MASTER

Social urban lighting in the creation of social capital

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Award date:
2019

Eindhoven, April 2019

Social Urban Lighting in the creation of Social Capital

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in partial fulfilment of the requirements for the degree of

Master of Science in

Human Technology Interaction

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Preface

As I come closer to the finishing line of my graduation project, which also represents the end of my journey as a student, I believe it is time to take a moment to thank all the people that supported me. I would like to thank my supervisors: Antal Haans, Elke den Ouden and, unofficially, Rianne Valkenburg. Thank you for your open mind and creativity, which allowed me to explore new paths, for being patient and believing in me when I was uneasy and doubtful, and of course thank you for your competent support and guidance during this academic adventure of mine.

Special thanks to my fellow "*afstudeerders*", supported by Jelmer Steenhuis and his puzzles, a crucial element of stability in my often frightfully unstructured weeks. To my "*afstudeergroep*" colleagues, skillfully lead by Hedwich van Engelen, also many thanks: as I have said before, I would not have come this far without your help.

I also want to express my gratitude to my (very extended) family and my wonderful friends, for their encouragement and appreciation, and sporadic inquiries about my progress. Most of all I want to thank Frank, unbelievably patient and understanding, for taking care of me and reassuring me countless times.

Enjoy reading!

Abstract

The inspiration for this master thesis was an interest in the current developments around urban lighting and the city of the future, designed for the people. The needs and desires of people living in urban areas are different than those of people living elsewhere (Jacobs, 1961), and should be supported by proper urban lighting: social urban lighting. Social urban lighting is defined as a system of lights and other elements (e.g. sensors) that is designed to positively influence the social aspects of people living and dwelling in the city. Social capital is indicated as the criterion for valuable urban development: social urban projects, including social urban lighting projects, should focus on the support of local social capital development. A review is presented illustrating the different definitions and applications of social capital. A framework for social urban lighting is developed based on such social capital perspective. Three theoretical pillars are identified on which social urban capital should be based to support social capital development: information flow, co-operation and identity. An empirical study follows, in which eight case studies of social urban lighting are analyzed and balanced in the framework. All the case studies fitted, to various degrees, in the framework, confirming its reliability and applicability for future projects. Through cross-case analysis, four general themes were developed, encompassing a changing sensibility around social urban themes, a divide between a focus on social or environmental elements, the relevance of academia in social urban lighting development and the crucial role of the human factor in urban projects.

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Chapter 1: General Introduction

1.1 What is Social Lighting?

In recent times, public urban lighting has been developed and designed following two main guidelines: on the one hand product performance, which refers to the general trend towards energy efficient solutions, based on quantitative data and monetary value (Casciani & Rossi, 2012), and on the other hand the urban experience at night, where safety plays a primary role, alongside many other facets of the quality of life of urban residents and dwellers (not exclusively human). As explained by Jane Jacobs (1961), urban illumination is only able to grant the urban users safety and control if there are "eyes on the street": crime and vandalism do not solely occur in the darkness, well-lit streets can as easily become the stage of deplorable behavior when there are no observers. Fighting crime with over-illumination has been a popular policy for decades, causing inequalities in public lighting strategies and accentuating the social divide in the urban sphere (Sloane, Slater, & Entwistle, 2016). The social perspective of urban lighting is emerging as a crucial aspect for resilient cities. Increasingly often cities and municipalities choose for lighting solutions that go "beyond illumination": Urban lighting solutions not just provide visibility and a sense of safety at night but fulfill other functions too. This is also apparent in the vision documents and guidelines for urban lighting renewal produced by several Dutch municipalities, which reveal that a wide spectrum of features is being taken into consideration. Some examples:

- "The modest character of the medieval cityscape and the historical structure of the street profile are at the foundation of the design." (Gemeente Amersfoort, 2017, p. 5);
- "Find an optimal balance between good, safe and comfortable light on the one hand, and less CO2 emissions on the other, less energy consumption and easy maintenance." (Gemeente Etten-Leur, 2017)
- "The mission of the project is to improve quality of life in the urban environment through the development of relevant light innovations." (Jouw Licht Op 040, 2017).

Next to rules concerning efficiency, efficacy and energy savings (i.e. how much light is needed at night on streets and sidewalks to guarantee safety and how much electricity should be available for it), recent lighting projects tenders have been including sections about wildlife health and preservation, wellbeing of residents, or the importance of supporting social activities and cultural identity. More complex needs of urban residents are addressed by public illumination solutions: sharing relevant information or conveying specific emotions, reinforcing the identity of a neighborhood for instance, or highlighting the spirit of a city center during a festivity. Good quality urban lighting is an evolving concept, which has been slowly but surely expanding its functions; from visual performance, to visual comfort, to visual ambiance, to social experience.

Technological progress in other fields also presents new chances for the field of social urban lighting. New digital control systems and Internet of Things applications offer a wide range of

possibilities for intelligent urban lighting solutions, alongside new challenges regarding privacy and control, amongst others. These possibilities are starting to be explored by lighting designers, urban designers and other practitioners, whom, by doing so, have broadened the horizons of what is feasible in the urban environment with regard to illumination. These kinds of improvements can be useful for a radical and meaningful transformation of contemporary cities at night. Adding a social value to the public realm is a fundamental piece of the larger puzzle of developing healthy and livable urban environments, suitable for the future, as cities are expected to become home and workplace for the majority of world population (The World Bank Groups, 2018).

Socially oriented lighting designs represent a new approach aimed to create accessible and sociable cities, still accommodating sustainability needs. As it appeared relatively recently as a research topic, the field of social urban lighting is in great need of structural measurement methods and theoretical frameworks. Several are the aspects that contribute to the characterization of a lighting system as "social". Urban lighting can influence social interactions in the public space — encouraging informal exchanges or impeding them. Carefully designed urban lighting can improve one's connection with a place and a community, increasing mutual trust and a sense of control. Including residents and other users in the process of designing their urban environments contributes to a feeling of belonging and common responsibility. Social oriented urban lighting projects including forms of co-creation have been found to be compatible with environmental goals (Casciani, 2014), as people showed more eco-responsible behaviors as a consequence of being involved in the ideation and/or realization. These, and other social resources that positively influence the wellbeing of people living in urban areas can be classified as parts of a bigger concept, a set of assets often referred to as Social Capital (Bourdieu, 1986; Coleman, 1988). The current study suggests that the goal of social urban lighting solutions is, ultimately, to facilitate the development of such resources. Facilitated social interactions play a role in supporting, nursing and extending social connections. The theoretical mechanisms connecting social capital with the physical characteristics of the urban environment, especially the role of public lighting, will be investigated and placed in a comprehensive framework.

1.2 Relation with Social Capital

Lighting applications designed to influence social connections are called social lighting applications and represent a highly interesting and current topic of research in the several fields of research. The value and availability of meaningful social contacts form a resource often referred to as Social Capital (Bourdieu, 1986; Coleman, 1988), therefore one could argue that the ultimate aim of social lighting applications is to foster such resources, aiming at reinforcing and broadening of one's social connections as a consequence of facilitated social interactions.

In recent decades, the importance of the social dimension of human life has gained more and more importance: "no man is an island" (Flap, 2002). As Flap proceeds to explain: "Practically all aspects of people's lives are embedded in the social networks that they form with each other and these networks

affect their lives in manifold ways" (Flap & Völker, 2005, p. 2). Social integration has even been found to positively influence life expectation.

The urban environment presents unique and singular aspects with regard to the social existence of its inhabitants and dwellers, and it is capable of influencing their connections (Ross, Talmage, & Searle, 2018). Urban communities are divers and heterogeneous, mixing inhabitants and dwellers from multiple ages, ethnicities, social backgrounds. Cities are not to be considered as expanded villages: neither in a physical way, nor in the way people live in them: suburban areas, with low rise housings and local cultural centers might be considered an urbanized version of a small town, but city centers, with high rise buildings, busy streets and anonymous dwellers are a totally different system (Jacobs, 1961). Therefore, special attention needs to be put in the design of the urban environment, including how places are lighted at night. Urban nightlife has a richer and more complicated profile than nightlife activities in rural or suburban areas. Public spaces can assume totally different meaning depending on how they are illuminated. At the same time, people can be scared by a dark alley as much as they are drawn away from too bright and bare scenes. Balance is as needed as it is difficult to achieve.

In sociology, social capital is described primarily as a resource capable of facilitating social actors within a specific social structure. In the field of politics, more focus is put on the community aspect of social capital: civic association (Putnam, 1995). Economists often define it as a mean to produce potential benefits (Adler & Kwon, 2002). To develop effective social lighting applications, a better and deeper understanding of the construct of social capital is needed: what social capital is, how does it develop in urban areas, what kind of interventions may influence it?

1.3 Research Aims

The current study aims at contributing to a better understanding of the concept of Social Urban Lighting, by developing a theoretical framework that explains why and how social urban lighting is expected to be effective. Furthermore, existing examples of either realized projects or projects in realization will be examined to research how this relatively new kind of urban illumination solutions is currently approached.

The current study consists of two parts. The first part is an extensive literature review on the topic of Social Capital and its implications in the field of social urban lighting. The result of this review consists of the elaboration of a theoretical framework to explain the dynamics behind the application of social urban lighting to foster social capital in urban communities. The second part is an empirical study on existing projects, either realized or in realization, followed by a thematic analysis in order to identify trends and recurring issues in the current practice. This thesis is concluded by a general discussion and conclusion about the research findings and process, and the implications for the field of social urban lighting.

Chapter 2: Literature Study

2.1 Current Study

The first of the two studies comprised in the current report is a literature review on the topic of social capital theory and its possible theoretical linkages with the assumptions sustaining social urban lighting. The more complex and crowded cities of the present and the future could use countless aids when it comes to Quality of Life, sustainability or other contemporary challenges. Social urban lighting is one of those aids, designed to positively influence the lives of those living in the city through encouraging and supporting social capital development. The mechanisms governing social urban lighting are explored in this chapter.

