of a building. The social impacts of adaptive reuse are only represented in two criteria in the DGNB system. Thus, some of these impacts are made invisible by the inscription device. If the DGNB sustainability assessment system is altered so that these social impacts are better integrated and made visible, then there can be more positive social outcomes on adaptive reuse projects, and further use of the practice can be encouraged.

2.4 Research Design

In order to answer the research question, this project first draws upon a literature review of adaptive reuse as a construction practice, and then analyses empirical data from professionals working with the practice. The data consists of interviews with professionals in the field as well as online material and reports which represent the views of practitioners employed by certain companies and governmental bodies. The insights from the literature relating to adaptive reuse are compared to the knowledge of the professionals, and this knowledge is also compared between different professionals as well. This analysis involves the examination of themes recurrent through the state-of-the-art and the collected data, and takes place in the framework of the different

registers of valuing presented by Heuts and Mol (2013). This leads to the construction of a body of knowledge of the experiences and valuations of practitioners within the construction industry concerning the social impacts of adaptive reuse projects.

This is followed by an investigation into how the DGNB system can be used to make this body of knowledge visible to different actors in the construction industry. This involves an analysis of how the system currently integrates the social impacts of adaptive reuse and recommendations on how to improve this integration. This is based on knowledge from professionals on how they currently utilise the tool and what their opinion is on more effective ways to integrate social impacts, as well as data from how these impacts are integrated in other building sustainability assessment systems. This will be informed by the theory relating to inscription devices and their ability to bring knowledge 'out of the laboratory' to drive change in society.

2.5 Method

To understand the state-of-the-art of this project, there was extensive research into the literature relating to adaptive reuse. The literature used consisted of journal articles, books, PHD and Masters theses, reports by various international organisations and governmental bodies, websites, and news articles. The websites and news articles were used to find specific facts such as statistics and information on examples used in the text. Initially, the search was undertaken using the database Primo, as it is a comprehensive tool containing work from many different research types and scientific areas. This was useful as the topic of adaptive reuse covers many different fields, such as historical research into the origins of the practice, sociological research into its social impacts, financial based research into its economic impacts and environmental modelling research regarding its environmental impacts. In the initial database search, keywords were 'adaptive reuse', 'social impacts', 'building reuse', 'historic preservation', 'gentrification', 'neighbourhood identity' and 'building sustainability'. From the initial search, papers were identified which were most applicable to this project. Within these papers, further references were identified which were relevant to the given topic.

Many papers regarding adaptive reuse were from the Asia Pacific region, specifically Australia, New Zealand, and China. There has been extensive research done by researchers such as Craig Langston, Peter Bullen, Esther Yung, and Edwin Chan, who are all professors in construction, architecture or real estate at tertiary education institutions. Papers authored by these academics along with the references within them were found to be high quality sources of information regarding adaptive reuse and help form much of the conceptualisation of the practice in this report.

Not all of the papers specifically addressed adaptive reuse; some related more specifically to heritage preservation, others more to renovation, but all were related to the topic in the context in which it is being studied in this report. For example, the report 'The use of historic buildings in regeneration' by Drivers (2013) related more to the social impacts of preserving historic buildings in a broader sense. Much of the analysis in said report could be applied to those adaptive reuse projects which also serve to preserve historic buildings. In the literature there was a gap identified concerning adaptive reuse and gentrification; there were few papers which dealt specifically with this subject.

A larger number of sources would have increased the validity and depth of the research, but the body of literature which was drawn upon was found to be sufficient for the purposes of this report. More focus was given to literature regarding the socio-economic impacts of adaptive reuse as opposed to environmental impacts, as it is particularly relevant to the research question. However, it is important to present the environmental impacts as they are interlinked with the socio-economic impacts.

In order to generate the required empirical data for the analysis section, two methods were used: a series of interviews with professionals working on different adaptive reuse projects; and a strategic search for material from actors within the Copenhagen construction industry relating to the social impacts of adaptive reuse, material relating to adaptive reuse in Copenhagen as well as material relating to DGNB certification in Denmark and other building sustainability assessment tools.

To generate empirical data from practitioners, different professionals who work with adaptive reuse in Copenhagen were contacted. The actors who are most relevant to the topic of the social impacts of adaptive reuse of buildings are architects, planners, consulting engineers, contractors and developers. As such, relevant actors in these different professions from organisations across Copenhagen were identified through various means: organisational structures available on websites; LinkedIn profiles; recommendations from within organisations; and recommendations by fellow Masters students. If it was clear that the professional worked with adaptive reuse and their details were available, then they were directly contacted with an interview request via email. Otherwise, the organisations were contacted via their general email address, and professionals were then recommended by the organisation's administrative employees. Many emails resulted in either no response or a response indicating that no professionals were available for an interview, which was connected with the uncertainty caused by the COVID-19 crisis. The first interview, with Amalie Christine Nyholm, was held as a result of an email sent to the general email address of the organisation NCC. Their administration reached out to her as they believed her to be relevant to the topic, and she in turn contacted the author stating she would be available for an interview. This initial contact led to a snowball effect, where she then contacted the architect Helle Lyng Svensson,

who was working on the same project and was interested in an interview. The third interviewee, Kristian Westh, was found by reaching out to the head of communications and external research collaboration at Vandkunsten architects. She recommended Kristian, who agreed to an interview when contacted. The fourth interviewee, Johanne Thurmann-Moe, was recommended by an employee at the organisation Rambøll, who the author had previously collaborated with. Although she is based in Norway, she was recommended as she has valuable insight into the field. These four interviewees consisted of an engineer working for a contractor, an engineer working as an environmental consultant and two architects. They were deemed relevant as they are all employed in the construction industry, all but one are based in Copenhagen and they are all currently working on, or have in the past worked with, adaptive reuse projects. It is important to understand the background of the interviewees in order to analyse their valuation of the social impacts of adaptive reuse. Table 1 describes the professionals with whom interviews were conducted.

Table 1 Interviewees

Name	Institution	Role	Description
Amalie Christine Nyholm	NCC	Engineer	Amalie is a sustainability project engineer at NCC, and is currently working as the DGNB consultant on the adaptive reuse project Strandgade 7, which is transforming an office building into a hotel. She studied architectural engineering. She is relatively new to the industry and this is the first adaptive reuse project she has worked on.
Helle Lyng Svensson	Arkitema	Architect	Helle is an architect with 13 years of experience. She works on the transformation team at Arkitema, and so she works with both heritage buildings and ordinary buildings which are adapted. She is also working on the Strandgade 7 project.
Johanne Thurmann-Moe	Rambøll	Environmental Consulting Engineer	Johanne is an engineer working as an environmental consultant for the Norwegian branch of Rambøll, a global engineering consultancy headquartered in Copenhagen. Her work involves performing Life Cycle Assessments and Life Cycle Costings, and applying Circular Economy principles to accelerate reuse of building materials. She has 3 years of experience in this field.
Kristian Westh	Vandkunsten	Architect	Kristian is an architect who has 20+ years of experience in the industry, mostly working as a project manager on new construction projects rather than adaptive reuse. Approximately 5 years ago he was on the project team for the Konstabelskolen project, which converted an old military school into student housing. The project won the 2016 Renovate Prize.

More interviews would have given the results of this study more validity, and effort was made to hold interviews with property developers, planners and governmental organisations. However, as mentioned, there was some difficulty in finding interviewees. The data from these interviews, supplemented by additional written material, was considered sufficient to conduct an analysis representing differing viewpoints within the construction industry.

It is important to note that the interviews were conducted in English, which was not the native language of any of the interviewees. Therefore, it is acknowledged that this had an impact on the data collected as they may have not been able to articulate their thoughts or opinions as clearly as if they had been speaking in their native tongue. It is also important to acknowledge that Johanne Thurmann-Moe has experience from the Norwegian construction industry, and she noted that building practices, materials and standards vary across borders. As such, her insights are based on the Norwegian context, and any conclusions drawn from her interview do not fully align with the Copenhagen context. Despite this, her opinions were found to be relevant and useful for this project.

Empirical data was also generated from online sources such as web pages and reports created by different actors within the construction industry. These sources gave an insight into how differing professional values influence the rhetoric which is used to discuss adaptive reuse. For example, the webpage of the architecture firm COBE relating to their adaptive reuse project, The Silo, was used to represent COBE's perception of the practice, and the contents of Copenhagen Municipality's city plans were used to represent the perception of a local governmental body. It is acknowledged that this is not as useful for the research as a direct interview would have been, as it could have addressed specific topics more relevant to this report. However, given the aforementioned difficulty arranging interviews, it was found to be suitable for this research. Data concerning the DGNB system in Denmark was generated from the Green Building Council of Denmark's website and the various documents which are made available there, and the Danish DGNB manual was provided by Amalie Nyholm, who works with the tool as an employee of NCC. Data concerning other sustainability assessment systems was generated from relevant organisations after a high level review of tools was performed to find those which had more criteria relevant to adaptive reuse. After this review, the following tools were investigated in depth: LIDERA, Leadership in Energy and Environmental Design (LEED), Green Globes and Green Communities. Table 2 summarises these assessment systems.

Table 2 Building Sustainability Assessment Systems

Assessment System	Country of Origin	Description
Green Communities	USA	Created specifically for affordable housing by an NGO looking to help transition the sustainable building movement from solely high-end projects.
Green Globes	USA	Also popular in Canada. This system markets its usability and simple self-assessment process, which means it is generally used for smaller projects.
Leadership in Energy and Environmental Design (LEED)	USA	The most widely used assessment tool worldwide. It was established by the United States Green Building Council in the early 1990s as one of the first building rating systems.
LIDERA	Portugal	The main Portuguese sustainability assessment system. It has more of a focus on socio-economic factors than similar systems in other countries.

Three of the systems are from the US. Their inclusion could be in part due to them being fully available in English, but could also indicate that adaptive reuse is more common there. The Portuguese tool LIDERA was chosen after a search for sustainability assessment systems containing heritage preservation criteria was undertaken. It is important to note that these systems have been designed to operate in specific contexts and cultural settings, and therefore the contents of the systems may not be directly applicable to the DGNB system in Denmark. This report intends only to offer recommendations of criteria which could be integrated into the Danish system after going through an adaptation process in order to align them with Danish standards, law and practice.

2.6 Data Analysis

The literature was explored and systemised into numerous concepts, presented in the state-of-the-art. These concepts were the history and definition of adaptive reuse, and the environmental, economic and social impacts of the practice. The interviews were semi-structured, in order to allow different practitioners to view their own opinions which they believed to be most relevant, which gave an insight into how their subjectivities affect their viewpoint. The interviews were recorded and transcribed. Online material from relevant companies and organisations was used to

supplement the interviews, and was similarly analysed in order to find information regarding the valuations of the social impacts of adaptive reuse by different bodies.

Using the transcriptions and the online material, valuing registers were created which were informed by the five registers presented in the paper by Heuts and Mol (2013). This created a framework where information from interviews was compared: between different professionals; to other online material produced by relevant companies and organisations; and to the literature. The created valuing registers were:

1. Monetary valuing: valuing according to financial effects.
2. Complexity valuing: the valuing of building practices relating to how complex they are to undertake.
3. Narrative valuing: the value in the story that a building has to tell, which is strongly connected to its history and heritage.
4. Sense of Place valuing: connected to narrative valuing, this relates more to the feeling of connection and sense of identity that buildings can provide.
5. Visual valuing: how aesthetically pleasing buildings can be.

The created registers can be seen as an inscription device, used to categorise the data generated in this report in order to compare it better, so that statements can be made about the research topic.

The registers were incorporated into the analysis, which is structured into the following subsections: the prevalence of adaptive reuse in Copenhagen; conceptualisations of the practice; the perception of the social impacts of the practice relating to heritage & identity, which is where the valuation registers are first implemented; the perception of the social impacts of the practice relating to gentrification, also implementing the valuation registers; how these social impacts are related to environmental and economic considerations, which is the last subsection implementing the valuation registers; and the potential for integration of these impacts into the DGNB tool.

3.0 STATE-OF-THE-ART

This section contains the literature review relating to adaptive reuse. First, the history and conceptualisation of the practice is presented in order to provide context for its discussion. Then, the impacts of adaptive reuse according to the literature are presented in three separate categories: environmental, economic and social. As mentioned in the methodology, there is more focus given to the social impacts than the environmental and economic. The two major sub-categories in this section are: section 3.2.3.1: Heritage & Identity and section 3.2.3.2: Gentrification. The above will set the context for the analysis which follows.

3.1 Defining Adaptive Reuse

The concept of adaptive reuse is increasingly being adopted throughout the world (Bullen, 2007; Oppio and Bottero, 2017; Yung et al., 2014). With this increasing popularity comes a broader spectrum of ideas concerning the practice, and a difficulty in establishing a shared and accepted vocabulary and definition. It is a meeting point of architecture, development, interior design, conservation and planning, and is driven and challenged by economic, environmental, cultural, social and political factors. Due to this broad spectrum, there are numerous terms which are used interchangeably: renovation, retrofitting, conversion, adaptation, reworking, rehabilitation, historic preservation or refurbishment (Plevoets and Van Cleempoel, 2013). It is important to describe these different ways of conceptualising adaptive reuse in literature to understand how professionals in the field define the practice and its social impacts, and to see how it may be better integrated into the DGNB tool. In order to understand definitions of a concept, it is useful to understand its history.

Despite its recent increase in popularity, adapting buildings for new uses is not a modern phenomenon. In the Renaissance, between the 14th and 17th centuries, ancient monuments were repurposed for new uses, and after the French Revolution religious buildings were converted to suit industrial and military purposes. Most of this early historic reuse can be classified as pragmatic, with reasons for the change tending to be functional and financial with little notion of heritage preservation (Plevoets and Van Cleempoel, 2013). This is opposed to later conceptualisations where the preservation of historic value has more importance placed upon it. In the present day, the environmental benefit of the practice is also taken into account along with heritage and financial motivations (Bullen, 2007).

