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D4.20 Co-design and implementation of public lighting concept

WP4, Task 4.8

Transition of EU cities towards a new concept of Smart Life and Economy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

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Lead beneficiary	FVH		
Contributing beneficiary(ies)	HEL,HEN,VTT		
Task description	**Task 4.8: Public Lighting improvements** – SMART LIGHTING [HEL] (FVH, HEN, VTT) Definition of a smart lighting solution through the Smart Kalasatama living lab based on adaptive LED-based outdoor lighting system and including features like navigation and communication. Report on the connection of the lamp post infrastructure to the urban platform.		

Date	Version	Author	Comment
22/10/2018	0.1	Timo Ruohomäki (FVH)	First draft
29/10/2018	0.2	Timo Ruohomäki (FVH)	Minor corrections
17/10/2019	1.1	Timo Ruohomäki (FVH)	First draft of updates for the final M36 version
27/11/2019	1.2	Roope Husgafvel (HEL), Maria Viitanen (HEL)	Minor corrections

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Table of Content

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Table of Figures

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Table of Tables

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Abbreviations and Acronyms

Acronym	Description
CRI	Color Rendering Index, a quantitative measure of the light source to reveal the colors of objects faithfully in comparison with an ideal or natural light source
LED	Light Emitting Diode, a power-saving lamp technology
mySMARTLife	Transition of EU cities towards a new concept of Smart Life and Economy
Open311	Open311 is a city-driven initiative to define an API for feedback on city services. Originally developed to support the 311 phone service in Washington, the service was adopted by the CitySDK project and was further developed in Finland as part of the ERDF 6Aika open city APIs.

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1. Executive Summary

This deliverable provides an overview of actions related to the public lighting improvements as described in Task 4.8 and Action 15. The deliverable includes a short report on the previous work and studies related to the smart public lighting concept in the Kalasatama District, including the Helsinki LED project in 2014 and the participatory design project with residents in the Kalasatama in 2016. These were used as a basis for the technical mySMARTLife actions.

The deliverable contains a description of the connection of lighting control system to the urban platform and is therefore related to other urban platform actions. The deliverable also includes the deployment of smart lamp posts and lighting control systems in the Korkeasaari Zoo. The smart street lighting system upgrade in the Korkeasaari has been delayed due to design issues in the power distribution system of the whole island. The connectivity activities have been planned and tested despite of the delay because the control system is cloud-based and already in use in other parts of the city. In addition, there has been progress in the data integration and supportive benefits have been gained through an access to the data from the existing C2 smart light system of the city. Integration tests have been implemented with the C2 system.

Overall, this deliverable provides an overview definition of a smart lighting solution that is based on the Smart Kalasatama living lab and on adaptive LED-based outdoor lighting system. The concept includes features like navigation and communication. In addition, the connection of the lamp post infrastructure to the urban platform is addressed.

2. Introduction

2.1 Purpose and target group

This deliverable provides an overview of the actions and also high-level technical descriptions of the innovative lighting solutions. The deliverable takes the perspective of the planning of city light system so it is of interest to planners involved in this work.

2.2 Contributions of partners

The following table depicts the main contributions from participant partners in the development of this deliverable.

Table 1: Contribution of partners

Participant short name	Contributions
FVH	Main contributor to text and technical work
HEL	Technical work, comments and updates
VTT	Comments and updates
HEN	Comments and updates
FOU	Peer reviewer
CARTIF	Final review

2.3 Relation to other activities in the project

The following table depicts the main relationship of this deliverable to other activities (or deliverables) developed within the mySMARTLife project and that should be considered along with this document for further understanding of its contents.

Table 2: Relation to other activities in the project

Deliverable Number	Contributions
D2/3/4.1	This deliverable is related to the use cases defined in Open Specifications Framework
D4.11	Links to lighthouse-specific data processing methods to generate indicators

3. Background

3.1 Helsinki LED

In 2013, the City Board of Helsinki established Helsinki LED project at their budget session. The project proposal was to renew all the 83.400 discharge lamp luminaires of public lighting system with LED lighting solutions by the end of 2016 (Valve 2015). At the same time, a service and maintenance agreement were made with ISS corporation that covered the whole network. The duration of the agreement is 15 years, lasting until 2028. ISS provides the city 24/7 support and maintenance covering all the lamp posts and 1.750 control cabinets. As a result of the actions, the city aims to reduce running costs, saving energy and enhancing the amenity of urban space.