The idea that the urban environment plays a role in the development of social connections, and can therefore be designed to facilitate positive social interaction, has already been explored by sociologists, urban planners and designers. New urbanism, for example, is a design theory developed to promote sense of community in urban areas (Talen, 1999). The Urban Village theory originated in the field of urban planning as an attempt to develop sustainable, mixed use urban areas, with a sense of place and community commitment (Franklin & Tait, 2002). Similarly, several other applications have been investigated in the past decades. The current study focuses on these approaches as convenient and valid examples or theoretical bases of the reality of the possibilities of urban social lighting. Some are also applied in the final theoretical framework as valuable opportunities for designers of the urban environment.

In order to develop a complete and accurate framework that describes why and how social urban lighting acts on a community to foster social capital, research needed to be done about the construct of social capital. Firstly, what is it? This question appeared to require a complex answer as scholars have been debating on it since the beginning of the adoption of the term. Where does this term come from? Who started using it and why? Who is using it now? Different fields of knowledge have been adopting the term, shaping its meaning depending on the context. Framing and remolding the concept is needed for several reasons. Alongside the direct applicability in a certain field, it is also necessary for scholars to allow their public (i.e. their colleagues and the people reading academic journals in their field) to understand the working and importance of the concept. Therefore, terms and correlations are sometimes adjusted to suit a certain audience. Social Capital is therefore a transdisciplinary concept. As opposed to multidisciplinary, which looks at a problem from different disciplinary angles, or interdisciplinary, which focuses on disciplinary intersections in terms of theory, methods and concepts, transdisciplinarity searches for common ground while recognizing differences and unique characteristics of each approach. This might lead to contradictory knowledge, which would still be useful for the purpose of understanding the way scholars look at the concept (Després & Piché, 2017).

In the following section, the method of information gathering and coding will be explained, followed by an overview of the results. In conclusion of this chapter, the developed framework will be illustrated and discussed.

2.2 Method

In order to identify relevant sources, a two-steps approach was applied. The first step consisted of the consultation of the Scopus database. The Scopus database was chosen as one of the most comprehensive, but also specialized, databases for academic articles. The second step consisted of an additional search using the Google Scholar database. This second step was added for two reasons: (1) to access highly cited studies that might not appear on Scopus or (2) to access relevant papers or reports cited in other works in specific cases. Figure 1 illustrates an overview of the article search and selection process.

	Found	Included
1st Iteration: social capital AND sense of community AND neighboring	title or abstract or keywords — 9 documents	5 documents
2nd Iteration: social capital AND sense of community	title or abstract or keywords — 687 documents title or keywords — 12 documents	7 documents
3rd Iteration: social capital AND neighboring	title or abstract or keywords — 200 documents title or keywords — 4 documents	2 documents
General search (Scopus and Google Scholar)		13 documents
Preliminary search (also Google Scholar)		10 documents

Figure 1: Article searching and selection process

2.2.1 Keywords

Based on prior knowledge and a preliminary literature research, the following keywords were selected: *social capital*, *neighboring* and *sense of community*. Those keywords had appeared in several studies as being connected semantically and were linked to each other in a number of theories that had come up during the preliminary research. For instance, the social capital theory by the social psychologists Perkins and Long (2002), which classifies neighboring and sense of community as

dimensions of social capital, had often emerged in different fields during the primary stages of the research.

2.2.2 First Iteration

The first search was executed with these three keywords, resulting in nine found documents containing all three the keywords in the title, the abstract or the keywords. In this report, this phase will be referred to as the first iteration. Upon reading the abstracts, four articles were discarded as they did not match the topic of the current study. The remaining five articles were added to a Microsoft Excel file. Basic information was extracted and reported: the author(s), title, publication year, source (publisher) and research field (based on the publishing journal and background of the authors).

2.2.3 Second Iteration

The following step, which will be referred to as the second iteration, was divided in two sections: first, a general search on Scopus using the keywords *social capital* and *sense of community*, which delivered 687 documents. As that appeared to be quite a large number for an in-depth analysis, a second, more elaborate research was executed, in which only documents were retrieve where the two keywords would appear in the title or as given keywords by the authors. The second search delivered 12 documents. One of the retrieved papers was already present in the results from the first iteration and was therefore discarded. Two papers could not be accessed within the time limit of the current research. Two papers were discarded upon reading the abstract as not relevant for the current study. A total of seven papers were then added to the Excel file, in the same fashion as the results from the first iteration.

2.2.4 Third Iteration

The third iteration, which included the keywords *social capital* and *neighboring*, was conducted in a similar way. The first general search generated 200 results, which was considered a number too large for a detailed analysis. The same technique as before of only looking for the keywords in the title and keywords of the paper was applied, generating four results. Again, one of the retrieved papers was already present in the results from the first iteration and was therefore discarded. One paper was discarded upon reading the abstract as not relevant for the current study. The remaining two papers were added to the Excel file, in the same fashion as the results from the previous iterations.

2.2.5 Coding

At the end of this first searching phase, a total of 14 papers had been added to the Excel document. These 14 papers were read and the information concerning social capital was coded and added to the Excel document. In the coding process, the first objective was to find an explicit definition of social capital. These definitions were copied in a dedicated column in the Excel document. In case no overt definition could be found, we would look for specific characteristics or qualities that the authors would ascribe to social capital and note those in order to still be able to frame the concept. Subsequently, specific observations or reasonings were noted, that helped gain insight in the way the authors approached the concept of social capital and its connections to the other concepts relevant for the current

study (e.g. neighboring behavior or the urban environment). Finally, other notes or remarks were noted that were considered to possibly be of interest in the development of the framework. These were noted in a dedicated column (appropriately labeled "extra").

2.2.6 Additional Selection

All the created search lists were saved on a personal Scopus account in order to preserve them. The two largest lists were consulted in later stages of the analysis. In case of uncertainty on specific matters, the two lists were adopted as starting points for further research. For example, as the third iteration only delivered two entries in the set of manuscripts, that list was subject to further scrutiny to gather a broader understanding of the theoretical connections between social capital and neighboring. Applying some of the filtering features available on the Scopus database, the lists could be rearranged or refined to simplify the searching task: e.g. "searching within results" allows to scan for specific terms in the list of documents, and specific subject areas can be included or excluded from the list. A relevant example of why this extra step was helpful for the current study is the addition of terms like "urban environment" or "public lighting" as keywords in the in-list searches. By doing so a selection of specialized papers was retrieved that explored the construct of social capital from an environmental point of view.

The articles were also classified (in the Excel document) according to the way they were retrieved: whether they were found as results of the Scopus searches (and which iteration of the search process) or they were found in other phases, e.g. the preliminary literature research or as relevant cited works in other studies.

The quest for relevant literature was completed by specific papers that were either cited by multiple other studies or were cited by a singular other study but considered to be of specific interest for the current study, based on the found citation. This was done with the Google Scholar database.

Following the procedure described above, a total of 37 manuscripts were selected for inclusion in the literature review. The results of the analysis can be found in the following section.

2.3 Results: Literature Review

2.3.1 Social Capital Theory

Social Capital (SC) has made its appearance in several research fields in relatively recent times. At the beginning of the 1990's, different scholars developed the concept, initially as a mean to illustrate the importance and (also monetary) value of the social dimension to investors and policy makers. The basic theme for all the original social capital theories is that strong and stable social networks are profitable for individuals and communities: resources are shared, and so is the profit. What is it about social connections that function as a factory, moving actors and things and producing resources? Economists have centered their attention on individual utility maximization: if friendship, trust or interpersonal respect are just means to an end (maximal personal profit), then those things can be handled as additional commodities to be exchanged, likewise material goods (Robison, Allan Schmid, & Siles,

2002). Sociologists and psychologists, on the other hand, stress out that behavior is not always calculated, but learnt and internalized though largely unconscious mechanisms, underlying the fragility of the link between action and reward (Robison et al., 2002). Numerous scholars worked on the subject in the past decennia, with different points of view and different goals. This review presents a limited number of theories, considered the most relevant for the current study. The first constructed theories about social capital are attributed to James Coleman, an American sociologist, Pierre Bourdieu, a French sociologist, and Robert Putnam, an American political scientist. Their most basic and general definitions state as follows.

Coleman: "Social Capital is a variety of different entities, with two elements in common: they all consist of some aspect of social structures, and they facilitate certain actions of actors — whether persons or corporate actors — within the structure." (Coleman, 1988, p. 98)

Bourdieu: "Social Capital is the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition." (Bourdieu, 1986, p. 51)

Putnam: "Social Capital is the features of social organizations such as networks, norms, and social trust that facilitate coordination and co-operation for mutual benefit." (Putnam, 1995, p. 67)

All define a clear set of characteristics of Social Capital:

o Social Capital is the sum of a number of elements;

o Social Capital is embedded in a social network;

o The network is organized: the members share a set of rules;

o Social Capital is expected to have a positive influence on the members of the network.

All three the definitions underline the following elements: (1) what social capital is: a complex composition of different elements. (2) Where social capital resides: there needs to be a community of interacting actors for social capital to develop; the actors in the community share rules and values and trust each other in order to function and punish those who act outside of the rules. (3) What can be achieved through the availability of social capital: social capital makes it possible to mobilize the resources embedded in the network in order to create (either individual or collective) profit.

Even though the three definitions look very much alike, several are the differences in the underlying theories once each characteristic is analyzed individually. Mainly the characteristics of the communities, the kinds of actions and actors, and their reasons to act have been widely discussed, also by later scholars. In Coleman's theory, individual profit does not represent the prime motive of action of an actor in the community. As social capital is a public, shared resource, individuals' good will is needed to sustain the system. Reciprocal trust, authority, norms and sanctions play an important role in this process (Coleman, 1988). Putnam's position is similar: increased social capital is expected to result in an increased "taste for collective benefits", where the "I" turns into a "we" and the sense of self is broadened (Putnam, 1995, p. 68). In other words, Coleman and Putnam recognize that singular, direct profit is not the only trigger for action: altruism and generosity might also guide actions, likewise interest

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in collective profit rather than individual. On the other hand, Bourdieu defines communities as social hierarchical classes, and argues that the principal goal of social capital is for every individual to maintain or improve their social status. He locates social capital in a more individualistic light: community profit is equal to the sum of all the individual profits of the members. Moreover, Bourdieu claims economical resources are at the base of all other types of capital, including social capital, suggesting that the absence of economic capital decreases the accessibility to other resources (Bourdieu, 1986).