As suggested by the early examples of adaptive reuse above, society plays a large role in whether a building is demolished or reused. In the 19th century, the reuse of buildings started to become a popular topic. The public ownership of many older French buildings after the revolution led the architect Eugene Viollet-le-Duc to conduct numerous restoration efforts on these buildings in

order to either preserve them or to prepare them for their new use as cultural spaces or museums. This new direction for the use of older buildings represented a shift away from pragmatic industrial use to a historical preservation-based approach, where more attention was given to heritage value. These restoration efforts often involved adding new sections to the buildings to better accommodate new purposes; Viollet-le-Duc stated that the *"best of all ways of preserving a building is to find a use for it"* (Viollet-le-Duc, 1854/1990, p. 222). This approach was critiqued by numerous figures, including influential art and architecture critic John Ruskin, who believed that historic buildings should be preserved in their complete original form. Ruskin favoured the protection, conservation and maintenance of older buildings, describing Viollet-le-Duc's restoration methods as *"a destruction accompanied with false description of the thing destroyed"* (Ruskin, 1849, p. 148). Viollet-le-Duc's restoration of the famous French castle Carcassonne, intended to turn the medieval fortifications into a tourist attraction, added new buildings and roofing based on hypotheses and assumptions of the original design (Figure 2). This project was criticised at the time as the type of 'restorative destruction' referenced by Ruskin. Viollet-le-Duc also worked on the restoration of Notre-Dame Cathedral in Paris in 1844 (Jokilehto, 2002). In 2019, a fire in the cathedral destroyed the wooden spire, the roof, and parts of the interior. A design competition was announced for a new spire design, which led to fierce debate on whether the spire should be restored to its previous incarnation, which was in turn a restoration by Viollet-le-Duc of an earlier design (Marshall, 2019). This indicates the question of how to handle the preservation of a building is still a controversial topic today.

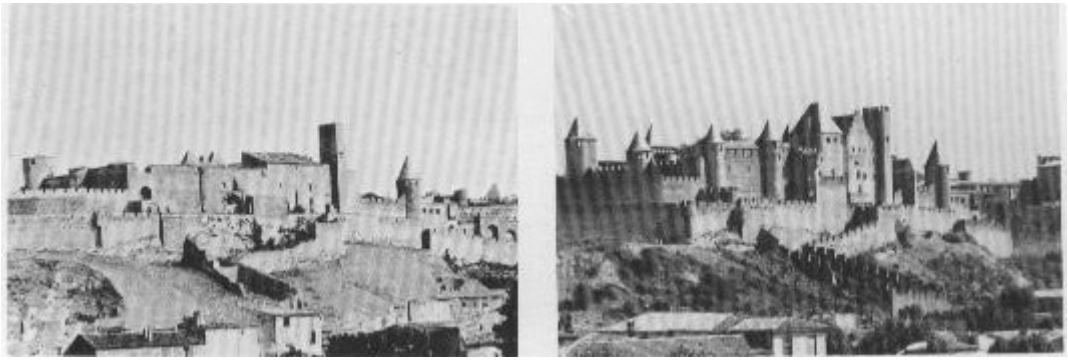

Figure 2 Carcassonne before & after Viollet-le-Duc's restoration (Voskaridou, 2013)

The ideological battle between the two approaches of Viollet-le-Duc and Ruskin continued into the 20th century until they both came up against a new architectural mindset: modernism. During much of the mid-20th century, a functionalist architectural paradigm existed where buildings were viewed as fit-for-purpose constructions which, when no longer fit to fulfil this intended purpose, would be demolished (Dirckx, 2010). Functionalism intended to bring stability to society, based on the idea that form follows function; famed modernist architect Le Corbusier notably described

a house as 'a machine for living' (Lang, 1994). One of Le Corbusier's ideas was Plan Voisin, which involved the demolition of many historic buildings in the centre of Paris to facilitate the construction of new high-rise apartment buildings and highways (Figure 3). Modernist attitudes towards historic buildings were summed up at the CIAM (International Congress of Modern Architecture) in 1933. The congress's conclusions on how to deal with historic buildings when designing an ideal city showed a firm rejection of integrating modern aesthetics into old architecture (Yazdani Mehr, 2019). One of these conclusions was that *"an aesthetic adaptation of new parts of the city to the historic area has a catastrophic effect on the development of a city and is in no way to be desired"* (Plevoets and Van Cleempoel, 2013, p. 5). Modernist obsessions with the future led architects to dismiss existing architecture as isolated historic monuments in the modern urban fabric, and as barriers to development and advancement. This rigid way of thinking led to some well-known planning and architectural failures, and prompted a need to transition to a new way of thinking about buildings.

Figure 3 Plan Voisin by Le Corbusier (Dodman, 2015)

In 1964, the Second Congress of Architects and Specialists of Historic Buildings took place in Venice, which led to the adoption of The Venice Charter, an international charter on conservation which reviewed theory on the topic (Yazdani Mehr, 2019). The charter introduced adaptive reuse as a practice to conserve buildings, with Article 5 stating: *"The conservation of monuments is always facilitated by making use of them for some socially useful purpose"* (ICOMOS, 2006, p. 51). With this shift away from modernism and constrained ideas about preservation, adaptive reuse began to make its way into mainstream architecture, with theory and practice relating to the practice becoming formalised in the 1970s. At the same time, the shift in ideology from architects paralleled a change in conservation concepts about what constitutes a historic building. Previously, notions of heritage were linked to medieval and antique buildings. Following the first and second

world wars, where many buildings from different periods were destroyed, the awareness of the value of buildings from different time periods increased. This included different types of buildings such as industrial structures. A notable example of adaptive reuse from this time was the conversion of the Parisian railway station Gare d'Orsay into the Musée d'Orsay, an art gallery (Figure 4). As stated by Yung et al. (2014), "*an evolving shift in heritage conservation has broadened the scope of built heritage from buildings of international and national identity to the everyday, familiar, and locally cherished buildings"* (p. 1).

Figure 4 Musée d'Orsay, converted from a railway station (Tucker, 2016)

In the 1980s, more writings on the subject began appearing. Cantacuzino (1989) wrote on how the main driver for adaptive reuse had been the structural durability of older buildings. He believed that the adaptation and preservation of existing buildings in an urban setting led to an increased sense of identity for communities, stating that *"because structure tends to outlive function, buildings throughout history have been adapted to all sorts of new uses. Except when the cataclysm of natural forces or war wreaked wholesale destruction, change in the urban fabric was slow, which enabled generation after generation to derive a sense of continuity and stability from its physical surroundings"* (Cantacuzino, 1989, p. 8). His beliefs, shared by many in the architectural community, indicated that there had been a shift away from earlier modernist ideas and emphasised the importance of older buildings for urban fabric. The realisation that buildings needed to be adapted to future uncertainties led to a greater embrace of combining the old with the new (Dirckx, 2010).

More recently, adaptive reuse has involved more technical considerations. Initially, professionals in the 1980s created guidebooks to bring older buildings up to current standards with regards to fire safety, thermal performance, acoustic properties, and accessibility. This has led to efforts to now ensure that adaptive reuse projects match stringent environmental standards and perform at similar levels to modern constructions (Plevoets and Van Cleempoel, 2013). This focus on the well-documented environmental impact of adaptive reuse, which will be discussed further in section 3.2.1, as well as an increasing interest in the economic benefits of the practice, has meant that there is less focus on older buildings' socio-cultural importance when deciding whether to adaptively reuse them (Listokin et al., 1998). Due to this, there has also been further widening of what is considered an historic building, and adaptive reuse projects increasingly utilise the general building stock of cities rather than only buildings of traditional heritage value (Yazdani Mehr, 2019). A famous modern example of this type of reuse is the Elbphilharmonie concert hall in Hamburg, where an old harbourside warehouse was converted into a cultural and residential space (Figure 5).

Figure 5 The Elbphilharmonie in Hamburg (Elbphilharmonie, 2020)

Modern adaptive reuse projects sometimes retain only structural envelopes or foundations of the original buildings for purely technical reasons, such as material recycling, or financial gain. A reason for this can be the lack of energy efficiency in older buildings, which can make projects utilising more of the original structure less financially and environmentally viable (Plevoets and Van Cleempoel, 2013).

Technical approaches to adaptive reuse have been criticised as treating older spaces *"as a container that can be adapted for functional, financial and technical ends"* (Plevoets and Van Cleempoel, 2013, p. 8). As such, there is a need to integrate this new technical approach with the preservation of socio-cultural value. There has been an increasing trend in adopting adaptive reuse since the turn of the century, which has been linked to increasing awareness of the importance of sustainability (Bullen, 2007).

The history of adaptive reuse provides an insight into why it covers such a broad field today. Deciding on one common definition is difficult, and determining the 'best' way to implement the practice is even harder; whole books are dedicated to these subjects, such as those by Douglas (2006) and Wong (2014). As Yazdani Mehr (2019) states, "*different experts apply different theories, depending on philosophy, country, culture, and heritage policies"* (p. 934). In her book 'Adaptive Reuse: Extending the Lives of Buildings', Wong (2014) exemplifies the complexity of the terminology used to refer to the practice. She explains how concepts related to the adaptive reuse of a building cannot be defined based on a single understanding at a particular point in time; the evolution of preservation ideology and definitions is what originally led to adaptive reuse being adopted. In the book, it is posited that the aforementioned Article 5 in The Venice Charter from 1964 gave rise to adaptive reuse in building conservation, and since then, further definitions have broadened its scope. Wong proceeds to list 98 definitions from international organisations, international building regulations, building research papers and historic commissions defining the terms shown below in Figure 6.

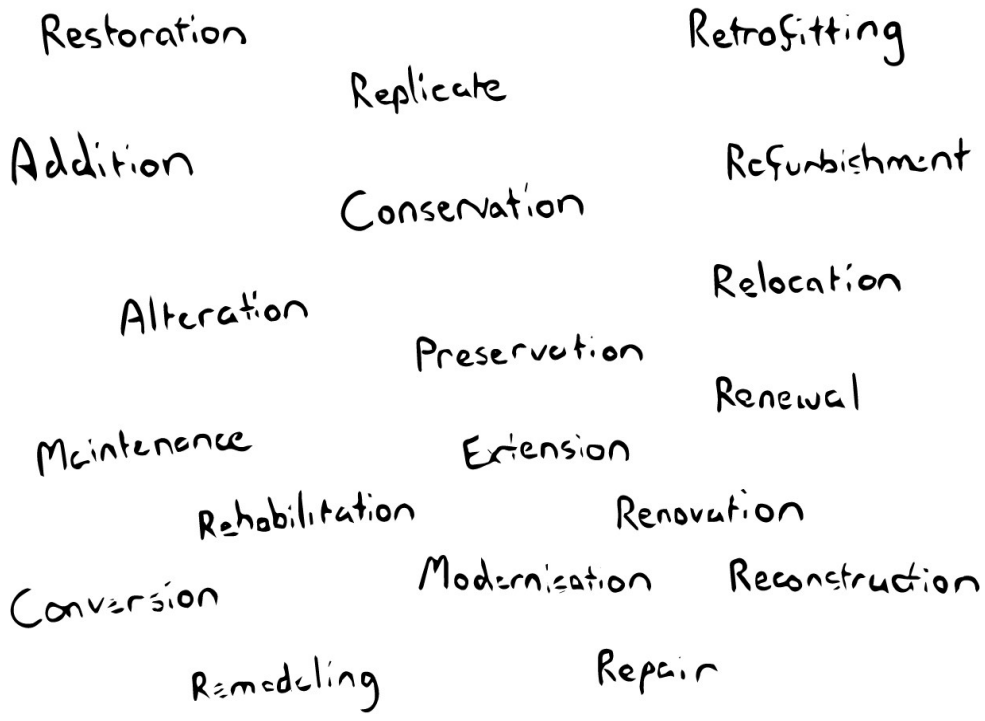

Figure 6 Adaptive Reuse Terminology

It is clear that when discussing adaptive reuse, one must navigate a quagmire of terms with overlapping meanings. Therefore it is important for authors of reports, guidelines, and research papers to establish a framework in which to explore the practice so that it is possible to make targeted conclusions in a given context. Table 3 below shows some definitions taken from the literature.

Table 3 Adaptive Reuse Definitions

Author	Definition
Australian Department of Environment & Heritage (2004)	*"A process that changes a disused or ineffective item into a new item that can be used for a different purpose"*(p. 3).
Cantell (2005)	*"Process by which structurally sound older buildings are developed for economically viable new uses"*(p. 2)
Costa et al. (2019)	*"A radical approach carried out by adapting the content to a new use that can differ from the one for which the container (building, infrastructure, place, or area) was originally designed. The idea is to minimize the transformation, in physical and economic terms, and maximize the conservation of the asset"*(p. 194).
Langston et al. (2008)	*"[Adaptive reuse] can of itself take many forms, ranging from simple redecoration to major retrofit or reconstruction. Sometimes the buildings are in good condition but the services and technology within them are outdated, in which case a retrofit process may be undertaken. If a particular function is no longer relevant or desired, buildings may be converted to a new purpose altogether"*(p. 1710).
Winson-Geideman et al. (2007)	*"The restoration and reuse of historic buildings originally built for occupation by a different type of land use than that for which it is currently being used"*(p. 1).
Yung et al. (2014)	*"Adaptive reuse in heritage conservation means modifying a place to suit the existing use or a proposed use, which serves some socially useful purpose while remaining self-financing. At the same time, the different use should have a minimal impact on the heritage significance of the building and its setting, and should add a compatible and contemporary meaning that provides value for the future while at the same time enhancing the spirit of the place and conserving the culturally significant fabric of a heritage place"*(p. 1).

Definitions of adaptive reuse can range from general conceptualisations (such as that of the Australian Department of Environment & Heritage, which doesn't even mention buildings) to more specific, niche definitions. Peter Bullen, an academic who is a prolific and commonly cited writer on adaptive reuse, compiled a set of definitions from various researchers in his 2007 paper 'Adaptive Reuse and Sustainability of Commercial Buildings', which provides a broad, simple conceptualisation. According to this paper, adaptive reuse can be:

1. A process that retains as much as possible of the original building while upgrading the performance to suit modern standards and changing user requirements;
2. Conversion of a building to undertake a modified change of use required by new or existing owners;
3. Rehabilitation or renovation of existing buildings or structures for any uses other than the present uses;
4. A process that changes a disused or ineffective item into a new item that can be used for a different purpose (Bullen, 2007, p. 21-22).

This can be seen as a more modern definition, focusing mainly on a new use for the building as well as on technical aspects such as upgrading performance. The only reference to heritage preservation is retaining as much as possible of the original building, but there is little in terms of ensuring that the architectural heritage and identity of the building is preserved and maintaining its value in the local context.

There has also been much discussion and variation of opinion amongst researchers and professionals on the impacts of adaptive reuse projects. Most of the time when a building has especially significant heritage value, there is a concerted effort to preserve it, although there are notable examples where this hasn't been the case. For example, Pennsylvania Station in New York City (Figure 7), was demolished in 1963 to make way for Madison Square Garden, an entertainment precinct. This demolition sparked outrage in the community and architectural circles both locally and internationally, which led to new laws being implemented to protect such buildings (Zorn, 2017). As such, it is highly likely that most buildings with outstanding heritage value will be preserved adequately today, whether it be through restoration or adaptive reuse. Buildings which do not have this obvious historical value, however, are more likely to be demolished in favour of new construction if there is a belief that demolition is financially advantageous, even though these older buildings may play a large part in urban identity.