As part of the service contract, 10.000 lamp posts were to be equipped with smart lighting controls. The company that won the tender process was C2 Smartlight, a Finnish company specializing in intelligent outdoor lighting. A key selection criterion was cost savings throughout the whole life cycle. The lighting control system was also integrated with the ISS energy management system, providing new tools to optimize energy consumption at the system level.

In the 2014 inventory of public lighting system, the following lamp types were identified:

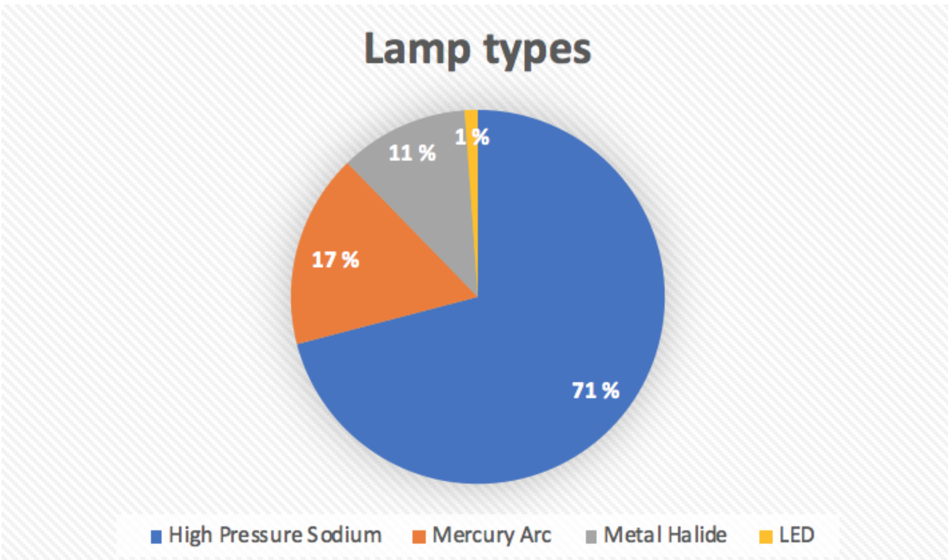

Figure 1: Lamp Types in Helsinki (2014)

The total energy consumption of public lighting system was estimated to be 49,1 GWh and the total energy cost being 5.400.000 Euros. At the time, this represented of about 3% of the total city energy consumption and 5% of the carbon emissions.

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The expected technical lifetime of a lamp post is 30 years. In the 2015 inventory, about 18% of the lamp posts were older than 30 years.

3.2 Lifetime Cost Calculations

As part of the Helsinki LED -project, a Master's Thesis was made by Mr. Tommi Valve in 2015 on the feasibility of such large-scale replacement project. As part of the work, lifetime costs were calculated for all the types of lamps based on the inventory and the historical information available on the lamps. The lifetime of LED luminaires was expected to be the same 30 years. The unit cost indicator was defined as Euros per kilometer to compensate possible differences in light output that would require a higher density of lamp posts. The intelligent control options like dimming capability of LED was taken in account. The following table provides the results of the calculations on different types of streets in the case of retrofit scenario:

Table 3: Lifetime Costs by Lamp Type (retrofit), €/km

	Metal Halide	High Pressure Sodium	LED
Main Street	95.010,00	90.359,00	102.750,00
Collector Street	55.093,00	52.435,00	50.611,00
Access Road	49.991,00	46.891,00	41.253,00
Parks and Openings	38.177,00	35.076,00	28.163,00

The following table provides the same information in the case of a new installation scenario:

Table 4: Lifetime Costs by Lamp Type (new installation), €/km

	Metal Halide	High Pressure Sodium	LED
Main Street	226.562,00	210.891,00	244.700,00
Collector	186.809,00	177.604,00	177.338,00
Access Road	165.328,00	162.729,00	160.136,00
Parks and Openings	133.496,00	130.749,00	122.894,00

The results indicate that the selection of LED is the most economical in both retrofit and new installation scenarios with the exception of main streets. This was because of the significantly higher cost of the lamp in cases where the required light output was high and the quality of light (CRI) or color temperature were not significant criteria. Naturally the cost-effectiveness of the retrofit scenario will also depend on the age of the lamps to be replaced: if their age is less than 30 years, the cost of the previous investment would not have been fully covered prior to the replacement.