Putnam's approach focuses on what he calls "civic engagement", the importance of individuals coming together, either formally or informally, to engage in activities that contribute to the vitality of urban areas (Putnam, 1995). Putnam's approach puts all people on the same level, everyone participating in civic activities is able to positively influence a community, and all communities are in the position of being positively influenced by their members. As criticized by Crisp (2013), this view fails to recognize that the possibility to develop social links and enjoy the advantages of being part of a community is bound to prior access to other resources. This tendency can be recognized in what he defines "undermined communities", disadvantaged urban neighborhoods that, in his opinion, could be able to re-establish themselves socially through material improvements.

2.3.2 Extensions of the Famework

Lin (1999) defines social capital as follows: "Resources embedded in a social structure which are accessed and/or mobilized in purposive actions."(Lin, 1999, p. 35), introducing a new element inherent to the structure of a network: accessibility. Accessibility needs to be separated from availability, as the presence of resources in a network does not represent the immediate possibility for an individual to mobilize those resources. Lin define those as the three ingredients for social capital: availability of resources, the possibility to access them, and the following utilization of the resources. The relevance of accessibility is also underlined by Hyman, who defines: "Social capital as an asset representing actionable resources that are contained in, and accessible through, a system of relationships" (Hyman, 2002, p. 197). This means that the social capital embedded in a network can be accessed in different ways, depending on one's position within the network. Moreover, one's use of the resources (the way an individual mobilizes the reached capital) varies depending on several personal and situational, but also structural variables. Accessibility can be measured based on three characteristics: range, which is the distance between positions in a network, extensity, or heterogeneity, indicating the number of accessed positions, and upper reachability, which indicates the status of the highest possible accessed position (Lin, Fu, & Hsung, 2001).

Consequently, some resources might be more easily accessible to some members of a community than to others, depending on one's position in the network, creating unequal situations of privilege and deprivation. Other scholars confirm this approach. Burt (1997, p. 340), who defines social capital as "an individual's asset in the form of her/his position within a specific network", concentrates his attention on the importance of the quality and quantity of links between individuals. He states that low-density areas of the network ("structural holes"), rather than a highly populated areas, represent more profitable

positions for individuals, as the person will be able to exert more control on the information and resources moving in either direction (Burt, 1997); thus confirming that different locations have differential accessibility to embedded resources. Burt's assumption relies on the idea that weak ties between members of a network, referring to connections of little importance and meaning, like friends of friends, are key points in a network as they extend the number of reachable people (Granovetter, 1973). Stances alike Burt's are often referred to as "structuralist": "Give me the network and I will tell you what they will do" (Flap, 2002, p. 30). In this optic, a person's position in a network is the most important element in the explanation of that person's actions.

Völker and Flap (2007), even though they oppose the structuralist view, support the added element: alongside the availability of resources, it is crucial for an individual in need that those possessing the desired resources are also willing to share them. In other words, the links between individuals need to be of positive nature for social capital to develop and be accessed (Völker & Flap, 2007). An important element in their work is the attention put towards the development of positive connections between neighbors in urban areas. Those are the people one cannot avoid meeting, as they coexist in the same physical area. One might meet neighbors in person while taking out the trash, or at the local grocer, with a higher frequency than other "strangers". Other elements can also help create a sense of presence of others around, like cooking odors or the level of tidiness of one's front yard. As they explain, people understand the importance of present value for future support, and also the similarity of their destinies to those of their neighbors: One neighbor's problem today might be another's problem tomorrow (Flap & Völker, 2005; Völker & Flap, 2007). Their analyses on the importance of meeting places in urban areas will be further explained in the next section (p. 18).

Resources accessibility is the focus of the theoretical approach by Carpiano and Hystad (2011), who define social capital as "the resources embedded within social networks, the actual or potential material, informational, and affective resources that individuals have access to via social networks and that may be used as a means to pursue individual or collective action" (Carpiano & Hystad, 2011, p. 606). In their framework designed to apply social capital theory to health surveys, they recognize that a network-based approach to social capital enables a more accurate analysis of people's uneven access to resources that may promote or harm their health outcomes, supporting health inequalities research (Carpiano & Hystad, 2011). They oppose network-based, or general social capital, to geographically bounded social capital, which only exists within particular locations (Carpiano & Hystad, 2011). An alternative approach is proposed by Van Der Gaag and Snijders (2005) as they develop a model around the measure of the mobilized resources, rather than the availability or accessibility of those resources. They define social capital as "the collection of resources owned by the members of an individual's personal social network which may become available to the individual as a result of the history of these relationships." (Gaag & Snijders, 2005, p. 1) and developed a tool to measure the productivity of general social capital.

The distribution of resources through society also plays a role, as Edward and Foley (1997) explain. The meaning of social capital can vary within specific sectors of society, meaning that access to a similar asset of resources in different social contexts can have divergent results (Edwards & Foley, 1997). A wealthy neighbor might represent a useful asset in a trustful and safe neighborhood, while it could also be a source of stress and instability in a neighborhood dealing with crime: e.g. regular police visits or visible anti-crime precautions influence the image of a neighborhood.

2.3.3 Social Capital defined in Other Fields

In the field of economics, different scholars have been working towards an integration of the concept. Woolcock and Narayan (2000) define social capital as "the norms and networks that enable people to act collectively" (Woolcock & Narayan, 2000, p. 2). They decide to focus on the sources of social capital, referring to one's networks, like family or associates, as assets one can enjoy, call upon in times of need or appeal to for material profit. They mark the importance of social ties by emphasizing the effects of the absence of ties. They distinguish between intra-community connections ("bonding") and extra-community connections ("bridging"), underlying the importance of a healthy balance between the two. Wealthy people might enjoy a broader share of bridging social capital, a resource they could deploy to "get ahead", which might be missing in the networks of poorer people, who will need to rely more on bonding social capital in order to "get by" (Woolcock & Narayan, 2000).

Pavičić, Alfirević and Bežovan (2017, p. 554) elaborate the theory even further, adding the element of leadership: "[social capital] should be the result of the interactions among the resources, social systems/mechanisms, individual identification with the community and their motivation to participate in collective action, as well as the capacity of individual leaders" (Pavičić et al., 2017). They elaborate on the importance of common goals, as they serve as channels to direct joint action in a community. Narayan and Pritchett (1999) state the following: "By social capital we mean the quantity and quality of associational life and the related social norms"(Narayan & Pritchett, 1999, p. 872). As "capital" is something accumulated which contributes to higher income or better outcomes, so is social capital expected to act: facilitating cooperative action, supporting governmental activities and speeding up the diffusion of innovations, allowing individuals to pursue more risky and higher return activities (Narayan & Pritchett, 1999). In an attempt to clearly define social capital for what it is, leaving out its services (what it does) and location (where it resides), Robison and colleagues explain: "Social capital is a person's or group's sympathy toward another person or group that may produce a potential benefit, advantage, and preferential treatment for another person or group of persons beyond that expected in an exchange relationship." (Robison et al., 2002, p. 6). The term "sympathy" is added to differentiate between selfless actions and actions motivated by narrow self enhancement, placing this definition further away from most economists positions (Robison et al., 2002). Another alternative term introduced to define social capital is good-will: sympathy, trust, and forgiveness offered us by friends and acquaintances, which is a valuable resource and the substance of social capital (Adler & Kwon, 2002; Pooley, Cohen, & Pike, 2005).

In the field of management and business studies, many scholars refer to the work by Nahapiet and Ghoshal (1998). They position social capital in their "organizational advantage" model, defining it as "The sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit" (Nahapiet & Ghoshal, 1998, p. 243). In their model, they propose social capital as three-dimensional; the three dimensions being structural, relational and cognitive. The structural dimension refers to the network, its ties and configuration. The cognitive dimension refers to shared codes, languages and narratives within the community. The relational dimension refers to trust, norms, obligation and identifications (Nahapiet & Ghoshal, 1998). Zhao and colleagues apply this model to virtual communities to research emotional attachment, sense of belonging and knowledge transfer, confirming that similar mechanisms apply in the digital behavior of people (Zhao, Lu, Wang, Chau, & Zhang, 2012).

A further ramification of social capital is illustrated by de Souza (2011) in her framework for social capital and attitudinal change in communities. She describes trust and reciprocity, alongside feelings of self-worth and personal value, as the cognitive components of social capital. This way, she illustrates that social capital is developed by different elements, and the elements belong to different spheres of human life, rather than merely the social sphere. Similarly, Pretty and Ward (2001), who define social capital as "the idea that social bonds and social norms are an important part of the basis for sustainable livelihoods." (Pretty & Ward, 2001, p. 210), refer to four central aspects of social capital: (1) relations of trust; (2) reciprocity and exchanges; (3) common rules, norms and sanctions; (4) connectedness, networks and groups. Pretty and Ward, thus, use similar terms as seen in precedent definitions (Coleman, 1988; Putnam, 1995; Souza, 2011) to refer to similar elements, but are more precise in their definitions. There concepts are therefore more suitable for operationalization.

Xu and colleagues (2010) illustrated the cultural limitations of social capital theory, as they found different results when studying social capital in China. Social capital was found to have a more personal and individual character in China as compared to Western societies. They define social capital in China as more cognitive than structural, describing the first as based on personal, individual relationships as opposed to based on collectivity and civic involvement (Nahapiet & Ghoshal, 1998; Xu et al., 2010). Studying Asian communities, Marzuki and colleagues (2014) developed a model which includes six dimensions of social capital: participation in community activities, proactivity in the social context, neighborhood connections, multi-racial tolerance, a sense of trust and protection, and life values (Marzuki, Ahmad, Hamid, & Ishak, 2014). This was done to support the development of a measurement method for social capital, as creating dimensions allows for more detailed measures. This is also done by other scholars, as can be seen in the following section.