Figure 7 Pennsylvania Station in New York City (Zorn, 2017)

Environmental concerns also play a large role. Although it seems natural that reusing old materials and embodied energy is environmentally beneficial, there are also some drawbacks of reusing old buildings, such as the difficulty in upgrading them to meet modern environmental performance standards. Researchers have undertaken multiple studies to gauge the environmental, economic and social impacts of adaptive reuse in order to identify in which contexts it is beneficial from different perspectives. The following section describes these impacts in detail in order to set the scene for how adaptive reuse can impact a city like Copenhagen.

3.2 Impacts of Adaptive Reuse

The environmental, economic and social impacts of adaptive reuse are all linked to one another. Reusing the materials already contained in a building saves the use of new materials, bringing an environmental benefit, but also an economic one as it lowers the cost of materials on the project. There are also negative impacts: bringing buildings up to modern environmental standards requires installation of features such as insulation and heating, ventilation and cooling (HVAC) systems which can be more costly than on a new project. Sometimes, the same impact can have both positive and negative ramifications: adaptive reuse can increase the value of a building by giving it a unique historical identity, but this same value increase can drive poorer residents out of an area. Balancing all of these different considerations is crucial for a successful adaptive reuse project, and is difficult: "*the foremost challenge in adapting historic buildings for reuse is balancing and integrating the different components of sustainability"* (Yung et al., 2014, p. 1). In the construction industry there is "*divided opinion concerning the extent of the benefits and barriers to carrying out adaptive reuse*" (Bullen, 2007, p. 29). However, when balanced properly, most researchers find that overall, the practice can contribute significantly to the sustainability of existing buildings (Aigwi et al., 2018; Bullen and Love, 2011; Itard and Klunder, 2007; Kurul, 2007; Langston, 2008; Yung et al., 2014). As Yung et al. (2014) state, "*the linkage between sustainability and adaptive reuse is commonly agreed upon*" (p. 1).

Often, economic considerations drive decision making in the construction industry. However, with more emphasis being placed by governments and society on the environmental and social impacts, and the wider impacts that these have on economics, there is a movement in more developed countries towards more balanced sustainability outcomes. The following subsections describe the impacts of adaptive reuse according to the literature in order to be able to compare them to the views of professionals in the industry, and to recommend how the social impacts could be integrated into the DGNB system.

3.2.1 Environmental Impacts

Although the origins of adaptive reuse lie in the economic and social benefits of the practice, there are many environmental considerations which have come to the fore in recent decades. This has aligned with an increased focus on sustainable development in general in cities, which began by focusing mainly on ecological and spatial factors with an 'ecological modernisation perspective' (Bromley et al., 2005). This perspective had a specific and practical concentration on pollution minimisation, energy efficiency and negative effects on the living environment, and aligned with the environmental benefits which could be achieved through adaptive reuse. As Bullen (2007) states, it has a positive environmental impact by *"lowering material, transport and energy consumption and pollution"* (p. 20). A study by Assefa & Ambler (2017) found that adaptive reuse can lower environmental impacts in multiple categories such as fossil fuel consumption and global warming potential by 20 - 41%. In developed countries, new buildings constructed each year make up just 1.5-2% of the existing building stock (Bullen, 2007). The large amount of already constructed buildings provides motivation to look at how environmental impacts can be reduced by reusing them (Bromley et al., 2005; Bullen, 2007).

One of the major environmental benefits of adaptive reuse is the saving of embodied energy. Embodied energy can be defined as *"the energy consumed by all of the processes associated with the production of a building, from the acquisition of natural resources to product delivery, including mining, manufacturing of materials and equipment, transport and administrative functions"* (Australian Department of Environment & Heritage, 2004, p. 4). Reusing buildings retains this embodied energy and partially removes the required output of energy to produce a new building. A study by Itard and Klunder (2007) found that embodied energy can comprise 20-30% of a building's primary energy use over a 40-50 year life cycle, and some estimates can put this figure as high as 70% for some buildings (Gorgolewski, 2017).

Another issue linked to adaptive reuse is resource scarcity. Scarcity of resources, such as water and minerals, is one of the most pressing problems facing the world today. The United Nations Environment Program (UNEP) has stated that "*as the global population continues to rise, and the demand for resources continues to grow, there is significant potential for conflicts over natural resources to intensify in the coming decades"* (UNEP, 2009, p. 5). Resource scarcity sometimes occurs through the exhaustion of the supply of a particular resource, such as gravel. Some estimates say that Denmark's natural gravel reserves could be depleted by 2030 with current construction projections (Rambøll, 2020). Often, however, it is linked to ease and cost of extraction, processing energy intensity and transport (Gorgolewski, 2017).

To give a sense of the resource intensity of producing new buildings, in industrialised countries in 2001 new construction accounted for:

- 40% of annual energy and raw materials consumption;
- 25% of timber harvesting;
- 16% of freshwater consumption;
- 44% of landfill volume;
- 45% of CO2 production; and
- Up to 50% of total greenhouse emissions (Australian Department of Environment & Heritage, 2004).

This is not to say that adaptive reuse does not require any additional resources and energy use, or create any waste. Bringing older buildings up to modern standards can sometimes require significant modifications, which increases the energy used for the project, and some adaptive reuse projects use only structural skeletons of older buildings and require completely new interiors. Sometimes structural or aesthetic elements which have been substantially compromised need to be demolished as well. However, a study of the adaptive reuse of apartment buildings found that the transformation produces only 10-20% of the waste which demolition and new construction would produce (Itard and Klunder, 2007).

One concept with which to encourage the removal of waste from the construction process and address resource scarcity is Circular Economy. Circular Economy is an economic system which maximises the value of products and materials and drives a transition towards a regenerative economy which is as waste free as possible. Figure 8 displays the difference between the predominant linear economy and a circular economy. Adaptive reuse closely relates to this concept, as using the practice creates a circular supply chain of in situ building materials.

Figure 8 Linear vs. Circular Economy (World Economic Forum, 2017)

In the future, resource stockpiles will continue to grow scarcer and demand for these same resources will increase. Increasing populations, growing consumption patterns and the push to raise living standards all contribute to this demand. Transitioning towards a Circular Economy may help reduce the strain on the earth's resources as well as reduce the impact of waste disposal. Construction & Demolition Waste (CDW) makes up more than 30% of global waste, and as such it is important to apply circular strategies, such as adaptive reuse, in this sector (Lauritzen, 2018). A case study of the potential for Denmark as a Circular Economy has identified the construction industry as one of the sectors with highest potential for Circular Economy adoption, and repurposing buildings is one of the strategies included in the report as part of this adoption (Ellen Macarthur Foundation, 2015).

Concrete, for example, makes up 50% of global CDW; the material is the basis of most urban built form in our world due to its various beneficial structural properties (Lauritzen, 2018). Each year, approximately 0.6 tonnes of concrete are used for each person of the world's population (Gorgolewski, 2017). It also comes with a high environmental cost: the manufacturing of cement alone accounted for 7% of CO2 emissions globally in 2015 (Jin and Chen, 2015). Due to this large impact, there are many efforts underway to reuse, recycle and recover concrete. In his book on CDW management, Lauritzen (2018) presents a concrete waste hierarchy (Figure 9), detailing the most effective management methods for minimising environmental impact. The reuse of concrete structures is ranked first, and as such adaptive reuse of concrete structures is one of the most

effective ways to improve the environmental impact of construction. This is especially applicable to concrete, as due to its durability it generally has a useful structural lifespan longer than the intended lifespan of a building (Lauritzen, 2018). A study in Minnesota in the United States found that only one third of 227 buildings scheduled for demolition were demolished because of their physical condition. It is likely that many of these buildings were constructed using concrete, and could have been reused for other purposes (Gorgolewski, 2017).

Ranking	*Reuse, recycling, recovering*
1	Reuse of concrete structures
2	Reuse of concrete construction elements
3	Recycled Aggregate Concrete (RAC) Recycling of concrete as aggregate in new concrete)
4	Recycled Concrete Aggregate (RCA) Recycling of concrete as unbounded road materials
5	Recovered crushed concrete as backfill

Note: Ranking the value of applications for recycling concrete.

Figure 9 Concrete Waste Hierarchy (Lauritzen, 2018)

There are also, however, some disadvantages to adaptive reuse relating to environmental considerations. Many older buildings were not constructed to meet modern environmental standards, which may not have existed at the time or have since become more stringent. If buildings are reused without updating standards, energy and water use over the life of the building can exceed that of a modern construction. Modern materials used in construction outperform those used in older buildings in other properties such as durability as well, which has its own sustainability ramifications (Bullen and Love, 2011). Therefore, it is necessary for adaptive reuse projects to ensure that buildings match modern performance standards. In some countries, such as Belgium, this is a requirement, whereas in others, such as Denmark, older buildings can be given special concessions (Dirckx, 2010).

While it is acknowledged that there are certain disadvantages, there have been many studies which confirm the environmental benefits of adaptive reuse as opposed to new construction (Assefa and Ambler, 2017; Bullen, 2007; Itard and Klunder, 2007; Langston, 2008; Lauritzen, 2018). The decision whether to adopt it therefore mainly hinges on socio-economic concerns, which will be discussed in the following sections.

3.2.2 Economic Impacts

The first priority in almost any construction project in the modern world is that it makes sense economically. The same is true of adaptive reuse buildings: their new purpose should be able to provide economic benefits (Aigwi et al., 2018). These economic benefits can be direct, such as return on investment from selling or renting residential and/or commercial space, or indirect, such as wider advantages from cultural institutions or increasing tourism. Numerous researchers suggest indicators to measure the economic success of adaptive reuse projects, including: amount of newly established businesses and employment prospects for locals, increase in value of adjacent property and increased revenue for tourism (either cultural or business) (Chan and Lee, 2008; Drivers, 2013). Studies have shown different results on whether adaptive reuse is economically beneficial compared to new construction, and as such it can be said that economic impacts are more context dependent than environmental impacts. Bullen (2007), states that in the 1990s and early 2000s, there was a growing perception that adaptive reuse projects were cheaper as opposed to new construction, but he also acknowledges that others state the opposite, such as Ball (2002). Economic impacts also vary according to the amount of the building that is reused: when a large amount of the building is preserved, there are benefits attached to its heritage value, whereas when only the shell of the building is preserved, cost benefits mostly relate to reduction of material costs. The economic impacts can be generally categorised into four groups: the cost of development, job creation, the impact on property value, and the economic value of heritage.

3.2.2.1 Cost of Development

Property developers often finance construction projects through routes such as lending capital from banks, which must be paid back at high interest rates. It is advantageous for developers to minimise overall cost as well as the timeframe in which this construction takes place, as the length of the construction process has impacts on not just the direct capital required but also the effect inflation has on the project. Therefore developers wish to hire contractors who will be able to complete the project in shorter time periods. Numerous studies have found that adaptive reuse of buildings takes only half the length of time required to demolish and construct a new building per unit of floor area which can mean a significant saving on labour cost (Langston et al., 2007). Douglas (2006) and Shipley et al. (2006) found that usually, adaptive reuse projects costs are lower than on projects where demolition and rebuilding is needed. Burkhardt (2017) estimated that rehabilitation projects such as those utilising adaptive reuse cost approximately 16% less in construction costs and have an 18% shorter construction period. This is mainly due to structural materials already being in place, and expensive problems such as asbestos removal and foundation subsidence are avoided.

The embodied energy savings from not demolishing a building also play a part economically. As mentioned earlier, embodied energy can represent 20-30% of a building's energy use over its

lifetime (Gorgolewski, 2017). Removing this energy use from the construction phase translates into economic savings by avoiding associated energy costs (Australian Department of Environment & Heritage, 2004). This can also mean, however, that a building may have increased costs over its lifetime if it is less energy efficient than a new construction.

There can be costly issues associated with adaptive reuse, such as bringing buildings up to modern standards if a large proportion of the original building is preserved. This includes providing adequate disabled accessibility and fire safety measures as well as meeting efficiency standards for resources such as energy and water (Langston et al., 2007). Due to this, older buildings which require extensive modification can be more expensive to rehabilitate than new construction (Kohler and Yang, 2007). This has led to a perception amongst some building owners and property developers that adaptive reuse has decreased rent returns and carries commercial risk due to uncertainties in the construction process (Aigwi et al., 2018). Developers and contractors wish to avoid risk and uncertainty, as well as protracted discussions with local planning authorities and heritage bodies (Drivers, 2013). Despite some of the potential issues and this perception, it is generally presented in research that demolition and construction of buildings is more expensive than adaptive reuse (Aigwi et al., 2018; Ball, 2002; Bullen, 2007; Douglas, 2006; Shipley et al., 2006).

3.2.2.2 Job Creation

The creation of jobs is vital in the renewal of economically depressed urban areas (Mohamed et al., 2017). Adaptively reusing a building is labour intensive, and one report found that the process requires more manual workers than new construction: on a new construction project, labour makes up 50% of costs, while on adaptive reuse projects this figure is 60-70%. This means more jobs can be created for construction workers. The same report estimated that a community that rehabilitates 2-3% of its building stock each year will have perpetual employment for its manual construction workforce (Rypkema, 2008).

This economic benefit of job creation, however, is sometimes shifted out of the local community. In an analysis of adaptive reuse projects in Boston, it was found that few construction workers were employed locally due to requirements for highly skilled and specialised workers (necessitated by the complex work involved in some restorations) and contractors advertising for labourers in external areas (Werwath, 1998). From this it seems that the practice can create more jobs overall, but these jobs may be sourced from locations which do not benefit local economies.

3.2.2.3 Property Value of Buildings

The way in which developers recoup expenses is through the property value of their completed building. Through either renting out or selling the space, they are able to repay loans and turn a

profit. Studies have shown that impacts of adaptive reuse on property value is positive: the Australian Department of Environment & Heritage (2004), found that it *"created commercially viable investment assets for the owners"* (p. 5). Increases in value can range from modest through to extreme, due to many contextual factors such as the extent of the rehabilitation and the location of the building. Two Hong Kong studies showed that adaptive reuse conversions of historical buildings to residential purposes increased property value by 6.6 - 10% (Aigwi et al., 2018). In Copenhagen, the conversion of an old grain into a residential complex created some of the most expensive apartments in the city (DAC, 2020). There is growing evidence that return on investment from adaptive reuse projects is higher than new construction (Mohamed et al., 2017; New Buildings Institute, 2011).