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The proposed Helsinki LED project would have included the replacement of 67.300 lamp posts and new installations of 13.600 lamp posts during 2015-2016. The total investment costs were 101,4 million Euros with the annual savings of 3,2 million Euros. The annual energy savings were 27,7 GWh and carbon emission savings about 6.012 metric tons.

Based on the calculations referred to above, the Helsinki LED project as a large-scale replacement action was not proven economically viable. Since the cumulative savings would not have covered the total investment, it wasn't possible to calculate return on investment (ROI).

However, the results also show that in other types of locations than the main streets the LED option would have been economically viable. It is also expected that the cost of LED lamps is getting lower, thus making them more viable in the future. The comparison of costs on other types of locations however prove that LED can even be the default option on public lighting, saving energy and costs.

4. The Humble Lamppost

4.1 Background

The *Humble Lamppost* is an initiative of the European Innovation Partnership for Smart Cities & Communities (EIP-SCC) and Sharing Cities lighthouse programme (2016 – 2022). The goal was set by EIP-SCC in 2014 to upgrade 10 million lampposts across the EU cities to be smart lampposts by developing a common component-based solution that could be tailored to local needs. The aim was to boost the adoption with smart add-ons, creating scale through demand aggregation and by building investor interest and confidence.

The Humble Lamppost initiative is supported with three identified motivations. Firstly, upgrading the outdated street lighting infrastructure with LED lamps shall provide over 50% energy savings when compared to energy inefficient luminaires. The public lighting infrastructure is also typically old and there is significant technical debt: on European level, it was estimated that 80% of the street lighting infrastructure elements were over 25 years old when typical expected lifetime is 30 years. Secondly, upgrading the lampposts was seen as a "quick win" on smart city projects being visible to the residents and providing visible comfort. Thirdly, the street lighting network would provide a platform to new city services. The lamp posts are able to provide both the mounting location and electricity to various smart city services, such as wireless substations, displays, sensors, cameras and so on. The following illustrations explains the options available:

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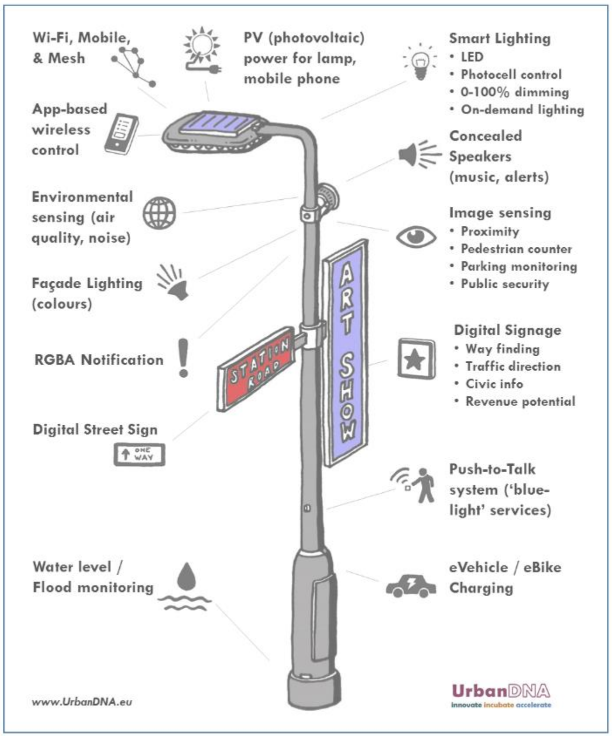

Figure 2: Humble Lamppost

The Humble Lamppost concept is not seen as a specific design or product, but rather as a concept or vision of the role of the public lighting system in a smart city service. The motivation is clear: the street lighting network covers the whole city, includes the supply of electricity and provides a mounting point for equipment on the level of 3-4 meters and higher. The actual rollout plans will naturally be up to the cities: additional needs arising from digital services such as the 5G network or WiFi4EU may act as a catalyst to also improve the capabilities of the lampposts even though the lamp replacement with LED would not alone be feasible.