2.3.4 Social Capital and Sense of Community

Carpiano and Hystad (2011) illustrate an important controversy in the realm of social capital. They explain the potential for conceptual overlap with Sense of Community, a concept mainly applied in (community) psychology (Carpiano & Hystad, 2011). On the one hand, scholars agree that there is a

correlation between social capital and sense of community, as it is often considered a constituting element of social capital. On the other hand, the two concepts are theoretically independent from each other, while considered similar and driven by analogous mechanisms (Stanley, Stanley, & Hensher, 2012).The following two largely accepted and often cited theories illustrate the issue.

Firstly, McMillan and Chavis (1986) developed a framework for sense of community, ascribing four key components to it: membership (''feeling of belonging or of sharing a sense of personal relatedness''), influence (''a sense of making a difference to a group and of the group mattering to its members''), integration and fulfillment of needs (''the feeling that members' needs will be met by the resources received through their membership in the group''), and shared emotional connections (''the commitment and belief that members have shared and will share history, common places, time together, and similar experiences'') (McMillan & Chavis, 1986).

This four-sided idea is also brought forward by Perkins and Long (2002) in their work on operationalizing social capital for psychological research. They mainly apply Coleman's definition, and describe social capital as "to political science, sociology, applied economics, and community development what sense of community and empowerment have been to community psychology." (Perkins & Long, 2002, p. 291). They describe the concept as four dimensional, with the four dimensions being: sense of community, neighboring, collective efficacy and citizen participation (Perkins & Long, 2002). In later works, social capital is identified as one of the many predictors of sense of community, whilst the latter should still be considered a constituting element of social capital (Long & Perkins, 2007). At risk of creating a paradigm between what creates and is created by social capital, Perkins and Long elaborate on the four-dimensionality of the concept, confirming once more the positive link between social capital and quality of life. A community in which members trust one another, collective action is efficiently organized, neighbors engage informally, and members are involved in community organizations, is a community rich with social capital. Complications in the operationalization of social capital regarding an unclear line between its sources and its outcomes have also been underlined by Appel and colleagues (2014). While reviewing measurement methods, incongruencies are found in the definitions of contributors and contributes of social capital, impeding a clear assessment of costs and benefits of social networks (Appel et al., 2014).

The second model has been largely adopted in psychology and Quality of Life research: sense of community is handled as a component of social capital. As a consequence, if inferences can be made about the effects of sense of community or on how it is fostered, then similar mechanisms might be expected to apply for social capital (O'Connor, 2013; Ross et al., 2018; Sengupta et al., 2013). Similarly, Pooley and colleagues (2005) conclude in their study that sense of community might be a useful means to assess social capital. Further steps in the process of connecting the two concepts comprehend models in which social capital mediates the effects of sense of community, amongst others. Yetim and Yetim (2014) developed a model in which social capital is a mediator variable between fulfillment of needs and sense of community. They ascribe social capital two dimensions: "civicness", which is related to

citizenship and social responsibility, and "trust" (Yetim & Yetim, 2014), and confirm the vital link between these two constructs, and their connection with well-being. Dallago and colleagues (2009) also developed a model in which social capital acts as a behavioral mediator between place attachment and safety perception, as high levels of social capital in a community facilitate the exercise of social control over deviant and uncivil behaviors (Dallago et al., 2009).

2.4 Conclusion: Framework for Social Lighting

"Life is easier in a community blessed with a substantial stock of social capital." (Putnam, 1995, p. 67)

The previous chapter presented a review of the different definitions and operationalizations of social capital. The current chapter aims to enclose that information in a framework to be applied to social urban lighting interventions. It is of great importance that communities are supported wherever possible in the development of social capital. Policy makers, designers and construction companies are in the position to succor communities in need and help develop urban areas that promote social capital. We developed a framework to assist professionals working towards urban lighting interventions. The framework proposes a number of ways in which the urban environment may be shaped to support social capital development. The following three pillars were recognized as essential in social urban lighting projects: information flow, co-operation and identity.
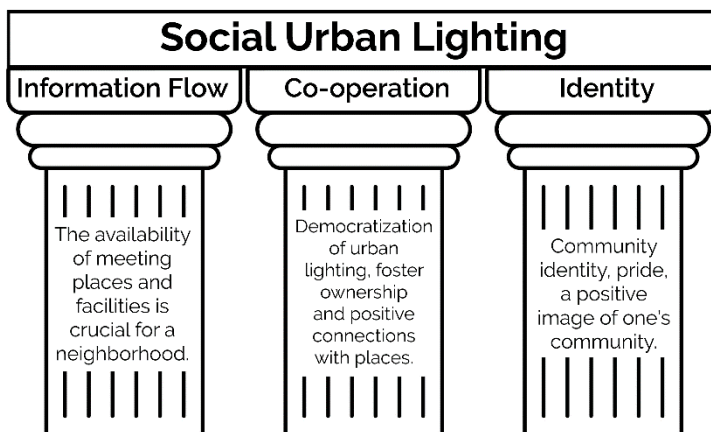
Figure 2: The three theoretical pillars of Social urban Lighting

2.4.1 Information Flow

The optimization of the strength of the connections between people is the pedestal for social capital development (Pooley et al., 2005) and how the urban environment is shaped influences those connections (Ross et al., 2018). As illustrated by Coleman (1988), information flows, or channels, are an important component of social capital. Information is critical for action: from baking an apple pie to designing a spaceship, people base their decisions and actions on what they know. Facilitating information flows in a community, therefore, represents an opening for social capital development. Knowledge and experiences are shared within the system of a social network. As information acquisition is a costly process, in term of time, attention, and other assets (Coleman, 1988), communities can benefit

from interventions that simplify it. Information flow is supported by encouraging opportunities for individuals to meet and attend the quality of their relationships, increasing the chances that individuals will share information, possibly of value for one another. Forms of social interactions are neighboring activities, casual social encounters, community participation and social support (Kim & Kaplan, 2004). Of these four, neighboring activities and casual social encounters present the most room to be influenced by physical interventions, creating meaningful places in the urban space. Support collaboration and foster community commitment are important assets in social capital development (Perkins & Long, 2002). In the urban environment, one's neighbors are means for access to information. People meet on the streets, in shops and cafes, and, more importantly, they cannot avoid meeting others. The area one lives in represents therefore a particularly relevant meeting setting. Social connections are only developed through contact, meaning that the availability of meeting places and facilities is crucial for a neighborhood (Flap & Völker, 2005; Völker & Flap, 2007).

Theoretical approaches towards urban development designed to increase meeting opportunities have already been formulated. New Urbanism, for example, was developed in the 19th century as a countermovement to conventional modernist city planning, which promoted function separation and low density planning, and prioritized cars above all other street users (Jacobs, 1961). The goal of New Urbanism was to foster sense of community and encourage social interaction through the reorganization of streetscapes and public spaces as well as reorienting city planning towards pedestrian and transit friendly environments. New Urbanism relied on the general rules delineated by Neotraditional Development (or Traditional Neighborhood Development or Neo-traditionalism or the many other names given to this general approach towards urban design) which focus on the application of walkability, human-scale and mixed-use designs (Furuseth, 1997). All these approaches are meant to invite people on the streets, to create a safe and welcoming urban sphere. If people feel at ease outside of their house, spend time on streets and squares, they are more likely to engage in conversation, get acquitted with each other. Urban lighting has the potential to support these approaches, stretching the part of the day people feel comfortable on the street beyond sunset.

Assessing and considering users mobility in a public area is an important step towards the development of engaging, accessible and comfortable night streetscapes. (Sloane et al., 2016). Commutes and other daily dwellings are some of the main reasons people leave their houses, so understanding how and why residents and visitors of a specific area decide to move around in that area is fundamental (Jacobs, 1961). The ambition is to create places where people enjoy spending their time in the evening, where they do not feel the urge to leave as quickly as possible, experience discomfort or annoyance. Several elements of public lighting could play a role: light intensity, temperature or color; lighting patterns and direction; height, shape and frequency of illuminating elements. Moreover, other aspects of the physical environment could support, e.g. seating opportunities (Mehta, 2007).

2.4.2 Co-operation

The social capital embedded in the relations between neighbors is a mean to improve individual welfare as well as the welfare of the community as a whole (Hyman, 2002). These resources could be directed towards shared purposes, when residents co-operate and collaborates to reach mutual goals. Positive and stable relations in a community simplify the struggle of working together: people are not afraid of engaging in collective action, knowing that other neighbors will do the same (Pretty & Ward, 2001), and shared positive experiences of collaboration are an indication that future collaboration will probably be positive too (Putnam, 1995). Facilitated collaboration potentially leads to more positive outcomes than non-cooperation action (Narayan & Pritchett, 1999). Moreover, the feeling of control derived from organized collective action, alongside the expectation that collective efforts will have positive effects on the residents of a community are fundamental aspects of community participation (Perkins & Long, 2002). Anti-social behaviors, such as resource degradation, are less likely in an environment where users work together towards shared goals (Pretty & Ward, 2001), as involvement enhances the feeling of responsibility and ownership. Encouraging collaboration between neighbors and involvement in local matters represents a second opportunity for social capital development.