A secondary effect of this increase in property is the increase in value of properties in the vicinity of a new project. De Sousa et al. (2009) found in their research of brownfield redevelopments in Milwaukee and Minnesota that nearby property values increased by 11.4% and 2.7% respectively. Even though there is evidence that adaptive reuse has a positive impact, flow-on effects on adjacent property values have been found to be higher when projects were new constructions (Ding et al., 2000). Listokin et al. (1998) also describe the concept of an improvement cycle, wherein property rehabilitation catalyses more such rehabilitation, leading to a positive feedback loop. As more properties are rehabilitated, lenders make loans more readily available. As the lenders compete for these loans, the terms become better, which increases property values. This cycle can improve the economic attractiveness of an area, and can occur rapidly: "*once investors sense a turnaround, property values and rents begin to increase even before the real estate experiences much improvement*" (Werwath, 1998, p. 489). Researchers agree that more investigations need to be conducted into this field due to the difficulties in establishing causation and the highly context dependent results of the studies which have been done so far (Mohamed et al., 2017).

3.2.2.4 Heritage Economic Value

Heritage economic value is only applicable to those projects which aim to preserve a high proportion of the visible parts of the building, such as facades and interiors. Recently, historic preservation rhetoric has been economically focused. As Listokin et al. (1998) state, "*economics takes its rightful place as one of the pillars upon which the preservation ethic is based*" (Listokin et al., 1998, p. 431). Historic preservation is increasingly being used as an economic revitalisation strategy: in the United States, a survey of economic development tools in cities found that historic preservation was the seventh most used revitalisation strategy out of a group of 45 (Listokin et al., 1998).

Heritage tourism is a multi-billion dollar industry (Winson-Geideman et al., 2007). In 1998, it was estimated that 5% of all trips in the United States were heritage related, with estimates of $20-$25

billion dollars spent annually on heritage travel (Listokin et al., 1998). Adaptive reuse has been found to be a significant contributor to this industry: buildings which are adaptively reused not only provide a glimpse of the past, but also offer something new and exciting. It should be noted, however, that over-tourism can have negative social impacts and contribute to gentrification, discussed in section 3.2.3.2 (Cantell, 2005; Mısırlısoy and Günçe, 2016). The Tate Modern, an art gallery in London, was created by adaptively reusing an old power station in 2000 (Figure 10). The gallery has become a cultural icon and is one of the most visited tourist attractions in London and the most visited modern art museum in the world (Mollard, 2016).

Figure 10 The Tate Modern Art Gallery (Mollard, 2016)

The impacts summarised above show the many different ways in which adaptive reuse can affect economies in cities. While some of the positive impacts drive positive social change as well, such as cultural tourism creating jobs, there are also negative social effects attached to some of these impacts. These social considerations will be discussed in the following section.

3.2.3 Social Impacts

Buildings have always played a key part in society. The entirety of life in cities revolves around them. They are peoples' homes, workplaces, educational institutions, and cultural facilities, and "*the quality and design of the built environment in our towns and cities are vital to our standard of living"* (Australian Department of Environment & Heritage, 2004, p. 4). As mentioned earlier, newly constructed buildings make up only 1.5-2% of the building stock each year (Bullen, 2007). It follows that old buildings make up a significant majority of our cities, and their importance in defining urban character cannot be understated. As Jane Jacobs said in her seminal work 'Death and Life of Great American Cities', *"cities need old buildings so badly it is probably impossible for vigorous streets and districts to grow without them."* (Jacobs, 1961, p. 187). Older buildings improve quality of life in cities, and adaptive reuse is a way of preserving them. The practice not only preserves the buildings, however; it also turns them into accessible and usable places. There are multiple associated social benefits from this, including:

- The creation of community resources from unproductive property;
- Revitalisation of neighbourhoods;
- Reduction of land consumption and urban sprawl;
- Enhancement of aesthetic appeal of built environment;
- Retaining streetscapes that maintain a sense of place; and
- Retaining visual amenity and cultural heritage (Bullen and Love, 2011; Langston, 2008; Oppio and Bottero, 2017; Powe et al., 2016).

There can also, however, be negative social impacts from adaptive reuse. Studies have linked it to gentrification (Winson-Geideman et al., 2007; Yung et al., 2014), which can destroy the very neighbourhood character the practice supposes to maintain.

Despite their prominence, social impacts of adaptive reuse receive less attention in recent times compared to environmental and economic concerns, potentially due to the fact that they are difficult to measure (Aigwi et al., 2018; Mohamed et al., 2017). Bullen (2007), surveyed professionals from a sustainability industry group in Western Australia about the key issues surrounding the practice. Only 51% of respondents believed that social sustainability should be considered during the adaptive reuse decision process for whether a building is suitable for the practice, compared to 87% for environmental sustainability and 70% for economic sustainability. This is supported by Yung et al. (2014), who state that "*very often, adaptive reuse emphasizes economic growth and [pays] less attention to social well-being. As a result, it is often associated with issues such as heritage dissonance, commodification, gentrification, displacement, and social exclusion (p. 1).* It is necessary to remember that "*sustainability is more than just about physical resources. It is also about community and culture*" (Stubbs, 2004, p. 292). Given the impacts that

the practice can have on cities, it is important to understand them at a deeper level. In this report the discussed social impacts of adaptive reuse can be divided into two broad categories: the impacts relating to heritage & identity, and those relating to gentrification.

3.2.3.1 Heritage & Identity

As discussed in section 3.1, adaptive reuse grew out of the heritage preservation movement. The importance of this heritage in society is widely agreed upon. Historic buildings *"help to link residents to their roots by serving as collective memory, with which they can all reflect on their personal and cultural identities"* (Aigwi et al., 2018, p. 391). Certain buildings can become cultural icons, contributing to a sense of place and community well-being. Even older buildings which do not have this iconic status are still a vital part of urban fabric and help define an area's character and give it a sense of place. In an English study "*nine out of ten people agreed that their local area counted as much as 'heritage' as castles and stately homes*" (Stubbs, 2004, p. 292). Historic neighbourhoods which are not as classically aesthetic as traditional heritage areas in cities such as Berlin are renowned for their character and offer popular meeting places for both locals and tourists (Figure 11). Increasing the attractiveness of streetscapes also provides a sense of status to communities, and reducing the number of vacant or dilapidated older buildings in an area can create a more vibrant community and increase living standards through revitalisation and investment (Aigwi et al., 2018; Bullen, 2007; Drivers, 2013).

Figure 11 Street Life in Berlin (Taggart, 2019)

People, both tourists and locals, gravitate towards historic areas of cities for numerous reasons. Drivers (2013) lists eight of these factors which make these urban areas attractive:

1. A variety of spaces, building types, sizes and uses;
2. Interesting architectural features;
3. Architectural beauty and local character;
4. Associations with the past;
5. Human scale buildings and streetscapes;
6. Richness and warmth of design;
7. Physical manifestation of a city's reinvention; and
8. Social interaction, a sense of place and quality of life.

It is argued in literature that the primary role of architecture is to *"give people personal meaning in the structures and locations around them"* (Willson and Mcintosh, 2007, p. 77). This paper posits that the core experience of heritage buildings is providing pleasure through the viewing of something aesthetically pleasing, but that there are also many other experiences for people to receive. These experiences can be *"complex, emotionally engaging, and potentially rich in narrative and personal meaning"* (Willson and Mcintosh, 2007, p. 77). An example of this, as described by Willis (1999), is that modern life can sometimes lack *"fulfilment, significance, spirituality and a sense of belonging"* (p. 14). It is the view of numerous researchers that historic architecture can assist in filling this gap. The concept of sense of identity is highlighted as a key driver behind preservation, and is described as *"a feeling of belonging to a particular community or group and members which are important to one another"* (Yung et al., 2014, p. 3).

Communities attach a lot of importance to heritage in the areas in which they live. To get a sense of this, one only needs to look at the countless grassroots movements which have emerged around the world; these groups of urban activists fight against development which threatens the heritage and character of their neighbourhoods. Community campaigners played a key role in transitioning development policy from complete demolition based redevelopment to regeneration and revitalisation of urban areas with adequate heritage conservation (Pendlebury et al., 2004). This movement came to the fore in England and the United States in the 1960s, and was sometimes spearheaded by well known figures such as Jacqueline Kennedy Onassis, who the following quote is attributed to:

"Is it not cruel to let our city die by degrees, stripped of all her proud monuments, until there will be nothing left of all her history and beauty to inspire our children? If they are not inspired by the past of our city, where will they find the strength to fight for her future?"
(Advisory Council on Historic Preservation, 2019, para. 7)

It follows that cities have a prerogative to preserve these buildings to continue to benefit locals and attract visitors. In order to do this, heritage preservation has been incorporated into government policy. Heritage preservation policies concerning buildings stipulate that redevelopment should maintain and conserve architectural and heritage character, which enriches a community's experience through the physical quality of a building as well as historic or community associations. Heritage bodies around the world, such as English Heritage, have been attempting to dispel the misconception that heritage buildings need to be preserved exactly as they are. Their goal is to 'conserve rather than preserve' and provide management of the transformation of buildings to guide acceptable change (Drivers, 2013). Adaptive reuse has been flagged as a means to achieve this protection while also regenerating urban areas through new functions and local community development (Alpopi and Manole, 2013; Plevoets and Van Cleempoel, 2011). While maintaining the historical and cultural significance of historic buildings, it is important that their reuse also *"addresses the social needs of the people"* (Yung et al., 2014, p. 2). New uses for historic buildings activate spaces and impact not just the building itself but also the surrounding streetscape (Yung et al., 2014). This potential for adaptive reuse to create distinctive communities is an important consideration in regard to the flow-on effects it has, both socio-culturally and socio-economically.

As highlighted above, the involvement of heritage in development can: encourage community support, involvement and pride; attract interested occupants; and improve investor confidence. These factors, however, can be hard to measure (Drivers, 2013). There is a growing movement in recent decades to be able to attach a monetary value to socio-cultural impact to help inform policy, as *"markets concerning heritage are not able to reflect the value users and society attach to the cultural goods"* (Oppio and Bottero, 2017, p. 608). This involves estimating the value of an abstract good, and it is difficult to quantify these intangible benefits. Cultural tourism is one way in which there are attempts to be able to justify the benefits of heritage preservation by tying it to the economic benefits of tourism. 'Architourism' is a recent global trend where tourists choose a destination based on interesting architecture. This form of tourism is based on the aforementioned experiences which people can receive from historic architecture. Through this, an economic benefit can be ascribed to the built heritage of an area, measured as described in section 3.2.2.

Despite the proven value of heritage preservation to communities, it is argued that historic preservation can also be detrimental to the poor through causing reduced economic development opportunities and higher property values, leading to displacement (Werwath, 1998). This process is one of the many drivers of gentrification, which can have the effect of *"displacing excluded groups and suppressing narratives of place that do not sit easily with new commodifications"* (Pendlebury et al., 2004, p. 25).

3.2.3.2 Gentrification

The term gentrification was first used in 1964 by sociologist Ruth Glass, who observed that *"working class quarters of London have been invaded by the middle classes – upper and lower"* (Glass, 1964, p. xviii). Older, rundown cottages had been taken over by these middle classes when leases expired, and turned into high quality, expensive residences. Once this process has started, Glass (1964) explains, *"it goes on rapidly until all or most of the original working class occupiers are displaced and the social character of the district is changed"* (p. xix). Although the conversions of buildings that occurred during this early gentrification did not directly align with adaptive reuse, where the final use of a building is generally different to the initial one, there is a strong relationship between the two. Over the decades, the conceptualisation of gentrification changed, just like adaptive reuse; it grew to incorporate processes of social, spatial and economic restructuring. Included in these conceptualisations were urban change projects such as waterfront redevelopments, the emergence of hotel and convention complexes in central areas of cities and luxury office and shopping redevelopments. All of the above contributed to increases in property values, which benefit owners and punish renters. Increased tourism from redevelopments also led to property owners renting out former local residences through schemes such as Airbnb, further compounding the problem. Some cities such as New York have been hotbeds of this development (Figure 12). New projects led to further displacement, as residential buildings were being converted into other uses which forced locals to move even if they had been able to afford newer apartments. Renewal of not just residential, but also industrial and commercial buildings solidified adaptive reuse as a key factor in gentrification (Lees, 2015).

Figure 12 Luxury Hotel Adaptive Reuse in Brooklyn, New York (Eldredge, 2016)

Since the emergence of this term, there have been many research papers, governmental reports, and books written about the causes and effects of gentrification. The impacts have been debated heavily. Certain parties welcome the practice as a revitalising force bringing much needed tax dollars into inner city governments, which can then be spent further on social programs. Others view it as a destructive force, displacing the poor and vulnerable with little regard for equality or social justice (Atkinson and Bridge, 2004). There have also been numerous studies about community perceptions of gentrification. Some find that certain communities perceive gentrification as having a positive effect by revitalising areas, increasing living standards and reducing crime, while many others find that it is perceived negatively by locals due to increased rents and potential loss of urban character (Butler et al., 2013; Chua and Deguchi, 2010). Table 4 below provides a broad summary of the positive and negative effects of gentrification.

Table 4 Positives and Negatives of Gentrification (Atkinson and Bridge, 2004)

Positive Effects	Negative Effects
• Stabilisation of declining areas • Increased property values • Reduced vacancy rates • Increased local fiscal revenues • Encouragement and increased viability of further development • Reduction of suburban sprawl • Increased social mix • Rehabilitation of property both with and without state sponsorship	• Displacement through rent/price increases • Secondary psychological costs of displacement • Community resentment and conflict • Loss of affordable housing • Unsustainable speculative property price increases • Homelessness • Greater take of local spending through lobbying • Loss of social diversity (from socially disparate to rich ghettos) • Increased costs and changes to local services • Displacement and housing demand pressures on poor surrounding areas • Commercial/industrial displacement • Under-occupancy and population loss

It should be noted that not all of these impacts occur in every case of gentrification; there is a high level of variation in factors such as demographics, regulations and politics that play a large role in determining outcomes. This is why there is potential for some polarised outcomes, such as increased social mix in some cases and a loss of social diversity in others. It should also be noted that the benefits of gentrification can be achieved through other means of urban revitalisation without many of the associated negatives (Sutton, 2015).