4.2 Helsinki 5G

Lately, the plans to rollout 5G telecommunication networks have been strongly linked with the lamppost infrastructure. The lampposts are well placed for the needs of communication networks since they are in open space, cover the whole public space and are tall enough for the needs of radio networks. The availability of electricity is another benefit; however, the network design may not be adequate to a larger array of higher-power substations.

In 2018, the city organized a design competition for a 5G substation that would fit to the urban space. The city organized the competition together with the network operator Elisa, the network provider Nokia and the designer association Ornamo. Five designs were picked for the citizens to choose from in the city open participation website https://kerrokantasi.hel.fi/5g. The evaluation criteria were: suitability to a variety

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of urban environments, innovativeness of the entry and general functionality, life cycle properties and the implementability of the design. The competition received 631 comments from the citizens and the top three were awarded with prizes total of 35.000€. The five top designs are illustrated below, the winning design being number 1, "Stadika".

Figure 3: Helsinki 5G Substation Designs

5. Smart Public Lighting Concept

5.1 Key Concepts

During the recent years, the technical developments in distributed lighting control systems and connectivity have led to more advanced and adaptive public lighting systems. In adaptive lighting, the lighting reacts dynamically to the real-time sensor data, monitoring the current environmental conditions or the presence of people.

According to Venla Kaikkonen (2016), adaptive lighting consists of different subcategories, which are overlapping and inside each other, like layers in an onion. Lighting is dynamic when it changes, but only adaptation of some data will make it adaptive. Intelligent lighting concepts can contain features from both the dynamic and adaptive lighting, but the data is adopted in real-time. Interactive lighting on the other hand would require some form of interaction with the user. Interactive component together with the intelligent lighting would create participatory lighting that would require some form of input from the participant to be either creative or meaningful. An example of participatory lighting would be a light art installation (Pihlajaniemi et al. 2016).

Adaptive lighting in urban spaces can create many possibilities to create environmental experiences in many levels for the user (Kaikkonen 2016). Lighting could adapt to the natural lighting conditions, to

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weather and to events, thus attracting people to participate and supporting social interaction. Lighting could even adapt to the individual needs of an inhabitant in a space to support the seeing of the environment and interaction.

Sense of security could be improved and adaptive lighting could even be used for communicate between citizens and from the government to the street users. Lighting can communicate with the user through changing the light intensity, color, its distribution or the pace of dynamic changes. The interaction with light can be implicit, meaning that the users do not need to exert any conscious effort primarily meant to change lighting, but for example walk in a park where sensors detect their presence. In contrast, explicit interaction is some act meant to give a signal or starting point for a dynamic change (Pihlajaniemi et al. 2016). In addition to effort and goal, dynamic changes in lighting require lighting technology that makes them possible. During the last ten years, the development of LEDs has given a whole new meaning for designing intelligent lighting. LEDs are dimmable, can provide colored light and lit up rapidly. Together with intelligent, bus connected drivers, they make dynamic changes possible.

The real-time data behind the intelligently changing lighting can originate from a city’s open public data resources, providing data from current energy consumption for example, actual weather data collected from sensors on site, weather report, motion sensors by adapting to the position of a user, weight sensors as used by the traffic lights, sound detecting sensors or sensors monitoring the brightness of the environment (Pihlajaniemi et al. 2016). The adaptation of lights can be local or even individual to a user, depending on the site, system and the wanted adaptation.

In the intelligent lighting concepts, the lamp posts will be equipped with intelligent drivers that have a control data input as an addition to a power inlet. The data connection can be either wired or wireless. The lamp driver can also have additional sensor inputs for proximity indicator units or generic sensors, that can measure e.g. temperature.

5.2 Kalasatama 2030

As a part of the planning efforts in the Kalasatama Smart District, Venla Kaikkonen created her diploma thesis about a participatory approach of the lighting design in the district. The methods used in the process were the co-design method, the scenario-writing method, conceptual design and implementation. The working process had the following steps:

Phase 1: Pre-design research and analysis
Phase 2: Participatory Design Workshop
Phase 3: Scenario Working
Phase 4: Conceptual Plan Creation

The start of the process was a study and analysis of the site. At the time, most of the Kalasatama district was still under construction or open area. For the analysis, the city structures and urban places were

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identified and their specific needs for the lighting collected into a table. For each place, the designer imagined what people would do in there, at which time, what the atmosphere could be and what kind of basic functional needs there would be for the lighting. The table was referred to in the later phases of the process.