Elements of trust, responsibility and control help members of communities to reach goals together, which would be unachievable as individuals. Moreover, diversity in urban communities, in terms of culture and heritage, is increasing, presenting new challenges related to integration and appropriation. The Urban Village movement, initiated at the beginning of the 1990's in England and analogous in philosophy to New Urbanism, argued that mixed-use, walkable and pedestrian friendly urban areas also needed to foster community commitment in order for the neighborhood to flourish (Franklin & Tait, 2002). Social urban lighting presents a number of opportunities to support co-operation in communities for social capital development. Particularly in the case of innovative, creative, multidisciplinary projects, employing new technologies or meaning to move beyond illumination as a mere physical need, there are plenty of possibilities to involve a community. Collaborative place-making, inclusion, co-creation are processes in which the residents of an area, the people working there or using the area for any other function are involved in the design process, are informed or even allowed to make decisions. Engagements like these support the democratization of urban lighting, foster ownership and positive connections with places (Sloane et al., 2016). The level of involvement of the urban users might vary. One may choose to position users at the border of the design process, informing them about projects and intentions. This may be seen as a slight improvement to a pure top-down approach, where plans are made and executed leaving the user in complete ignorance and powerlessness. The users may be asked to collaborate in the design, giving opinions, input or feedback. A "sideways" process, in between top-down and bottom-up, where users are invited in the conversation, among all other stakeholders, giving them a voice and a partner position in the process (Ellin, 2012). The users may even have decisive power on parts of projects. Approaches defined as peer-to-peer or open source urbanism, where information is shared, and so is responsibility and decision making, exemplify this

option: from community urban gardens to private alternative-energy stations, urban inhabitants are given increasingly more chances to design and manage their environment (Jiménez, 2014).
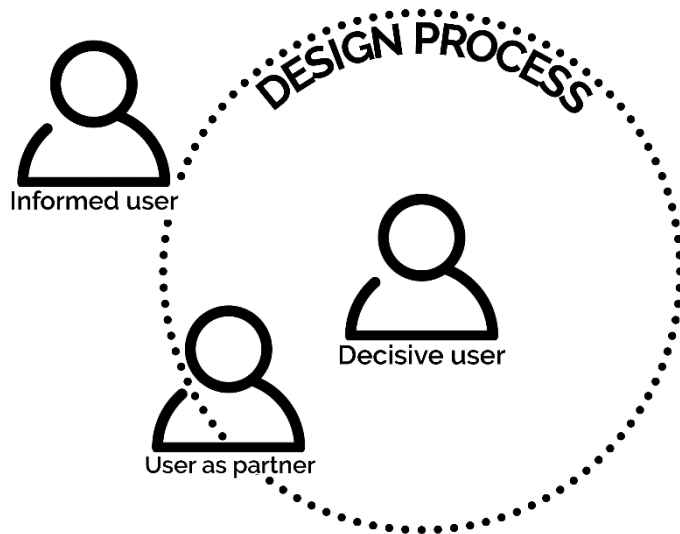
2.4.3 Identity

Figure 3: Different levels of co-operation

People who perceive to have social and emotional ties with their neighborhood tend to develop strong relations with their community and a strong feeling of mutual assistance (Dallago et al., 2009). The chance that people will recognize a chance for information exchange or collaboration is enhanced if those people identify with the same group (Nahapiet & Ghoshal, 1998). The feeling of belonging to a group can be reinforced by elements connected to pride and reputation as incentives for participation in a community (Sengupta et al., 2013). Community identity implies that a neighborhood enjoy characteristics features of the built and natural environment that create an identity of place (Kim & Kaplan, 2004). Supporting the development of a neighborhood identity is an ulterior occasion for social capital development.

People may develop a distinctive form of geographically bounded social capital when they are particularly connected with their environment (Carpiano & Hystad, 2011). Community identity, pride, a positive image of one's community are intrinsically related with individual's personal sense of identity and self-esteem. For a member of a group, it is important to feel unique and different from other groups, while at the same time being cohesive and congruent with the rest of the group (Kim & Kaplan, 2004). Social urban lighting offers several possibilities to improve the urban identity of an area and so support social capital development in that area. Factors related to aesthetics and pleasantness play an important role: illumination needs to create beautiful, interesting, amusing, engaging places for people to develop connections with them. To support community identity, eccentric, recognizable landmarks may be used to create a sense of pride, or cohesive, yet distinctive street lighting may reinforce community identity. With salient elements, distinguishing one urban area from the other, while creating a homogeneous atmosphere inside the area. Lighting technology has developed also with regards to material aesthetics,

resulting in a broad availability of fixtures and other elements which may also participate in the creation of atmospheres (Sloane et al., 2016).

Chapter 3: Empirical Study

3.1 Current Study

The urban sphere and the social sphere of people living in cities very often merge with each other, as going out in the streets often means meeting other people. In the last half century, this notion has been gaining momentum for local and central authorities, architects, urbanists, designers and other professionals while building (and rebuilding) urban areas. Alongside quality of life of the residents and users, several other factors play a role in urban development projects. One relevant factor, for instance, is politics, as the tenures of elected public administrators or officials are often shorter than the full cycle of an urban intervention (Matthews & Smith, 2015). Accumulated knowledge about areas, plans and projects might disappear over time, administration after administration. Goals and intentions might change, budgets might alter. The agenda of policy makers might evolve overtime, shifting the focus of projects. For political reasons, e.g., a party orientation towards environmentally sustainable solutions or the need to adhere to international agreements towards energy consumption. For economic reasons, e.g., recession times might call for budget cuts. Technological advancements might also influence the focus and development of projects, as new applications or knowledge might open new possibilities. Social factors also play a role, as local communities are increasingly involved in urban projects. Moreover, the skills and abilities of all parties involved, including communications between parties or even the personal attitude of a single stakeholder, influence the final result, often defining the line between a success and a misstep. Likewise, a large scale of other factors might influence how cities are built and renewed.

The current study means to portrait an overview of current practices around social urban lighting. How are projects brought to life? Who are the initiators and who pays for such projects? What theoretical backgrounds are considered and what is left out? What kinds of bottlenecks are often encountered? Based on the literature review presented in the previous chapter, and the framework developed for social lighting interventions, the projects were also tested in the extent to which they were actually aiming to impact social capital and whether they fit the proposed framework, which might become an important tool for project development and evaluation in the future.

The study consisted of the thematic analysis of a number of interviews with designers, project managers and academics involved in social urban lighting projects.

3.2 Method

3.2.1 Case Studies

The empirical part of the work consisted of the analysis of eight case studies of relevant examples of applied social urban lighting. The research design consisted of semi-structured interviews. The interviews were analyzed with a cross-case thematic analysis, exploring similarities and differences across cases to support empirical findings.

The case studies were selected to gather a wide scope of different projects. Cases were selected bases on the possibility to gather the needed information within the available period of time (convenience sample). The following factors were taken into consideration during the selection process: location within the urban environment (residential areas versus city centers), scale and duration of the intervention, involvement of the users (e.g. residents or visitors), nature of the intervention (e.g. was it driven by a need in a community or was it initiated by a company), kinds of enterprises involved in the design and realization process.

In the first chapter of this thesis, a theoretical framework is developed and explained to address how social urban lighting intervention may support social capital development. Three main pillars were identified: information flow, co-operation and identity. The selected projects were tested for how well they fit into this framework. Table 2, at the end of this section, summarizes how well the empirically analyzed projects match the theoretical framework.

Table 1 gives an overview of the case studies that were analyzed.

Table 1

Overview of the selected case studies

	Location	Duration		Progress	Kind of Intervention	Interviewee
Woenselse Heide	Residential area	3 years	Permanent installation	Concept design	Initiated by the municipality, brought forward by the companies involved	Academics
Lux Agitat Molem	City center	A couple of weeks	Temporary installation	Completed	Specific to the cultural event	Lighting designer
Light Splashes (Licht gooien)	City center	A couple of weeks	Temporary installation	Completed	Initiated by the municipality	Lighting designer
Fatih Mosque	City center	Indefinite	Permanent installation	Completed	Initiated by the mosque and the municipality	Lighting designer
Etten-Leur	Residential area	3 years	Permanent installation	Start of realization	Initiated by the municipality, brought forward by the companies involved	Lighting technician
Leeuwarden	City center	Several months	Permanent installation	Realized	Initiated by the municipality	Lighting designer
Amersfoort	City center	Several months	Permanent installation	Concept design	Initiated by the municipality	Lighting designer
Hoekenrode-plein	City center	Several months	Permanent installation	Completed	Initiated by the municipality, brought forward by the companies involved	Academic and designer

3.2.1.1 Woenselse Heide, Eindhoven

A multidisciplinary project in which innovative urban light is applied to tackle social needs in a social housing area. It is part of a larger municipal project called "*Jouw Licht Op 040*" ("Your light on 040", 040 representing the Eindhoven municipality), in which smart lighting solutions are being developed for a number of areas in the city of Eindhoven, the Netherlands, where urban lighting renewal was due. Eindhoven is located in a strategic area for both urban and lighting innovation, resulting in motivated, progressive and technology forward administrations, striving to remain ahead, nationally and internationally. From the beginning several stakeholders were involved: the municipality, experts from university to assess social needs and opportunities in the neighborhood and later evaluate the social effects of the project; lighting experts to develop a design to fulfill all needs and make use of the available opportunities; a contractor expert in urban renewal projects for management and realization. The residents and shopkeepers in the area were also involved from very early stages onwards. Alongside meetings to share information about the project and explain the goals, several sessions were held to assess needs and opportunities, and later also to discuss the plans and gather feedback and opinions from the users, in the form of co-creation sessions. I interviewed a member of the academic staff, and had the chance to participate in a couple of meetings with management and residents. The following needs were identified for the Woenselse Heide neighborhood: more contact and connectedness with the neighborhood, safety and outdoor activities, which translated in the need to create meeting places and a sense of pride in the community. At the time of the interview, the design process had not been completed yet, but some concept ideas had been discussed with the residents.

The project in Woenselse Heide fit the framework quite well. The sketch designs proposed to the residents included solutions for the need for more safe and comfortable places for people to casually meet and engage after dark. The residents and people working in the area were intensively involved: the very first step in the design process was the identification of the real needs in the neighborhood: "Needs assessment: intended to determine what the residents really need, looking beyond light and illumination". They were included in the design process, in several occasions they were asked to give feedback or input in the form of ideas for solutions, and they had decisive power on some aspects of the designs and implementation. The identity of the neighborhood was also taken into consideration in the sketch designs proposed to the residents.