Adaptive reuse has been linked to gentrification in numerous papers. As Yung et al. (2014) and Winson-Geideman et al. (2007) find, the practice causes an increase in property prices and rents. The displacement which accompanies this change "*threatens the social cohesion and inclusiveness of historical districts, in some cases leading to brutal social transformations, discontinuity of social life, and eventually forced evictions"* (Yung et al., 2014, p. 2). In 2007, a study was undertaken on the effects of adaptive reuse of buildings by an educational institution in Savannah in the United States. The practice is popular in Savannah due to its unique historic characteristics which are a driver of a $1 billion tourism industry. In the case study neighbourhood, only 25% of the existing buildings were owner occupied, and 13% of residents were African American with significantly lower income than that of the rest of the population. The study found that these low-income residents were being priced out of the neighbourhood, facing "*either the social trauma and inconvenience caused by displacement or increased rent"* (Winson-Geideman et al., 2007, p. 2). If it is accepted that property value increases contribute to gentrification, then it follows that there is a strong connection between adaptive reuse and gentrification, as according to some researchers a successful adaptive reuse project should have this value increase as one of its goals (Mısırlısoy and Günçe, 2016).

In a modern setting, there is an important question which must be asked about gentrification when discussing adaptive reuse projects: do these projects drive more gentrification effects than new construction? The answer to this question depends entirely on context. In former industrial areas where adaptive reuse projects are converting old warehouses and factories into residential apartments or office complexes, there is sometimes no former community to be displaced in the first place. These industrial areas are often disused, abandoned, environmentally unsafe places where there was little residential community beforehand. Working class residential neighbourhoods, on the other hand, are a different story. It is often difficult to construct new developments in these areas due to heritage protection as well as the fact that in the modern context consumers are looking for character and identity in their neighbourhoods, and therefore adaptive reuse is an attractive option (Drivers, 2013). These projects can end up creating highly desirable residential space which is impossible for poorer, local residents to afford, and thus they are taken over by wealthier owners or tenants from different areas, displacing the poor. From this initial displacement, there can also be what is known as exclusionary displacement. This is where

residents who are not displaced, be it due to financial ability or policies such as rent control, may feel isolated and excluded when their friends, neighbours, and/or family have been forced to move (Sutton, 2015). Displacement disproportionately affects at-risk groups, shown in Figure 13. Newer, wealthier residents can also end up bringing more expensive shops and amenities to the area, displacing local businesses as well as potentially raising the price point of goods and services (Atkinson, 2000). The need for old buildings in a neighbourhood was highlighted by Jane Jacobs, but she was not just referring to their character. Neighbourhoods need older, less high-end buildings which have lower rents so that local businesses can afford to rent (Jacobs, 1961). A lot of the time, adaptive reuse buildings charge a high amount of rent for commercial space (Powe et al., 2016). The practice can also be related to 'indiscriminate improvement': the blanket improvement of buildings according to standards defined by others, which do not necessarily align with wants or needs of a community (Jacobs, 1961).

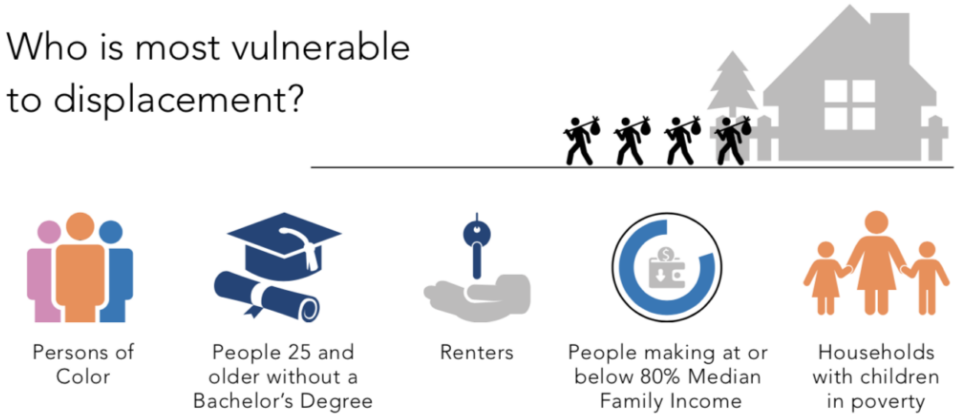

Figure 13 Groups At-Risk of Gentrification (Uprooted Project, 2020)

Some studies have found, however, that in some cases adaptive reuse has less of a gentrifying effect in neighbourhoods than new construction. As mentioned earlier in section 3.2.2, a study in Cleveland, in the United States, found that in larger projects, new construction has a greater impact on the value of surrounding properties. It also found that this impact is more significant in areas populated by low-income residents (Ding et al., 2000). There is also an argument that adaptive reuse does not afford the same opportunities as new construction in increasing urban density and creating more housing units as new construction does. Requirements for preservation may impede the production of affordable and flexible housing due to stricter regulations, and therefore there can be less housing options for lower income residents of a neighbourhood (Listokin et al., 1998).

As with many new construction projects, developers of adaptive reuse projects, along with different levels of government, often do not consider the ramifications of their projects on gentrification (Cantell, 2005; Shipley et al., 2006). The body of literature concerning the practice is

largely silent regarding affordable housing. Borrowing from sustainable land use literature, Mohamed et al. (2017) put forward recommendations which could be implemented to reduce the effect of the practice on gentrification. These include: rezoning areas to produce below-market rate housing; adaptively reusing buildings to create public housing; and providing grants to developers who create affordable housing via rehabilitation. Through acknowledging underserved and vulnerable populations, the researchers state that adaptive reuse can be part of the solution, not the problem.

All of the impacts discussed above play some part in the urban landscape of cities all around the world. Differing socio-economic and socio-cultural contexts influence the adoption of adaptive reuse projects and their outcomes. Investigating one city, such as Copenhagen, allows for an analysis of these contexts within a specific geographic area. Copenhagen is known worldwide for its approach to triple bottom line sustainability; the municipality hopes to make Copenhagen the 'Capital of Sustainable Development' (Global Sustainable Destination Index, 2020; Københavns Kommune, 2018). This focus on sustainability is also seen throughout the building sector, where the adoption of the DGNB system is increasing (Green Building Council Denmark, 2020). This setting then provides an interesting example to analyse the social impacts of adaptive reuse and how they can be better incorporated into a tool such as DGNB.

4.0 ANALYSIS: INSIGHTS FROM THE FIELD

The analysis is based on the empirical data collected from interviews and online sources. First, adaptive reuse in Copenhagen and how the practice is conceptualised by professionals in the construction industry is described. This delineates the site in which this report takes place. Then, the different valuations of the social impacts of adaptive reuse according to different professionals in the industry are presented and analysed. Finally, there is an analysis of the potential integration of these impacts into the DGNB system.

4.1 Adaptive Reuse in Copenhagen

This section gives an overview of adaptive reuse in Copenhagen, including a presentation of recent examples which will be referred to in the analysis and a brief description of drivers and barriers of the practice. As in any city, buildings play a large part in Copenhagen's history. There are many historically significant buildings such as inner-city palaces and historical apartment complexes which play a large part in the everyday lives of Copenhagen residents and act as a drawcard for tourists. Approximately 86% of the Copenhagen region's buildings are more than 20 years old (Statistics Denmark, 2020). This historic character has been supplemented with numerous waves of modern architecture as well, and Copenhagen is now known as the home of many world-leading architecture firms which design innovative, sustainable buildings with a high focus on quality of life. The Danish and international architectural communities acknowledge that Copenhagen has a good balance between old and new buildings (even though there are some contentious examples) and practices of reuse sometimes even add to the character of historic buildings (Wren, 2011). Copenhagen has been successful in avoiding much of the destruction of its historic buildings and districts to make way for modern commercial buildings and highways which has occurred in many other cities. Similar plans in Copenhagen were resisted by the public which led to the preservation of much of the central city's character (Dirckx, 2010). One way in which this preservation has been achieved is through the adoption of adaptive reuse.

Adaptive reuse in Copenhagen has chiefly occurred in old industrial areas bordering the harbour, where warehouses have been turned into homes and offices, but it also includes old churches and military buildings. One type of building which is particularly popular to reuse in Copenhagen is the concrete silo, as it is difficult to get approval for buildings above a certain height. Reusing older structures which are above this height but which already have approval is an easy way for developers to maximise their profit from a small area of land (Lauritzen, 2018). Examples of this include The Silo and the Portland Towers, located in Nordhavn, the Gemini Residence in Islands Brygge, and the Jægersborg Water Tower project in Gentofte Municipality.

Figure 14 The Silo (COBE, 2020)

The Silo (Figure 14) is a particularly prominent example of adaptive reuse in Copenhagen. Completed in 2017, it is a 17-storey former grain silo located in Copenhagen's newest neighbourhood, Nordhavn. The structure is now home to 39 apartments (some of the most expensive real estate in Denmark) and a restaurant (DAC, 2020). It was designed by architectural studio COBE for client Klaus Kastbjerg and was a collaboration between the engineers and contractors Balslev, Norconsult, Alectia and NRE Denmark. The Silo is cited within the Copenhagen construction industry as a high quality example of adaptive reuse (Nyholm, 2020). It is an architectural icon within the Nordhavn district and has made its way into popular culture through a feature in an episode of The Simpsons (DAC, 2020).

The goal of the project was to reuse the concrete structure in order to minimise the CO2 footprint, but also to retain the identity of the building in order to preserve the area's heritage. 2740 cubic

metres of concrete were reused, which is equivalent to 380 tons of embodied CO2 (COBE, 2020). The project is an example of adaptive reuse where the reused building did not necessarily have what is considered as classical heritage value, but was instead ascribed value by the developers in the sense of identity and history connected to the former industrial area. Although the facade of the building is new, the structure as a whole allows for the retention of the aesthetic image of the original structure. Alongside more showcase projects like this, there are many smaller adaptive reuse projects in Copenhagen as well, such as Konstabelskolen and Strandgade 7, two projects which some of the interviewees for this report were involved in.

Konstabelskolen (Figure 15), which is also located in an old industrial district, Refshaleøen, is "*an old military school which has been turned into student housing*" (Westh, 2020). Designed by architectural studio Vandkunsten for the property developer Sjælsø Management, the building was transformed from its old military use into 84 homes for students. Konstabelskolen is different from The Silo in that the building which they worked with was more suitable for conversion than a concrete silo as its previous use required a human scale rather than an industrial one.

Figure 15 Konstabelskolen (Renoverprisen, 2015)

Despite this, the developers initially wished to demolish the building, but due to restrictions placed on them by Copenhagen municipality, they had to leave the structure standing. As such, the goal of the architects was "*to not only change the function of the building but to also maintain as much of the original architecture of the building as possible"* (Westh, 2020). After discussions with the developer, the architects were able to convince them to retain more of the original building.

Konstabelskolen is seen as a high-quality example of the retention of identity in an area which has had its history preserved in part thanks to a master plan by Vandkunsten which ensures new projects are in harmony with already existing buildings (Renoverprisen, 2015; Westh, 2020). The Silo and Konstabelskolen both manage to retain a sense of continuity between the past and present through retaining the character and aesthetics of the original buildings. There are also adaptive reuse projects, however, which have less of an emphasis on this retention. Strandgade 7 (Figure 16) consists of the refurbishment of an old office building in Christianshavn, *"where they're basically only keeping the structural elements and everything else is new"* (Svensson, 2020). The project is being developed by ATP Ejendomme, with NCC acting as the contractors and Arkitema as the designing architects. The original building, finished in 1962, was an example of the modernist architectural style popular at the time, and was given the nickname 'The Desert Fortress'. Functionality of the building trumped embellishment, and as such it was constructed using a mixture of steel, concrete and glass materials that were easy to produce and use in the construction process (ATP Ejendomme, 2020).

Figure 16 Strandgade 7 (ATP Ejendomme, 2020)

Although the project aims to respect the nature and character of the building, much of the drive behind the decision to adaptively reuse the original building was the potential material savings, which provide both economic and environmental benefits.

In spite of the differences in the projects they worked on, the interviewees for this project acknowledged an overarching definition of adaptive reuse that can be applied to all such projects. The architect Svensson (2020) stated that "*adaptive reuse is to take an existing building and basically change the function of it and use as much of the original as possible*". Westh has a similar stance, answering that the practice is where *"by changing a building and its purpose, you can preserve the building, or some of it, for the future"*. Nyholm (2020), even though she has not worked much with the practice before, aligned with these ideas of preservation and adaptation, highlighting Carlsberg Byen as a positive example of the practice. Thurmann-Moe (2020), works more specifically with material reuse rather than adaptive reuse but has a good understanding of the practice. She states that in Norway there is increasing awareness of the practice in the industry and the government.

The three projects in Copenhagen described above show the wide range of contexts in which adaptive reuse projects can take place, with varying goals and end uses. They are just three of many such projects either completed, in progress or planned in Copenhagen. The drivers and barriers for the increasing adoption of the practice for these kinds of projects are important to understand in order to show the motivations of developers in initiating them.

One of the drivers is the requirement for new housing in the city to meet environmental sustainability goals set by the municipality. Copenhagen has a need for more residential housing, especially for youth and lower income groups, in order to meet the increasing demands of a rapidly growing city: the population is expected to increase by 20% by 2025 (Københavns Kommune, 2019). In the Copenhagen Municipality's 2019 plan, there are numerous references to how to cope with these increasing demands while also ensuring that this growth is sustainable. From an environmental sustainability perspective, there is an intention to recycle the city's building materials to the greatest extent possible in order to reduce new material use. One way in which this intention is being realised is through adding requirements for the amount of recycled building material in municipal projects, which indicates that public developers are leading the way in pushing for these types of projects.

Resource scarcity is also a pressing issue in Copenhagen which drives adaptive reuse. There are currently insufficient mineral and raw material resources in the Capital Region of Denmark to cover demand (Dansk Byggeri, 2019; Region Hovedstaden, 2020). This has major impacts on the construction sector: concrete, by far the most used construction material, requires a large amount of gravel to be produced. If reserves in the immediate area run dry, this gravel will need to be imported from afar, which is a costly and environmentally detrimental process. As mentioned in section 3.2.1, adaptive reuse aligns with Circular Economy principles in its reduction of waste and removal of resource demand, and improving resource efficiency and Circular Economy adoption is

one of the flagship projects in the Copenhagen Capital Region's action plan (Region Hovedstaden, 2020). This indicates that adaptive reuse will have a role to play in improving the environmental sustainability of the construction industry.

There are also various barriers to adaptive reuse in Copenhagen. The legal framework in Denmark for these projects is relatively unclear, lacking relevant policy and information for builders to support the process (Dirckx, 2010). Barriers to the process in the industry in Copenhagen were identified as mainly linked to perceptions of the cost and complexity of adaptive reuse projects; these barriers will be explored in further depth in the next section.

Environmental factors are the main drivers behind the adoption of adaptive reuse. The social impacts of the practice and how they interact with its adoption is less clear. This is what led to the investigation into the valuations of the social impacts by different actors which will be analysed in the next section.