3.2.1.2 Lux Agitat Molem

Designed for a street lighting festival, GLOW (NEXT) in Eindhoven, which is largely sponsored by the municipality of Eindhoven, alongside other partners, this project was ideated and realized by a designer and a PhD student, both affiliated with the Eindhoven Intelligent Lighting Institute. As the title suggests, the underlying meaning of the installation was to move (people) with light: "*Lux Agitat Molem*" ("light moves matter"). A 54-meter-long piece of sidewalk was illuminated by 56 luminaires programmed to project different patterns meant to influence people's walking pace. Three patterns were chosen, with variating motion speed and fluency (from smooth, slow movements of the lights, to fast,

harsh movements). Music was played, to which the light patterns could adjust, with the intention to give visitors the perception of "dancing" with the lights.

Figure 4: Picture of the Lux Agitat Molem installation, 2014, Source: studiophilipross.nl/lux-agitat-molem

Furthermore, the visitors were recorded. This was done to gather qualitative data to later be used to evaluate the efficacy of the installation. The footages, which were broadcasted on a screen right around the corner of the illuminated sidewalk, were also meant to give the visitors feedback about their behavior after they had walked through the installation, to sensitize them about the effects of light on their behavior. Residents of the area who spoke to the designer during the event manifested a positive attitude towards the installation, saying things like "I wish it [the installation] would remain in the area after the event". Users also expressed enjoyment after interacting with the system. I interviewed the lighting designer.

As a small, temporary project, Lux Agitat Molem only touches the identity aspect of the framework: "The main purpose was to make people move ("dance") with the light.", to sensitize people on the effects of light on behavior and therefore improve their interest and connection with the environment. We may argue that this project was not, in fact, a social lighting plan by design.

3.2.1.3 Light Splashes ("Licht gooien")

The municipality of Eindhoven reached out to a lighting design studio for a temporary urban project that would reflect the modern, progressive, innovative character of the city. Out of a list of possible projects, the municipality chose for the "light splashes": people walking around the city center after dusk were given flashlights with which they were able to "throw" light on the facades of the buildings surrounding them, resulting in "light splashes", emulating the behavior of a liquid dripping down the sides of buildings through projected animations. The project presented some technical challenges at the time. A student was involved to develop software, a graphic designer was asked to work out the visual animations, and an events company was responsible for the technical realization.

Alongside the entertaining factor of the installation, the design originated from the idea that positive experiences could result in positive connections with the urban environment, and therefore lower the chance that the same people will involve in undesirable behaviors on those locations. Users (people walking around the city center that were approached to use the flashlights) reacted positively to the installation, with comments about how they enjoyed using it. I interviewed the lighting designer.

The Light Splashes project was small and temporary. The focus was put on the positive connection that users would develop with the environment: "Linking positive experiences to places to reduce the chance that these people will misbehave in these places in the future", pushing this project towards the identity side of the framework.

3.2.1.4 Fatih Mosque, Eindhoven

The Fatih Mosque is located right outside the old city center of Eindhoven. It has a very unique and recognizable architecture, with traditional Arabic elements. Yet it did not enjoy the appreciation of all local residents once it was built. The outdoor illumination of the building was in need of replacement. The management of the mosque saw a chance to change their image in the neighborhood. The municipality decided to partially fund the renovation, under the condition that a skillful, innovative designer had to be put in charge of the design process. The municipality wanted to help the mosque integrate in the community, while the mosque wanted even more: their desire was to become a "red carpet" for the city center, to let the community know they were welcome in the mosque. Due to unsuccessful communication towards the residents, one resident of the area around the mosque filed a complaint related to the light intensity of a light source, which resulted in a modification in the final design. The final design comprehended a selection of dynamic light scenarios which would automatically interchange throughout the night. Customized RGB LEDs were used, from which the red-light source had been removed. This was done to avoid at all costs the possibility that the mosque might be lit in red light, which has a negative, inappropriate connotation (Dutch red-light districts). The mosque has the freedom to manually interchange the scenarios, or to let them change automatically. However, the mosque cannot design or modify the scenarios. In case they need a specific illumination for a specific event, or wish to modify an existing scenario, the adjustments have to be made by the designer. As a consequence, the mosque and the designer are still involved in a positive, understanding relationship. I interviewed the lighting designer.

The outdoor lighting renewal of the Fatih Mosque fits the framework. Thanks to the renovation, the mosque has seen an increase in visitors, which means more people are meeting there. One of the goals, which has also been achieved, was to help the mosque integrate more in the community around it, increasing co-operation. The identity of the neighborhood has been considered too, as both mosque visitors and residents have developed positive feelings towards the building and consider it an element to be proud of. Comments like the Imam personally thanking the designer show a display of great appreciation from the Muslim community.

3.2.1.5 Suburban Illumination, Etten-Leur

The municipality of Etten-Leur decided to take part in a European project developed to help towns cut on their energy consumption related to urban illumination. The project is called SLIC, Smart Light Concepts, and is partially financed by the European Union. Seven other European cities are involved in the project, alongside different academic centers. Each town involved local lighting experts and contractors for the specific designs, management and realization. The goal of the municipality of Etten-Leur was to find an optimal balance between good, safe and comfortable light on the one hand, and less CO_2 emissions on the other, less energy consumption and easy maintenance. The choice was made to experiment with a suburban area because of the large extension and therefore high number of lighting poles, offering a large margin for improvement. The project is extended over three years, during which a number of different lighting settings and scenarios are tested, gaining more information from every test phase, in order to deliver the ideal solution. The involvement of users, including residents, people working in the area or traffic passing through the area, represented a priority in the project. The users are informed about plans, intentions, progresses and delays during information meetings. During these meetings, the audience is asked to give direct feedback on the plans and on the current state of the lighting. Users can also give feedback through an online portal made available by the municipality. The feedback from the users is used to make decisions about what light scenarios will be tested next. Moreover, energy consumption is measured and taken into consideration alongside users' feedback, as well as information from the other projects. Sharing information about each project is a requirement of the SLIC project funding. At the end of the three-year testing period, the municipality will decide which light scenarios to keep to achieve all the social and environmental goals. I interviewed a lighting expert, who was also part of the management team. At the time of the interview, the first set of lighting scenarios was being realized.

The project in Etten-Leur fits the first two pillars of the framework, while the identity aspect is left outside of scope. One of the main goals of the project is to support "the ability (of users) to comfortably perform all desired tasks on and around the public road", which implies that users need to feel comfortable outside at night. Users are intensively involved in this project, they are often informed and asked about their ideas and opinions, making them more aware and responsible of the environment.

3.2.1.6 Lighting in the City Center, Leeuwarden

A group of business owners located in the city center of Leeuwarden asked a lighting designer to improve the outdoor lighting of some buildings. As this would probably lead to an incohesive picture in the city center, the designer, the municipality and the shop owners association decided to renew the illumination of the center as a whole. The design should focus on safety and the creation of appropriate atmospheres in the different parts of the city center. Prior to the start of the design process, the designer tested a selection of innovative options in the city center and gathered feedback from the residents, shop keepers and the municipality, which would later be included in further stadiums of the project. The opinion of the municipality was determinant. The designer then proceeded to sketch a vision for the

illumination in the city center: what will light communicate to the users? Then followed the assessment and inventory of the existing environment, critical points and strengths of the current situation: function, identity, striking elements in the environment, existing lighting, day and night picture. The following step was a light vision and strategy: what atmospheres should be created, where, and how (technical options)? The municipality then decided what options would be implemented, and the design was realized. According to the designer almost 50% of the drivers of the LED lamps were broken before they could be used due to inability of the people responsible for the installation. As a consequence, the project is not yet completed. Some of the designed functionality cannot be utilized because of the ruined drivers. I interviewed the designer. At the time of the interview the realization had just been completed.

This project focused mainly on the atmosphere of the area: it should suit all activities in the city center, and also the character of the city center. Unity and cohesion are important factors: "[the designer] refused to make plans for individual elements without an overall picture of the area". Therefore, it fits the framework with regards to information flow and identity. User involvement was applied in its most simple form, as the users were informed about the plans.

3.2.1.7 Lighting in the City Center, Amersfoort

The municipality wanted to renew the urban illumination of the city center. They sent out a tender looking for innovative, well rounded designers. A critical requirement in the tender was the need for the illumination to blend with the existing environment, while complementing its nature and identity. The design should go "beyond lighting norms" and pay attention to the user experience. Distinctive but cohesive atmospheres should help preserve the character of the city. The winning designer is the same as the one working in Leeuwarden and applied an analogous modus operandi. Providing stakeholders with information was considered a pertinent step in all stages of the process. Attention was put in providing the stakeholders with information. Prior to the project start, an actor analysis was executed to establish who needed to be involved, how, and in which stadium of the process. Residents were involved in the evaluation of the test settings. I interviewed the designer. At the time of the interview the total vision for the design had been completed.

The project in Amersfoort highly resembles the one in Leeuwarden, and so does its fit into the framework. Information flow and identity are addressed by the attention to the created atmosphere, which should "be integrated in the environment". User experience, and character, while co-operation does not gain a prevalent position in the process, as user are only informed, which represents the most basic form of involvement.

3.2.1.8 Hoekenrodeplein, Amsterdam

The project originated from a collaboration between three Dutch municipalities: Amsterdam, Eindhoven and Rotterdam. The three cities were working together towards smart city goals and decided that each city had to offer one pilot area to be used as a living lab to test new smart solutions. Hoekenrodeplein is a large square in a unique area, close to a large concert hall, a train station, a soccer stadium and a highway, with lots of office buildings, cafes and other recreation options. The original

goal of the project was to realize smart, adaptive lighting that would react to the different activities on the square. A lighting designer was asked to design the different scenarios, which would autonomously interchange depending on the activities on the square. For example, a "commuter" scenario was designed, which would be applied in the morning and afternoon peak hour when residents were walking between their homes and the train station. Another scenario would be applied before and after events in the concert hall to guide the public; the terraces of cafes would be appropriately illuminated to foster a cozy feeling; the "soft hills" present on the square were to be highlighted in order to become small stages for street artists that would request it. Academic staff was involved for scientific support. Moreover, a lighting expert, an IT expert and an energy supplier were involved in the project; all these partners are large, well established companies. Due to disagreements between the partners about funding, the project did not achieve the original goals. Only two cameras were installed, which were insufficient for the continuous monitoring of the whole square, making most of the adaptive light scenarios unusable and the lighting on the square far from smart. I interviewed the designer and one member of the academic staff.

The large-scale project for the smart illumination of Hoekenrodeplein in Amsterdam supports information flow as the lighting is designed to support the cohabitation of different kinds of users at the same time, increasing meeting opportunities: "The square should have a dynamic atmosphere that offers a suitable ambiance to the various user groups". However, co-operation and identity are not encountered as relevant aspects in the project.

Table 2
Case studies in the social urban lighting framework

	Information flow	**Co-operation**	**Identity**
Woenselse Heide	People enjoy being outside	Users involved in several design phases	Pride and identity
Lux Agitat Molem			Positive connection with location
Light Splashes (Licht gooien)			Positive connection with location
Fatih Mosque	More visitors = more connections	Integration in the neighborhood	Users proud
Etten-Leur	People enjoy being outside	Users involved in several design phases	
Leeuwarden	People enjoy being outside	Users Informed	Character and identity city centre
Amersfoort	People enjoy being outside	Users Informed	Character and identity city centre
Hoekenrodeplein	Mixed-use		

3.2.2 Data

Data regarding the aims and goals of the projects were gathered, alongside data about the processes leading to the development and employment of the final design solution. Challenges and barriers encountered during the process were also investigated. Finally, data was gathered on how the effectiveness of the intervention was assessed, and on whether, and why, the project was deemed a success. The data collection was done through semi structured interviews with different stakeholders (designers, academic staff members and project managers).

The following questions were used in the semi structured interviews.

- Where did the project originate? Who initiated it? Why?
- Where is funding coming from?
- Which stakeholders have been given a chance to participate in the project? What role did they play?
- What was the initial goal of the project?
- What drove decision making during the process?
- Is the project evaluated afterwards? If so, how?
- Would you deem the project a success?

The interviews were transcribed and sent to the interviewees to check for possible errors, and for further clarifications in case of uncertainties. All interviews were done in Dutch, the transcription was also in Dutch and was later translated to English.

Furthermore, the eight cases were evaluated according to the framework developed in the first chapter of this thesis. All the cases were rated based on the three identified theoretical pillars on which social urban lighting is structured: sharing of information, collaboration and identity.

3.2.3 Analysis

The transcribed interviews constituted the data to which a qualitative content analysis was applied. The analysis started by transcribing and translating the interviews, and then reading and rereading the data set to familiarize with the content. The data was later coded for semantic content and the codes organized in 14 overarching categories.

1. Initiating party: who started the project?
2. Financing party: where is funding coming from? Who is the paying client? Who makes decisions?
3. Urban area: what kind of urban area is involved?
4. Main goals: what are the main goals of the project? What are the essential elements that need to be included in the results?
5. Secondary goals / requirements: are there any secondary requirements or goals the project needs to address? What are those?

6. Involved parties / stakeholders (except for users): who is involved in the project? What role do these actors play in the design and realization process? Particular attention is put on the role of municipalities.

7. Users involvement: are users involved in the design process? What kind of users? How are they involved?

8. Existing environment: is the environment taken into consideration? How?

9. Technical solutions: what technical solutions are suggested, applied or developed?

10. Kinds of tests / measurements: what kind of data is gathered? How? For what purpose?

11. Project progress: how did the project progress? In what steps? How far is the project now?

12. Project duration (is the project completed?): how long did it take to complete the project? Or how long is the project expected to take, in case it has not been completed yet?

13. Project evaluation: has the project been evaluated? How? Was it a success (did it achieve its original goals?)

14. Limitations: what went wrong?

This was done by chunking the data in individual text snippets, so that each snippet would cover only a couple of matters. The snippets were then summarized by codes, describing the content of the snippet. Subsequently, themes were developed based on the codes. Based on valence (meaning) and frequency, the codes were sorted and mapped in order to identify overarching themes. After, the themes and their connections were reviewed. These last two steps were repeated until a sufficient understanding of the dataset was reached. Once the final themes were identified, they could be named in order to be universally understandable by the people involved in these kinds of projects. The following themes were identified:

1. Social aspects are recognized as relevant goals for urban lighting projects, and safety remains a main concern

2. Attention to either user involvement or the existing environment, but not both

3. Academic involvement supports innovative solutions

4. The importance of the Human Factor

5. Evaluation of the (social) effects of the installation often not planned

3.3 Results and Conclusions

The analyzed projects showcase a variety of features, some of which contributed to a positive progress, while some others formed barriers for success. In the current section, we discuss the themes developed in the thematic analysis and other salient factors encountered in the analysis.

3.3.1 Social aspects are recognized as relevant goals for urban lighting projects, and safety remains a main concern

The different projects presented a total of eight different goals, either main or secondary. In all of the projects, social aspects were included in the main objectives. Terms like livability, Quality of Life, user experience, hospitality, integration, appropriate atmospheres were used in the interviews to refer to the social features of the projects. A meaningful development for the field of social lighting, which, as the name suggests, relies on the social awareness of policy makers: important social goals may be achieved with the support of the right urban lighting. The social aspects encountered in the projects objectives are varied. Among the permanent cases, the projects in Woenselse Heide and Etten-Leur concentrated on comfort, livability, QoL and user involvement, while Leeuwarden and Amersfoort focused on atmosphere, user experience and urban identity, and the project at the Fatih Mosque and Hoekenrodeplein centered around hospitality, which may be considered a more specific desired atmosphere. With regard to the framework developed in the previous chapter, the goals described in the interviews, including the two temporary projects, can find their place. Terms such as comfort or livability can be redirected towards the concept of social capital, as a multifaceted need and desire to create better living, working, traveling environments. Similarly, creating pleasant and appropriate atmospheres, dealing with the different functions and characteristics of environments, indicates an ambition to improve urban spaces to support different kinds of human activities. User involvement and user experience are constituting elements of the second pillar, co-operation. Likewise urban identity fits perfectly in the third pillar, identity. Hospitality, as added social value to an area, finds its allocation in the first pillar, information flow: meeting opportunities are multiplied when people feel welcome to visit and remain in an area.

Four projects considered safety and safety perception to be one of the main goals, for one project is was a secondary goal. Nevertheless, this is not an indication that safety was not a priority in the other projects. Two of the three projects that did not mention safety as a goal were the two temporary, small sized projects. Due to the limited duration of the interventions and the entertaining character the need to create a sustainably safe environment was secondary. Lux Agitat Molem was part of a larger event, for which safety precautions had already been taken and did not need to be addressed by the design. Similarly, for Light Splashes the municipality had authorized the project in all its parts, guaranteeing its safety. The third project not mentioning safety as a goal directly is the Fatih mosque in Eindhoven. This project is realized on ground in possession of the mosque, meaning that safety concerns were probably handled by the mosque rather than by the designer. It might therefore be concluded that the safety and security of the users was an important matter in all the projects.

3.3.2 Attention to either user involvement or the existing environment, but not both

User involvement varied largely between projects. Local residents were involved in six projects, four of which also included shop keepers in the area or the people working there. Traffic passing through

an area was considered in one project, Etten-Leur. Three projects dealt with visitors of the area, the two temporary projects and Hoekenrodeplein. The levels of involvement of users differ largely between cases. In one case, Lux Agitat Molem, the only contact with residents was positive feedback towards the designer when they met him on the streets: "People on the street approached me to tell me they lived in the neighborhood and they liked the installation". In four cases, users were informed about the plans prior to the start of the project, in three of those projects information kept being shared with the public in different later sessions. Users were formally asked to give feedback on the project in three cases, two of which, Etten-Leur and Woenselse Heide, also integrated the feedback in the design.

The projects handled the existing elements of the area of the installation in different ways. In four cases, attention was put towards a smooth and balanced integration of the new elements into the present environment. In four other cases, the function of the area was mainly taken into consideration: the new lighting should support and guide the use of the area. In two cases, both large projects, very little was said about the existing environment during the interview, while further research online confirmed that both projects included attention for the environment.

The two projects that invested the most energy in the involvement of users, which are Woenselse Heide and Etten-Leur also illustrated the least interest in the local environment. In the conversation with the interviewee, possibly due to the questions asked or the flow of the conversation, aspects regarding the relevance of the inclusion of the existing environment in the design were less discussed than in the other interviews. Similarly, the two projects that dedicated the most attention to the integration of the design in the existing environment, which are Amersfoort and Leeuwarden, showed very little user involvement during the interview. Of course, it would be incorrect to imply that these projects "forgot" or "ignored" attention to either the environment or the people living in it. In the case of Woenselse Heide, the environment was taken into consideration by the designer, who wanted to exploit existing elements to create landmarks. In Etten-Leur, where the social urban lighting will be implemented in a suburban area, the physical area was considered to support traffic safety. In Amersfoort and Leeuwarden, the active involvement of users was little supported by the municipality but was still present as the designer informally interrogated residents and shop keepers about their opinions and wishes. During the interviews, the lack of importance of the one element was directly connected to a bigger focus on the other element. For Woenselse Heide and Etten-Leur, users involvement was such a priority that the environment assessment slipped out of the conversation, the same may be said of the Amersfoort and Leeuwarden projects. This is an indication that the four projects were developed with clear directions towards either the one or the other goal. None of the other projects indicated equal attention to the users and the environment. This duality represents a crucial factor for social urban lighting.

3.3.3 Academic involvement supports innovative solutions

Academic staff from different universities and other academic institutions were involved in five projects. Four of those were also the projects in which innovation was a guideline for the design, thriving

towards new, smart solutions. Two small and two large projects, which illustrates that academic involvement encourages a search for new solutions in different kinds of settings. Projects addressing urban lighting issues with innovative solutions often looked for scientific support. The inclusion of universities and other academic institutions could boost the development of ingenious new solutions thanks to the availability of research facilities and open-minded, curious and motivated students. For example, in Woenselse Heide, students were involved "for fresh and innovative ideas", indicating an understanding of the possibilities offered by academic participation.