4.2 Valuing the Social Impacts of Adaptive Reuse

This section looks at the valuations of the social impact of adaptive reuse according to professionals within the construction industry, and compares them to the relevant state-of-the-art literature. The valuations are discussed in relation to the valuing register which they can be categorised into, and differences and similarities between informants are highlighted. First, data relating to heritage & identity will be analysed. Then, gentrification will be focused on.

4.2.1 Heritage & Identity

There was a general finding that informants make a positive connection between adaptive reuse and its impact relating to heritage & identity. This relates only to adaptive reuse projects where the visible parts of the building are preserved. The connection is especially highlighted by the architects, and to a lesser extent Copenhagen Municipality. Concerning heritage preservation stemming from adaptive reuse, Westh (2020) thinks *"the history of the buildings is a big part of it. Tying the building or the area to the history of the area".* This is also emphasised by Svensson (2020), who describes heritage as *"hugely important".* Regarding the visual value of adaptive reuse, Westh (2020) states that *"when you build in an area that has old buildings you will always look at them when you do the new design. These areas then look less fragmented".* Svensson (2020) also supports this. She refers to the texture and detailing present in older buildings: *"there's also the textural aspect of the older buildings, whether they have a great amount of detailing that we don't see in modern buildings. They have another sense of handmade-ness".* When considered in terms of the valuing categories adapted from those presented by Heuts and Mol (2013), heritage valuation can be linked to the Narrative, Sense of Place and Visual registers.

Copenhagen Municipality have also expressed a positive valuation of heritage, shown in their 2019 city plan. There is a goal set in the plan to maintain the quality of the city's buildings which have conservation value. It is clear that the municipality places some emphasis on this value: they have identified a list of conservation worthy buildings that can be activated in the continuing development of Copenhagen, either in a preserved form or transformed for a new use that builds on their history (Københavns Kommune, 2019). Westh (2020) acknowledged their valuation, noting that Copenhagen Municipality prohibited the original Konstabelskolen building from being demolished.

Along with heritage value, the preserved sense of identity through adaptive reuse is highlighted by the interviewees as another positive social impact of adaptive reuse. The sense of identity can be mainly linked to the Sense of Place register. Westh (2020) states that *"the more you leave of the original buildings the better [...] to me it seems like you get an area that's not as cold. If you start from scratch everything is straight lines. It kind of lacks life in a way".* Svensson (2020), supports this, stating *"it really gives a neighbourhood a different feel, a different character, a different value*

from greenfield projects". She also highlights that not only heritage listed buildings have value, but also more 'regular' buildings. This is a clash between the Sense of Place and Narrative registers and the Visual register, noting that buildings do not need to be aesthetically pleasing to provide this effect: *"if we preserve more of the original structure even if it's not pretty or preserve-worthy from even an aesthetic point of view, it can still give us something different to work with, which can make a place unique"* (Svensson, 2020). Westh (2020) supports this: *"the building might look strange which gives you a story as well"*. Westh (2020) also indicated that adaptive reuse projects can mean a lot to the people living in them. In 2015, Konstabelskolen won the Renover Prize, an award given by the Realdania and Grundejernes Investeringsfond funds which recognises Denmark's best renovation projects. As part of the judgement process for the student housing project, the residents were interviewed about the building. It was found that they *"feel connected to it. To them it's a special building"* (Westh, 2020).

Copenhagen Municipality also highlights the importance of adaptive reuse in contributing to a sense of identity and quality of life. Their plan describes how spaces can and should be reused for cultural use, such as the Copenhagen Contemporary Art Museum, which occupies a former welding facility, and the cultural centre in Nordhavn, converted from a factory (Københavns Kommune, 2019). They have also stressed that new residences should relate to the city's unique character. Svensson (2020) indicated that in the planning process for Carlsberg Byen, which is under the remit of Copenhagen Municipality, *"there has been a focus on preserving a certain amount of the original building structures to give the whole area a sense of identity"*. This further supports the municipality's stance on this positive value of adaptive reuse. These valuations fall under the Narrative and Sense of Place registers. However, Westh (2020) doesn't believe they value heritage enough: *"it seems like the planners in municipalities get the idea but at the same time they don't really understand how important it is and they don't stick to the idea. In my opinion they let too much be demolished"*.

It is clear that architects and planners within Copenhagen Municipality have a positive valuation of adaptive reuse relating to its social impacts in the registers of Narrative, Sense of Place and Visual valuation. This awareness of the valuation of these registers by architects was reinforced by Svensson (2020), who noted that *"the transformation department at the school of architecture in Copenhagen is the most sought after department right now. They have more students than they can take in. I think it's for several reasons, and one of them is for the heritage side"*. Although there are few conflicts within these three registers, there are multiple examples of clashes with the Monetary and Complexity registers, which are valued more by contractors and developers.

Svensson (2020) acknowledges that sometimes there needs to be a compromise between the heritage of a building and preparing it for a new use. She states that the architects sometimes have

an argument with heritage authorities as they believe they *"have to change more than [the heritage authorities] would like us to in a listed building in order to change the use to preserve it for the future. It has to be used to be preserved. Sometimes it needs to be changed a lot to do that. So it's not a museum piece but an actual living building".* This represents a conflict between the Monetary valuations of adaptive reuse versus the Narrative and Sense of Place valuations. Svensson argues that the building needs to be changed in order to facilitate its new use and provide a business case for it (Monetary) which clashes with the history and original state of the building (its Narrative and Sense of Place).

The architects also commented on how they believe the developers value adaptive reuse and its impacts on heritage. Referring to the original building in the Konstabelskolen project, the developer Sjælsø Management *"wanted to demolish it"* (Westh, 2020). It was only because of Copenhagen Municipality's requirement that the building be preserved that meant that adaptive reuse occurred in the end. Westh (2020) highlighted that developers need to see monetary value in an adaptive reuse project to adopt it as a practice: *"if you speak their language and you tell them what economic benefits they'll get from it, they'll get the idea and think it's great. Otherwise they don't really care"*. Svensson (2020) supports this, noting *"we always have an eye for the economic aspect because that's often the leverage we need to persuade clients to move in a certain direction. They have to be able to see some kind of benefit from what we propose"*. Thurmann-Moe (2020) also supported this: at the moment, developers "*usually just want to do what's cost efficient"* . This indicates that Monetary valuation is the main concern of developers. However, Thurmann-Moe is working on some projects which show how to effectively deal with financial challenges on adaptive reuse projects *"which are blazing a trail for everyone, which will make it easier to justify the process"* (Thurmann-Moe, 2020). She is confident that *"everything is possible if you really want to do it, you just have to be more flexible [...] If you are willing to have another process [...] adaptive reuse can be efficient in many ways"* (Thurmann-Moe, 2020).

This reality means that architects often have to show how the adaptive reuse process can have economic benefits. As Svensson (2020) states, *"there's a case for building up an argument for preserving things, especially the not obviously pretty things. You can save money on the structure, you may be able to get through planning processes more easily if you give something back to the community, the municipality can be more lenient"*. Apparently, developers are *"realising now that they can actually save money as well"* (Westh, 2020). After they have realised there is an economic benefit from adaptive reuse, *"they try to make it look altruistic"* (Westh, 2020). This can be seen in the rhetoric developers utilise in advertising their adaptive reuse projects. On the Strandgade 7 project website, the importance of the heritage of the building and renovation is highlighted, even though as Svensson (2020) noted they are basically stripping the building down to its concrete core so that none of the original exterior is visible (ATP Ejendomme, 2020). The first page of the sales

material connected to The Silo project states that the intention of the project is to *"retain the silo's well-known identity, but at the same time renew and thus transform it"* (RealMæglerne, 2020), making its heritage and identity the key focus of the project. Thurmann-Moe (2020) also supports this. She states that in her experience with developers, *"why they want to put money into reusing old materials or areas is for the building to tell a story. They want that kind of value [...] people love that kind of stuff"*. Here, she is explaining that developers know that consumers value the history of a building, and so developers can increase their profits from preserving it. She also states that the value of this preservation *"depends on the end user. Is it to rent out office space or to sell apartments?"* (Thurmann-Moe, 2020). She believes that if the end use of the building is for an office, then it is likely that developers won't be able to attain the same monetary value as they would from prospective apartment renters or buyers. However, countering this, the importance of architecture in commercial areas is also important, as can be seen by the attention given to the adaptive reuse designs of office buildings in old industrial areas in Copenhagen such as Holmen and Carlsberg Byen.

Even when adaptive reuse is chosen for a project, the architects need to convince the developer to preserve as much heritage as possible. This can be seen as representing a compromise between the different valuing registers. On the Konstabelskolen project, the architects wished to do more work preserving the interiors. Westh (2020), stated that this cost more than what the developers had planned for economically, so the architects *"showed them what they would get if they took the project they had planned for, and then did some renderings that showed them what they could get if they put a little bit more into the project"*. The developers decided to support the architects, which came to Westh (2020), as *"a bit of a surprise"*. This is an example of an actor using an inscription device to achieve a compromise between the Monetary register and the registers related to heritage & identity.

Regarding contractors, Westh (2020) indicated that they focus predominantly on the Monetary and Complexity registers of valuing: *"contractors don't care, they just think about the money and what's cheapest. I often meet the contractors who say: can't we just tear it down? We'll build it like it was, but it's easier this way. They want it to be easy, they want it to be cheap"*. Nyholm (2020), who is employed by a contractor, backs this up: *"I can tell you the sad truth about being in a construction company is that the thing that they care about the most is the economic aspects [...] I think it's not only our construction company [...] You can have many great ideas about social and environmental impact but it really comes down to whether it's affordable"*. Linking to the Complexity register of valuation, Nyholm (2020) also states that *"it's more demanding in the design process to do adaptive reuse than it is to demolish and build new"*. This claim is repeated by developers on adaptive reuse project websites, which state that adaptive reuse projects can be much more complex (ATP Ejendomme, 2020). Thumann-Moe (2020) believes that the claim that

adaptive reuse can be a simpler construction process offered in literature *"hasn't been proven yet [...] so people are afraid of the process"*. In her experience, there are many difficulties which can arise on adaptive reuse projects, such as old buildings having insufficient ceiling height to add modern technical services, or insufficient daylight infiltration. These kinds of issues are *"very important"* (Thurmann-Moe, 2020) due to the associated costs which can arise.

4.2.2 Gentrification

Gentrification is also an issue in Copenhagen, and wherever gentrification has happened in the city it is possible to see numerous adaptive reuse projects which have contributed to the development in those areas. Although it is difficult to establish a direct link, one can see factors stemming from these projects that have a gentrifying effect. One of the neighbourhoods which has been undergoing a significant gentrification process is Vesterbro (O'Sullivan, 2016). Vesterbro was once a working-class neighbourhood and has always been one of Copenhagen's poorest areas, and was home to the city's Red Light and meatpacking districts. Since the early 1990s, efforts have been made by both local and central tiers of Danish government to renew the area. This renewal was based on the rehabilitation of many old apartment buildings in disrepair, but also the adaptive reuse of buildings in areas such as the meatpacking district, Absalon Church and more recently, the former Carlsberg brewery site. Adaptive reuse of older structures such as the former meatpacking buildings into high end businesses such as *'hip' first- and second-hand shopping, ethnic greengrocers, delicatessens, outlets for upcoming fashion designers, exclusive kitchen showrooms,[...] upmarket restaurants, cafes and wine bars*" (Larsen and Hansen, 2008, p. 2440) has led to problems. Despite characterisations of the renewal of the district as 'gentle' and 'democratic', with a departure point for the various projects being the needs of the current residents, studies and commentary by numerous professionals have shown that Vesterbro represents an example of middle-class gentrification with 'traumatic' consequences (Larsen and Hansen, 2008). As discussed in section 3.2.3.2, these businesses which cater to a different social class can inevitably indirectly displace previous residents of the area who may be priced out by this so-called 'social uplift'.

When questioned about gentrification, the three Danish interviewees acknowledged that it was a problem in various parts of Copenhagen, but related it to development in general and apartment renovation more than adaptive reuse specifically. Svensson (2020) sees gentrification as a problem that has been happening in relatively recent urban renewals in Østerbro, Nørrebro and Vesterbro. Identifying the difficulty in trying to improve an area without displacing locals, she states *"so how do you make an area better for the people living there while making sure they don't get pushed out? I don't know if anyone has an answer to that but it's something that almost always happens"* (Svensson, 2020). Westh (2020) is of the opinion that *"it's important to have a city that's really mixed, not divided between rich and poor"*. Like Svensson, he sees that gentrification is happening

in all the recent developments of large areas, which is a big problem. He believes these areas are being developed on too large of a scale, and states that there needs to be *"a better understanding of leaving existing buildings [...] that have their own history, that have their own aesthetics"* (Westh, 2020). This does not mean that these older buildings should be adaptively reused, as he sees this as a problem for gentrification as well. Regarding the adaptive reuse of old buildings in Refshaleøen, he states that *"you could rebuild them and make a lot of fancy flats or hotels or offices for companies, but I think it's important to actually keep some of the old buildings as they are and have an even larger contrast between the new and the old and then keep some of the life that is there already [...] otherwise you'll just have areas with only rich people"* (Westh, 2020). This would indicate a compromise in the Monetary register, however, and so developers and governments may be hesitant to do this. In discussing using adaptive reuse to construct affordable housing, another potential avenue to reduce the negative effects of gentrification, Svensson (2020) noted that *"it hasn't been used much, and I'm not really sure why. It could have something to do with the way which affordable housing is financed in Denmark, as it comes with a subsidy from a public fund, but they also have to live up to certain rules and regulations to get that funding. It's a slow system you could say".* This indicates that because the funding system is difficult to navigate, adaptive reuse is valued less in the Complexity register. This means there is less potential to address the negative social impact of gentrification. Thurmann-Moe (2020) states that the situation is similar in Norway, where *"for now adaptive reuse is mainly for more expensive end uses rather than affordable housing"*. Nyholm (2020) was also aware of the issue of gentrification but did not have an opinion on its connection to adaptive reuse. She also stated that she believes Copenhagen Municipality are aware of the issue, and are attempting to reduce the negative impact through the inclusion of social housing, but it is unclear whether this social housing is provided through adaptive reuse projects.

The analysis of the social impacts of adaptive reuse shows that there is variation in how actors within the construction industry value them. It is clear that planners and architects place a high value on the social considerations which relate to adaptive reuse, and their valuations fall into the Narrative, Sense of Place and Visual registers. Contractors and property developers, on the other hand, acknowledge that there is value in these registers, but their valuation is driven by the Monetary and Complexity registers. Consulting engineers have a balanced view but focus mainly on Complexity considerations. These valuations are affected by the subjectivities, social settings, culture and methods of the informants. Concerning gentrification, however, there was relatively little awareness of its link to adaptive reuse, but Westh (2020) acknowledged that financial considerations sometimes need to be put aside to keep character in a neighbourhood and ensure that it doesn't change too much. This involves not necessarily trying to maximise profit from every potential adaptive reuse project.