3.3.4 The importance of the human factor

Lots can be learned from errors. In five cases the projects were hindered by human factors. In one case, Leeuwarden, the project was obstructed by human error, as the lamps were damaged during the installation, causing some of the functionalities to become unusable. The capabilities and professionality of the involved parties have great influence on the results and should therefore be secured. In two cases, Hoekenrodeplein and Woenselse Heide, management issues caused the project to slow down or even fail, as the different parties struggled to agree on important matters. A whole body of research exists on managerial matters which exceeds the scope of the current thesis. In two cases, the Fatih mosque and in Leeuwarden, complaints by individual users resulted in changes of the design. Perhaps due to a lack of clear communication towards the public, individuals fearing that the final design would interfere with their interests complained and forced the design to be changed. Complaints have a two-sided negative impact on such projects: the original design, as good and complete as it might be, risks to be compromised, and, possibly even more relevant, the users lose trust in the project. Nevertheless, for complex, multidisciplinary projects that include a variety of stakeholders changes in the design are not necessarily negative for the final product. Due to the enormous number of factors to be taken into consideration while designing for the urban environment, many of which unpredictable before implementation, "first time right" designs are very hard to achieve, if not impossible. Including design variations in the planning may be an important part of such projects. Examples are the projects like Etten-Leur, in which a number of scenarios are tested on the field for several months before choosing a final design, or Amersfoort of Leeuwarden, where the design phase was preceded by a test phase in which some of the options for the final design were implemented on individual streets to help client and users make a more informed decision. It is of great importance to communicate as completely and transparently as possible. The municipality of Amersfoort is a good example: they brought in a communication expert to guarantee good communication between all parties.

3.3.5 Evaluation of the (social) effects of the installation often not planned

Explicit, planned evaluation of the social effects of the installation was found in three cases, and one of the projects, Hoekenrodeplein, included a living lab which could monitor behavior in the area (which was not developed in the end). In two cases the evaluation was not planned but was a possibility for later developments of the projects. Such as in the Amersfoort project: during the interview, the

designer suggested a study of the different urban environments, for instance individual streets, over a period of at least one year, in order to assess the situation in all four seasons. In four cases, the interviewee mentioned some form of positive feedback, from a resident's opinion (e.g. Lux Agitat Molem and Light Splashes) to a clearly visible increase in visitors (Fatih Mosque).

Evaluation is often given little importance. The available budget is distributed in order to develop and implement the best system possible, depending on the requirements and goals, so limited resources are left to test whether the project has the expected social results. As a consequence, little can be said about the real effects, rather than the expected effects, in most cases. Unique and relevant insights, which would probably be of great value for future projects, are left out of the conversation around social urban lighting interventions.

Moreover, social capital evaluation is complicated. Guidelines and techniques have been developed (e.g. Lin et al., 2001; Van Der Gaag & Snijders, 2005) to support and guide the work of researchers, but to assess the impact of one specific urban intervention over a meaningful time window (e.g. one year, as suggested by a designer) is a highly complex matter. Numerous other factors play a role on the enormous stage that is the urban space, making it very hard to isolate individual elements and their consequences for the social experience of residents and dwellers.

3.3.6 Other Factors

The local municipality was involved in all of the projects and was also a client and the (co-) financing party. All the projects also included lighting experts and an implementing party (e.g. a contractor). In two cases, commercial parties, including the lighting experts, involved in the project also participated economically. In one case, the funding was shared between the municipality and one other main client. In one other case, a semi-private organization was the client, which was mainly sponsored by the municipality.

Out of the eight projects, three had been completed before the interview took place, one was in the implementation phase, two were in the design phase, and two had been delayed because of flaws in the implementation.

Chapter 4: General Discussion

4.1 Conclusion

The inspiration for this master thesis was an interest in the current developments around urban lighting and the city of the future, designed for the people. People living, working ant traveling in urban areas have different needs and desires than those living elsewhere (Jacobs, 1961), and should be supported by proper urban lighting: social urban lighting, a complex illumination system equipped with different kinds of sensors and other elements that is designed to positively influence the social aspects of people living and dwelling in the city. Social capital is indicated as the criterion for valuable urban development: social urban projects, including social urban lighting projects, should focus on the support of local social capital development. The first chapter presented a review illustrating the different definitions and applications of social capital. A framework for social urban lighting is developed based on such social capital perspective. Three theoretical pillars are identified on which social urban capital should be based to support social capital development: information flow, co-operation and identity. The second chapter described the empirical study in which eight case studies of social urban lighting were analyzed and balanced in the framework. All the case studies fitted, to various degrees, in the framework, confirming its reliability and applicability for future projects.

Out of eight analyzed projects, in five cases elements of the first pillar, information flow, could be recognized. The majority sustained the necessity to develope spaces people enjoy visiting, increasing the chances of casual social encounters, which are crucial for information exchange (Flap & Völker, 2005; Kim & Kaplan, 2004; Völker & Flap, 2007). In the Hoekenrodeplein project, attention was put in the smooth integration of different functions of the space, with different kinds of users cohabitating harmoniously: illumination was designed to support a mixed use of the environment, a boost for urban liveliness, as theorized in the New Urbanism approach (Furuseth, 1997; Jacobs, 1961). The theoretical strength of the first pillar is supported by empirical findings, as the majority of the analyzed projects included elements associated with the importance of supporting and simplifying information flow.

In the case of co-operation, the second pillar, five of the eight projects showcased features associable with it. The projects in Leeuwarden and Amersfoort only applied a very basic form: users were informed about the plans. The project in Etten-Leur and the one in Woenselse Heide concentrated on user involvement, a constituting element of urban lighting democratization, fostering ownership and positive connections with places (Ellin, 2012; Sloane et al., 2016). In Woenselse Heide, co-creation was employed as a mean to engage residents and other users in the design process, locating them in a "partner" position within the process. In the project at the Fatih mosque, a main goal was to help the mosque integrate in the community around it, increasing community participation, enhancing the chances of collaborative actions in the community (Perkins & Long, 2002; Pretty & Ward, 2001). Even though most of the projects showcased some forms of user involvement, only two of them actively included the users in the process. The theoretical potential of social urban lighting projects to boost co-

operation in the urban environment is large and multifaceted, and offers opportunities that are worth exploring. For instance, the sample of projects analyzed does not contain any examples of peer-to-peer or open-source designs. As a consequence, many questions about these techniques remain unanswered in this study, while other academics speak very positively about the possible implications of a higher level engagement of the urban population in the development of cities (e.g. Casciani, 2014; Jacobs, 1961; Jiménez, 2014; Sloane et al., 2016).

The third pillar, identity, is represented in five of the analyzed case studies. The projects in Leeuwarden, Amersfoort, Woenselse Heide and at the Fatih mosque worked on the creation of urban identity and pride, which support the development of community identity (Kim & Kaplan, 2004; Sengupta et al., 2013). The two temporary projects, Lux Agitat Molem and Light Splashes, concentrated on creating positive emotional connections with places, creating geographically bound social capital (Carpiano & Hystad, 2011). Again, empirical findings support the theoretical existence of identity as a pillar for social urban lighting, validating its relevance.

Through cross-case analysis, four general themes were developed. Social aspects of urban lighting appear increasingly often between the goals and objectives of urban projects, paying attention not to overshadow the need for safety. Of course, the projects selected for this study were chosen based on their social character, meaning that the sample is not representative of the real "population" of urban lighting projects, and it does not pretend to do so. The valence and variety of social aspects discussed in the interviews is interesting evidence of a slowly changing sensibility in policy making. A divide is still present between projects focusing on users and projects focusing on the environment. This duality represents a crucial factor for social urban lighting. Future projects should put more effort in the integration of both the environment and the users, key elements for the development of livable urban areas. It is important to narrow this gap to design and realize effective social urban lighting. Academic involvement in a project is connected to innovative and progressive goals, as knowledge remains one of the forces behind advancement, both technological and social. The human component of urban projects, as it is people that design and realize projects after all, remain a crucial factor. Communication is crucial, as are complaints. Complaints may be a reason for users to lose trust in the design, while also conveying new needs or chances to the designer, who need to remain flexible and keep an open mind. Formal evaluation of the social effects of these projects is needed, but underrepresented in the analyzed cases. Future projects should focus on measuring possible effects of lighting installations on social capital or its derivates, possibly with academic support. Such results could help the field of social urban lighting reach a new level of reliability.

4.2 Limitations and Future Research

This study presents several limitations. The systematic approach of the literature review might have resulted in inconsistencies and incompleteness, as only the most relevant studies are included. The relevance of studies was subjectively determined, possibly excluding literature that other researchers

might have considered relevant. Although the sample was quite extensive, covering multiple disciplines and articles published over a long period, it was not feasible to encompass all social capital publications. Future studies might use the current review and framework as a starting point for an extension of the review, further research in a specific field or the in-depth analysis of the individual pillars.

The empirical part also comes with its limitation. Due to the unique character of social lighting, a small sample of case studies was available. Furthermore, this might be defined as a "opportunity sample": projects were included based on the possibility to interview someone involved in it, rather than on the intrinsic relevance of the project. E.g. a large and quite revolutionary project in Toronto, Canada, was initially included. Due to difficulties in gathering a complete set of information on the project, it was later removed from the sample. This might result in an incomplete image of the reality of social urban lighting projects. Furthermore, as the data was gathered through semi-structured interviews, the flow of the conversation was sometimes pushed in one direction rather than another, possibly resulting in polarized data. Further research should concentrate on including more cases, and possibly multiplying the interviews for each project, to be able to form a less biased picture. Multiple points of view on one individual project may safeguard from the simplification of complex issues. E.g. in the case of Leeuwarden, the disappointment of the designer with the craftmanship of the people installing the LED lamps was the only available opinion on the matter, whilst the error may not have been caused by a sequence of factors.

Despite these limitations, the studies presented in the current thesis represent an opening in the wide and complex realm of social urban lighting. The developed framework may be further perfected to apply to diverse urban, social and cultural environments: a resilient groundwork to support the development of urban areas as resources for their inhabitants to flourish.

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