As seen in the Konstabelskolen example, where communication from the architects led to a better compromise between Monetary and Narrative, Sense of Place and Visual valuing by the property developers, the industry can benefit from achieving balanced compromises between registers. The compromises allow for actors in the industry to achieve different kinds of 'good' at the same time if they adopt adaptive reuse as a practice. To inform these balanced compromises, inscription devices are helpful. Vandkunsten architects used a presentation to highlight the benefits of preserving additional heritage of a building to persuade the developers to spend more. Inscription devices such as the DGNB system could be a means to help make the social impacts of adaptive reuse more visible. This can lead to more balanced outcomes on projects using the practice, and also more adoption of the practice itself. The next section of the analysis describes how the impacts could be integrated into the DGNB system in Denmark to maximise the positive outcomes of preserving heritage and identity and minimise the negative outcomes of gentrification.

4.3 Integrating Social Impacts into the DGNB System

This section first introduces how adaptive reuse is currently integrated into the DGNB system. Then, the opinions of the informants regarding the system is presented. Finally, how adaptive reuse is integrated into other building sustainability assessment systems is analysed in order to provide recommendations on how to improve the Danish system in this respect.

The DGNB system in use in Denmark has been adapted from the German tool, with the version currently used being completed in 2016. Regarding changing the DGNB system, new criteria are generally introduced to the German tool and then adapted to fit the Danish context. In some circumstances, however, the Green Building Council Denmark can introduce their own relevant criteria. The decision is made by a board made up of relevant people from across the construction industry who discuss new criteria or modifications to existing criteria (Bentzen, 2020).

The system includes six separate categories for sustainability criteria: environmental quality, economic quality, sociocultural and functional quality, technical quality, process quality and site quality. As seen in Figure 17, the first four categories are each worth 22.5% of the overall rating, process quality is worth 10% and site quality is not weighted.

Figure 17 Weighted DGNB Categories (Green Building Council Denmark, 2020)

The two categories which have a direct connection to the social impacts of adaptive reuse are Site Quality and Sociocultural and Functional Quality. Site Quality consists of evaluations that need to be done, but it currently does not have an impact on the overall rating given to the building. It has four criteria: SITE 1.1:External Environmental Impact, SITE 1.2: The Image and Condition of the Area & Neighbourhood, SITE 1.3: Transport Access and SITE 1.4: Access to Facilities. Of these, SITE 1.2 is the only one which relates to adaptive reuse. This criterion seeks to ensure that a building is not only functional, but that it adds positively to the image of the area. To do this, a qualitative evaluation needs to be obtained from an expert which characterises the area surrounding a building, created using documentation and the opinions of other experts. Based on this, the expert can evaluate the general acceptance of the building in the surrounding community and its synergy or conflict potential with the immediate streetscape, which in turn allows for an assessment of whether the building has a positive impact on the community. No quantitative data is required to support this (Green Building Council Denmark, 2020). This evaluation can be influenced by choosing adaptive reuse as the building practice. It is shown in the state-of-the-art that the unique character of adaptive reuse projects has a positive impact on surrounding communities, and therefore this is a criterion where adaptive reuse projects could score highly. This criterion can also be linked to gentrification: buildings which clash with the surrounding area are more likely to contribute to exclusionary displacement. Nyholm (2020) describes the fact that site quality is excluded from the existing weighted system as something that is *"a bit sad"*. She notes that as they don't count towards the rating, there is little effort put towards improving the areas which are evaluated. DGNB constantly develops new versions, released every few years, to include new criteria or alter existing ones. According to Nyholm (2020), in the next version of the Danish DGNB manual *"the SITE criteria is going to have a weighting in the overall score. In the future manual, it's going to count"*. She sees this as a positive step forward for the system in including the social impacts of adaptive reuse.

The second category which relates to these impacts is Sociocultural and Functional Quality. There are ten criteria in this category, many which are related to indoor building comfort, such as thermal, visual and air quality. When the Green Building Council of Denmark were questioned about the link between the DGNB system and gentrification, they indicated that there is currently only one criterion that has an indirect link with gentrification: SOC 3.3, which translates from Danish as Plan Allocation (Bentzen, 2020). This criterion is linked to the interior floor plan of the building. In this criterion points are awarded based on variation of housing types available within a residential building. Variability in housing types potentially encourages a more diverse range of occupants if residences of varying sizes are offered at different price points. There is no stipulation in the criteria, however, on the affordability of these spaces; the housing can all be made high end, as long as there are different total floor areas for different residences. As such, there is little encouragement of affordable housing.

The investigation into the system indicated there is little integration of the social impacts within the current tool. The next step in this analysis is to look at the opinions of the interviewees on: building assessment systems in general; and the integration of the discussed impacts into the DGNB system. The system has been increasingly adopted in the Danish construction industry. Westh (2020) noted that *"most of our projects get DGNB certified now".* He also believes that there needs to be a change in the system to encourage adaptive reuse: *"it's quite important to be able to gain points by reusing the buildings more than you do today"*. While he acknowledges the usefulness of the tool, he also raises an issue that sometimes building sustainability assessment systems can be ineffective in improving the sustainability of the building if they are used in a different context to where they were created. Citing an example of a project in Saudi Arabia he worked on where they used the LEED system, it was possible for the project to be awarded points for sustainability if they provided shower and parking facilities for people who ride their bike to work. They ended up incorporating these facilities into the project, but they were unused due to the non-existent bike usage in Saudi Arabia. As such, *"you're using a lot of energy and materials and money on something that's never going to be used [...] so it makes it more 'sustainable' but it doesn't"*(Westh, 2020). This is an example of an inscription device which has made something more communicable but lost some of its context as a result of this, and is therefore ineffective when applied to another context. He believes that the tools should focus more on practical things such as reuse *"instead of giving points to something very theoretical"*(Westh, 2020). The drawbacks of using a sustainability assessment tool on a building even if the tool was created for a different context applies to adaptive reuse in Copenhagen as well. Nyholm (2020), stated that *"the whole DGNB system is designed for new buildings"*. For her this causes difficulty, as she has *"to fit a renovation project into a big system that's very specific to new buildings, so I spend a lot of time learning how to do things that I'm used to but in a new way as it doesn't fit exactly into the system"*(Nyholm, 2020).

Svensson (2020), highlights that the current DGNB system integrates social impacts of a building more from an urban planning point of view of *"what it gives to the urban space around it",* rather than heritage, identity or social inclusion. On the Strandgade 7 project, they are achieving points by opening up the facade to make the building more accessible to the surrounding area, and the DGNB system looks at things such as proximity to public transport and bicycle accessibility. This is repeated by Nyholm (2020). Svensson agrees with Westh that integrating the social impacts of adaptive reuse into DGNB would be useful: *"when they do make criteria that you have to meet, they also move the industry. If it could help push for more preservation policy, it could be helpful"* (Svensson, 2020). She states that the most efficient way to encourage preservation of heritage, however, is to focus on the materials used in the building. If there is more value attributed to the conservation of original materials, then it follows that more heritage will be preserved simply

through retaining more of the form of the original building. In doing this, Svensson (2020) also adds that *"there is also the benefit that it's not as fluffy. You can have a number on it"*. According to the Green Building Council Denmark, which offers assistance in the DGNB certification of buildings, the criterion which relates most to adaptive reuse is the Life Cycle Assessment (LCA), which is an assessment of environmental impact and use of non-renewable resources over the life cycle of the building, which makes up 13.5% of the total point score. Svensson (2020) notes that on the Strandgade 7 project, *"they can get [a certification] by doing little more than preserving the existing concrete structure because there is so much CO2 embedded in that structure"*. This means that there is already a strong incentive to reuse materials, and in doing so, preserve heritage. The issue with this is that reused material can come from other building sites, meaning there is not as much incentive to specifically reuse the existing building. This is another example of an inscription device losing context by making something more communicable: reusing materials which already exist in situ is the more sustainable option compared to importing material from external sites, but this reality is not reflected in the tool. Although there is room for improvement in how it is done, Nyholm (2020) agrees that making the social impacts of adaptive reuse measurable through numbers is key: *"I think that if you really want to do something for social impacts, we have to be better at calculating the economic benefit from social impact. The social category is very qualitative, not quantitative"*.

Thurmann-Moe (2020) works with a different assessment system, which is a version of the British system BREEAM adapted to the Norwegian context. She sees similar issues in this system. She discusses how there is a criterion related to waste reduction where an audit of existing buildings on the construction site is required to identify opportunities for reuse. The issue is that once this audit is done, the criterion is fulfilled and there is no further requirement or incentive to reuse materials. Thurmann-Moe (2020) echoes the sentiments of Westh (2020), stating *"unfortunately with BREEAM and many other certification schemes, there is a lot of documentation and I don't know how efficient it actually is"*. Despite this, she does say that building assessment systems *"can be a motivation of course"* (Thurmann-Moe, 2020), and she noted that there is change coming relating to circular building practices in the next version of the Norwegian system.

Looking at how the social impacts of adaptive reuse are integrated into other sustainability assessment tools can help inform how they can be better integrated into the Danish DGNB tool. A search of mainstream building sustainability assessment systems found that there is relatively little inclusion of aspects such as heritage, identity and gentrification, but there were some exceptions. As described in section 2.4, the systems which have been included in this analysis are Green Communities, LIDERA, LEED and Green Globes. LIDERA was included as it was the only tool found to include heritage preservation, and the other three were all found to have criteria relevant to adaptive reuse worth investigating.

Green Communities is based on the LEED framework but has a stronger focus on the social side of sustainability through community-based criteria. This allows the system to make the social impacts of adaptive reuse more visible than other systems. If the requirements of this assessment system are met, project owners can apply for affordable housing funding from the certifying organisation. The Green Communities system has a criterion specifically for adaptive reuse, which offers points based on the amount of reuse of existing buildings and stipulates that the original building cannot have been used for the same purpose as the new building. There is also another criterion which awards points based on increasing residential density, which is measured against the benchmark of the average residential density in the area where the building is located. As presented in section 3.2.3.2, increasing residential density can assist in reducing the negative impacts of gentrification. There is also a criterion which assesses local economic development and community wealth creation. Points are awarded for local hiring preferences and local employment for construction, but also through providing: spaces for community job skill development; reduced-cost spaces for educational institutions; commercial space for only small and/or local businesses; or spaces for financial services to assist the local community. There is also a criterion which awards points based on community involvement in the design of the building. All of these aspects have the intention of empowering the local community and lessening the effects of gentrification.

LIDERA, the Portuguese building sustainability assessment system, includes a criterion named Site & Integration, which has a sub-category named Heritage Protection & Enhancement. This criterion recognises that built heritage has *"a great influence in [a] place's identity and characteristics"* (Pinheiro, 2011). Points are awarded based on the adoption of conservation practices and the preservation and enhancement of the built environment. It also encourages local economic development in a similar manner to the Green Communities tool. Some systems, such as LEED and Green Globes (both popular in North America), have a category specifically for building reuse, similar to Green Communities. This awards points based on the reuse of buildings or parts of buildings already existing on site. Green Globes awards a higher amount of points if the reused parts of the buildings are part of the facade or non-structural elements, which ensures that there is more preservation of the visible heritage of the building rather than just its structural core. These findings indicate that there are multiple criteria which could be adapted to the Danish DGNB system.

This section has given an overview of how adaptive reuse and its social impacts are currently integrated into the DGNB tool, described the opinions of informants about the DGNB tool, and presented criteria from other sustainability assessment systems. In the next section, these findings will be discussed to provide recommendations on how adaptive reuse and its social impacts can be better integrated into the DGNB tool using these findings.

5.0 DISCUSSION

This section discusses the findings from the analysis. It first delves into the valuations of the social impacts of adaptive reuse in relation to their similarities and differences between actors and their alignment with the literature. Then, the integration of the social impacts into the Danish DGNB system is discussed, and recommendations for additional criteria to improve the system are offered.

The data collected represents the perceptions of architects, consulting engineers, contractors, planners and property developers. Some of this data came from interviews, while the rest came from materials available online which represent their creators' valuations. It was found that there was both variation and similarity between the different actors relating to their valuation of the social impacts of adaptive reuse. For example, the architects Westh and Svensson hold similar opinions on almost everything, from the importance of heritage through to their opinions on gentrification. This is to be expected: they are both architects, went to the same architecture school and have both been in the industry for longer than 10 years. Their subjectivities have been influenced by this and so they have similar valuations. It can be seen that these valuations fall mostly into the Narrative, Sense of Place and Visual registers. Svensson did mention, however, that architects do consider the Complexity and Monetary registers as they acknowledge that there needs to be a business case for any project, and that the reused building needs to be fit for purpose. They align with the literature on heritage and identity, which also highlights the importance of heritage and older buildings for a community. Thurmann-Moe, the consulting engineer, has a strong focus on the environmental aspects of adaptive reuse, but also looks to balance the social impacts and the practical aspects of the practice.

While developers seem to base their valuations mainly on Monetary and Complexity registers, they do see value in the other registers as well. This is exemplified by the compromise which was reached between the architects and the developer on the Konstabelskolen project, where more of the original building interior was preserved even though it cost more money. This did come, however, as a surprise to the architects, indicating that this is not so common. The ability of the architects to convince the developer shows that with effective communication, it is possible to reach these kinds of compromises which attune to different kinds of 'good'. Inscription devices play a key role in this communication: they allow for the architects to take what they know about the value of the original interiors and translate this value to something which the developer can appreciate.

Developers often highlight the Narrative, Sense of Place and Visual values of buildings, as shown in their advertising of The Silo and Strandgade 7. They may do this as these aspects are valued highly by consumers; as stated by Thurmann-Moe and the literature in section 3.2.2.3, the history associated with adaptively reused buildings can increase their value. The Monetary value that

developers see in preserving character can lead to a compromise with the money that they are willing to initially outlay on a building and the complexity that such a project may bring. There also may be other economic drivers behind the decision to adaptively reuse a building. This is exemplified in the case of The Silo, where the existing concrete structure allowed for the construction of a taller building than what would otherwise have been allowed under planning laws. This maximises the floor space of the building, which in turn increases profits.

It can be seen in the industry that the contractors and developers see adaptive reuse projects as more complex and more expensive than new construction. Each construction project is unique and brings its own challenges, and so it is realistic that in some adaptive reuse projects this would be the case, but there is a growing body of literature which states that often adaptive reuse can be cheaper when wider economic benefits are taken into account, and sometimes the construction process can be simpler as well. The reason that contractors and developers may not be aware of this is because of the difficulty in quantifying and communicating these benefits, and because there may not be a significantly large enough body of evidence supporting these claims. Another potential reason for this preference for new construction is that the economic benefits of adaptive reuse do not all go straight back to the developer. For example, the economic impact of increased heritage tourism can provide benefits for the local tourism industry, the government and other local businesses, but it does not provide any return for the developer. Adaptive reuse is also tied strongly to environmental drivers. With increasing environmental standards and a push for more DGNB certification, developers are looking to construction practices which can give substantial environmental benefits in order to achieve certification and satisfy standards. This is exemplified by the Strandgade 7 project, which is achieving a high number of points based solely on reusing the structural core.

As such, it appears that the drivers behind adaptive reuse in Copenhagen are mostly linked with environmental and economic concerns. The social impacts that occur with the practice's adoption are seen as either an added benefit, or mostly ignored, as is the case with gentrification. As mentioned by Svensson, an effective way to improve the positive social impacts that can stem from adaptive reuse is to attach them to environmental and economic benefits that are measurable, and less 'fluffy'. By doing this, it can be easier to justify these projects and achieve better social outcomes on them. An example of this is increasing the amount of material reused on a building. This has environmental benefits from energy and resource savings and economic benefits from savings on material and demolition costs, which are easily quantifiable. When more materials are reused, more of the original structure is preserved along with its historical and aesthetic values which have a positive impact from a heritage & identity point of view. However, in order to maximise social benefits there needs to be more effort in ensuring that the visible heritage of the building is preserved, not just the structural material.

Few of the informants had much insight into the connection between adaptive reuse and gentrification. The interviewees were all aware of the problem and the architects discussed some ways in which the negative effects could be reduced, but the local government and developers do not appear to consider the ramifications of their projects on gentrification. This echoes what is said in the literature. The potential for the adaptive reuse practice to be used in creating affordable housing was something that was not addressed by the informants, and which is also largely missing from the literature. Svensson stated that it may be due to the funding models currently employed for affordable housing in Denmark. This is a topic which could merit further investigation. One possible solution put forward by Westh was to keep older buildings in districts, but not adaptively reuse them in order to keep the rent prices affordable for local residents. This opinion reflects what is said in the literature regarding the topic. This is difficult however, as it does not align with the valuations of any of the actors in the construction industry, but rather with the community themselves. As such, an effective way to reduce the negative impacts of gentrification is to include citizens to a greater degree in building planning and design processes. One possible explanation for why the negative impacts of gentrification is not addressed is because it is difficult to draw a direct connection between it and adaptive reuse, even though the literature discusses a more indirect connection.

All of the informants and the literature, to varying degrees, acknowledge that there is a positive social impact stemming from adaptive reuse relating to heritage & identity. The issue is that sometimes the Monetary and Complexity registers of developers and contractors overrule the registers which are strongly connected to this impact. This sometimes results in new construction being chosen over adaptive reuse, or in decisions which reduce the potential social benefits of adaptive reuse projects. In order to increase the value that actors in the construction industry see in adaptive reuse and the positive impacts of heritage & identity, the benefits need to be made visible in communicable statements. This will in turn allow them to make compromises between registers which are attuned to more kinds of 'good'. The same is true for the negative social impacts of gentrification stemming from adaptive reuse projects: if the impacts and their wider consequences are made visible, then changes can be made so that there is reduced displacement and exclusion.

An effective way to do this is through the use of an inscription device, which can translate the impacts into a form more suited to communicating the relevant information. This project is one such inscription device; it gathers data on the social impacts of adaptive reuse from literature and practice and provides a description of this topic in the context of the Copenhagen construction industry. This can serve as a tool to make visible certain aspects relating to adaptive reuse which may not normally be considered by a professional operating in the field. The DGNB system in Denmark is another inscription device which makes visible information on the sustainability of a

building. Each criterion involves the translation of data to statements which can represent the social impacts of adaptive reuse. The findings from the investigation into the Danish DGNB system show that currently, adaptive reuse is not integrated well.

Overall, the environmental impacts are accounted for in the LCAs which are carried out for buildings, but there are currently only two criteria which are related to social impacts. These are: SITE 1.2: The Image and Condition of the Area & Neighbourhood, which is not even weighted in the final score; and SOC 3.3: Plan Allocation, which encourages variation in housing size but does not stipulate anything relating to affordability. Although the next DGNB manual will include the SITE criteria as part of the overall weighting, there is much room for improvement within the tool when it comes to integrating the social impacts of adaptive reuse. The informants who were involved with the DGNB system also highlighted there were multiple areas where the system could improve: Westh stated there needs to be a more practical inclusion of adaptive reuse in the tool, Svensson stated that better integrating the impacts in a quantitative manner could help move the industry and encourage preservation and Nyholm noted that there is difficulty encountered when trying to apply the system, which is designed for new buildings, to an adaptive reuse project. The investigation into four other building assessment systems found that there are multiple criteria which could be adapted to fit the Danish context in order to make the social impacts of adaptive reuse more visible.

From the investigation, recommendations can be created, all which have their pros, cons, and implementation challenges. The following recommendations are offered:

1. Include a criterion which awards points for the adaptive reuse of a building, with points being weighted so that preservation of material with heritage value is rewarded;

Merging criteria from some of the other assessment systems mentioned above, DGNB could award points for the use of an existing building on site. The amount of points awarded could be based on the percentage of the original building materials which is reused, with additional weighting being given to reusing the facade and other non-structural elements in order to ensure retention of building character. There could also be an increase in the points awarded if the existing building is adapted for another purpose than what it was originally used for. This criterion will encourage positive heritage and identity outcomes, and it is measured based on a quantitative study which makes it easier to benchmark. This criterion would also have the added benefit of encouraging material savings, which brings economic and environmental benefits. It would be relatively easy to implement into the Danish DGNB system: there are multiple international examples which are not particularly context specific which could be drawn upon in designing the criterion, and it is quite simple to implement.

2. Offer points for the adoption of heritage conservation practices for the project building, and also for buildings in the vicinity;

Something similar is offered in the LIDERA assessment system. These points can be awarded on the basis of adopting conservation practices for the building being assessed, but also for buildings in the vicinity. In LIDERA this criterion is included in a grouping similar to the SITE category in the DGNB system. This criterion would potentially be difficult to assess as heritage evaluation and conservation is a relatively qualitative practice, and can exist on a broad scale. For example, if you award points to a project for simply the act of adopting conservation practices, the practices may only be utilised for a small portion of the building which has heritage value according to the developer. Bringing in experts to perform evaluations could result in higher costs and more complexity.

3. Reward local economic development efforts, such as offering reduced rents to local businesses in commercial space;

This could be awarded based on a number of activities which the building owners undertake, including: offering reduced rents for local businesses if the building includes commercial space, offering reduced rent for educational institutions, offering apartments to locals at reduced rent prices or selling the apartments to locals at reduced prices. The literature presented in section 3.2.3.2 supports the efficacy of these measures reducing the negative impacts of gentrification. However, this could be difficult to implement due to the monetary priorities of developers. All of the suggestions would result in a financial loss for the developer along with the cost required to certify this criterion, and as such there would be less motivation to pursue achieving it.

4. Award points based on a certain percentage of residences in apartment buildings being classified as affordable housing;

This would result in a more diverse neighbourhood, and allow locals to afford new residences in a residential adaptive reuse project. Affordable housing is highlighted as one of the most effective ways to reduce the negative impacts of gentrification. However, in Copenhagen it seems that affordable housing and regular housing buildings are developed separately. As such, there would potentially be few private developers who would be willing to sacrifice financial gain to provide affordable housing.

5. Include a criterion for increasing residential density in an area;

This could be benchmarked from current average residential density. Increasing density allows for more residences, which means that property value increases will not be as large in the area due to the extra supply. This would be a relatively simple criterion to include, but there should not be a large emphasis on it. In many areas, such as former industrial spaces, it would be relatively easy to achieve and is not as effective in reducing gentrification as the previous recommendations, as the residences can still be excessively expensive for locals.

6. Reward the inclusion of communities in the design process through the completion of a cultural resilience assessment or the creation of a cultural advisory group;

Similar to what is seen in the Green Communities system. This could be evaluated based on the completion of a cultural resilience assessment or the creation of a cultural advisory group. Involving communities as an additional actor in the construction process is an important factor in achieving balanced social outcomes, but due to the qualitative nature of assessing this, it could be difficult to integrate into the system. There could be an issue that a project could complete a cultural resilience assessment or create an advisory group, achieve the point, and then not act on any insights from the activity.

7. Develop an adaptation of the DGNB system specifically for the reuse of buildings in order to simplify the certification process for adaptive reuse projects;

The current Danish system is designed only for new construction, and has to be significantly adapted for reuse. A new system would ensure that all of the necessary adaptations from the new construction manual to an adaptive reuse project are already documented so that the professionals involved in certifying a reused building would not have as much difficulty navigating the system. This would assist employees of contractors such as Nyholm, who face difficulty in their work process. In Germany, there is currently an adapted DGNB system for renovation, but this has not been adopted in Denmark as of yet. This recommendation would require a large amount of work in adapting another system to the Danish context. However, given that there is already the German equivalent in place, it would be a straightforward process. There are both positives and negatives to implementing a new system for adaptive reuse. The ease of use as mentioned above is a positive, however having the above criteria in a separate system from the main tool would mean there would be less motivation for developers to choose adaptive reuse over new construction. This is something which would need to be investigated further.

There are pros and cons to all of the criteria above, and each would need a more extensive investigation than what has been performed in this report in order to integrate them effectively. The addition of new criteria also involves the navigation of significant bureaucracy associated with the system. However, as a departure point, these recommendations can be seen as allowing the DGNB system, as an inscription device, to make visible the social impacts of adaptive reuse which are currently rendered invisible. Through doing this, there is incentive for the construction industry to achieve better social outcomes on adaptive reuse projects and also choose the practice over new construction on future projects.

6.0 CONCLUSION

This project has made visible the valuations of the social impacts of adaptive reuse by professionals within the Copenhagen construction industry, and has offered recommendations on how these impacts can be better integrated into the Danish DGNB system. It has done this through applying theory on the creation of knowledge grounded in STS studies relating to how inscription devices and different social settings, subjectivities and cultures affect this knowledge. This theory was applied to the generated data, consisting of interviews with actors in the construction industry as well as online material relevant to the use of adaptive reuse in the Copenhagen construction industry and building sustainability assessment tools. Supplemented by a state-of-the-art literature review of adaptive reuse, the analysis offered findings which answer the proposed research question.

Regarding the valuation of social impacts of adaptive reuse in the Copenhagen construction industry, it was found that architects and municipality planners place more value based on the registers of Narrative, Sense of Place and Visual registers. Consulting engineers balance the different registers but have a strong connection with practicality and therefore the Complexity register. Contractors and developers focus more on the Complexity and Monetary registers, but developers see the value in the other three registers when they are connected to an economic benefit. It was also found that compromises which balance different valuations can occur, rather than one register always overruling another. The interviewees all agreed that the key to improving social impacts on an adaptive reuse project is to make them quantifiable so that they can be easily communicated and related to other actors in the industry so that they can attune their work to different kinds of 'good' at the same time.

Integrating these impacts into the DGNB system was highlighted as a way to do this. By taking the opinions of the informants and investigating international building assessment systems, the following recommendations were formulated:

1. Include a criterion which awards points for the adaptive reuse of a building, with points being weighted so that preservation of material with heritage value is rewarded;

2. Offer points for the adoption of heritage conservation practices for the project building, and also for buildings in the vicinity;

3. Reward local economic development efforts, such as offering reduced rents to local businesses in commercial space;

4. Award points based on a certain percentage of residences in apartment buildings being classified as affordable housing;

5. Include a criterion for increasing residential density in an area;

6. Reward the inclusion of communities in the design process through the completion of a cultural resilience assessment or the creation of a cultural advisory group; and

7. Develop an adaptation of the DGNB system specifically for the reuse of buildings in order to simplify the certification process for adaptive reuse projects.

These recommendations serve to make visible aspects of the social impacts of adaptive reuse previously hidden by the DGNB system. Each recommended criterion can be seen as an inscription device, translating the impacts discussed by the literature and the informants into communicable statements. Adopting these recommendations would result in better preservation of heritage & identity and reduce the negative impacts of gentrification stemming from adaptive reuse projects. As stated by Svensson (2020), new criteria in building assessment systems help move the industry, and it follows that they could also increase the adoption of the practice. Through this process, it is possible to transition the construction industry towards a future where all aspects of sustainability are balanced to achieve the greatest total benefit.

7.0 REFLECTION

The results of this research are limited by multiple factors. The entire project was completed in four months, which is a relatively short period of time to conduct an in-depth investigation. The process was also affected by the 2020 COVID-19 Crisis, which caused difficulty in finding sufficient interviewees. With more time, and in a normal societal context, more interviews could have been conducted with actors across the industry which would have given more valid insights. For example, interviews with planners from Copenhagen Municipality and property developers would have been useful as their personal valuations would have been more applicable than the interpolations of their valuations from other professionals' opinions and online material. As it stood, there could have been a potential skew towards the valuations of architects and engineers, as they were the professionals who made up the interviewees.

There are also many issues which this report did not aim to address which are of great importance in this topic. The report did not aim to provide conclusions on whether adaptive reuse is more sustainable than new construction from any particular aspect. Instead, it offered a description of what is said in the literature and the industry relating to the topic. Regarding the DGNB recommendations, this report did not aim to look in depth at the challenges which implementing new criteria would bring, as this was outside the scope of this report.

There were alternative research designs considered in the writing of this report. Instead of using the valuation theory of Heuts and Mol (2013), the analysis could also have been done in the framework of a number of theories such as Institutional Ecology. Looking at the perceptions of the social impacts of adaptive reuse by different actors occupying 'different worlds' where the impacts are viewed as a 'boundary object' was considered, and this would also have provided interesting insights into the field. Another potential research design would be to focus on a particular case study to get a more in-depth insight on one project which could be generalised to the industry.

There were certain topics encountered which could be of interest for future studies. Flexibility was a topic which was encountered in the literature and which was discussed by some of the interviewees. Flexibility of buildings is currently regarded as an important topic in sustainability and the ease of making adaptive reuse buildings flexible was mentioned by the architects, and the consulting engineer discussed this topic at length. A future study could look at whether it is easier to incorporate flexibility into new or adaptively reused buildings. The topic of gentrification would also merit further investigation, as there was found to be a gap in the literature relating to some of the connections between it and adaptive reuse, such as regarding the topic of affordable housing.

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