The participatory part of the design process consisted of design workshops supported with material based on the scenario-working method. The scenarios in lighting concept design are similar to user stories in modern software design. They are stories about a specific scene and descriptions in detail on how the user would act in the space and how the light would react to it. It is useful to notice that when such work is related to physical structures and space with a specific purpose, the stories could also be used in other districts and areas where similar structures and spaces exist.

The form of a scenario is free. Kaikkonen noticed, that it was useful to describe a setting or a situation, where one or multiple actors go through some process. According to her, the scenario-working process is basically “sketching with words” which makes it a quick way to visualize possible options and at the same time consider the emotions and reactions of the user. In a participatory process such method is useful because reading the scenarios doesn’t require any technical knowledge of the concept and methods. The process is also iterative and that can be utilized when considering different options. A more complete description of the scenario-writing method in lighting concept design is available in the doctoral thesis of Pihlajaniemi (2016).

The following illustration displays a typical path in scenario-writing method (Kaikkonen 2016):

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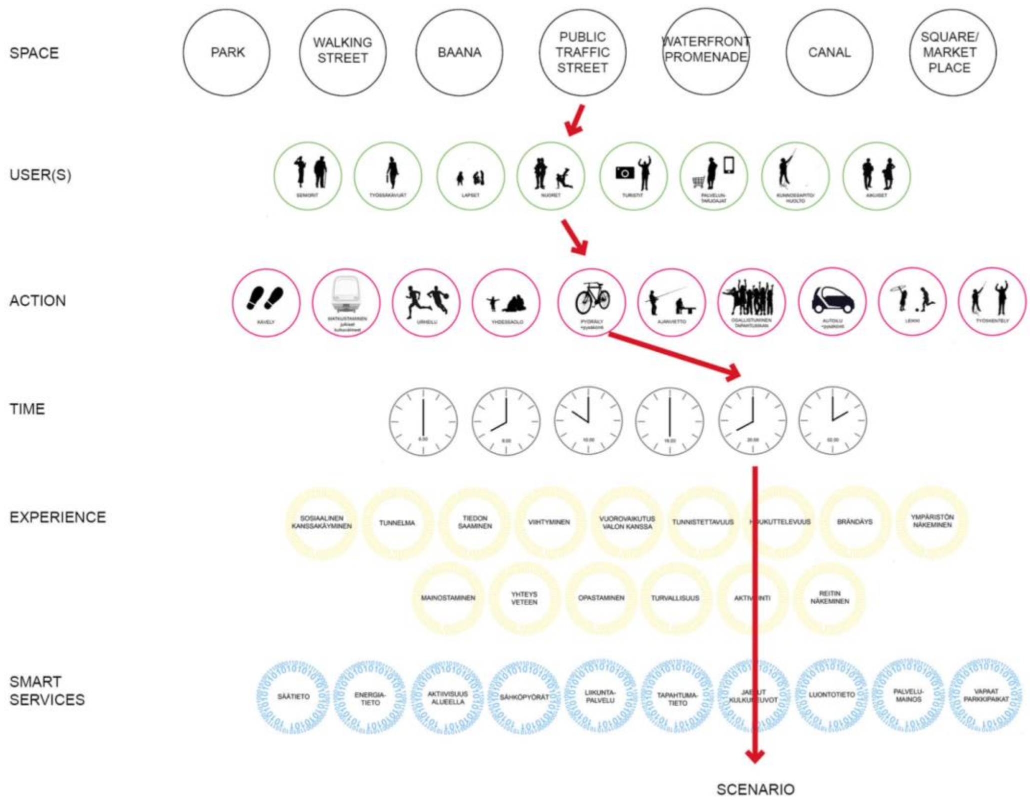

Figure 4: Lighting Scenario (Illustration Venla Kaikkonen)

5.2.1 Workshop Methods

The participatory design process has been an active topic during the recent years. Multiple methods and mindsets have been developed to find out the best ways on different domains and topics. In the case of the lighting design concept, Kaikkonen and Pihlajaniemi have defined an approach that can be split into four phases: *pre-design, generative, evaluative and post-design*.

In their methodology, *pre*- and *post*-design phases are used to better understand the participant's experiences and to prepare them to participate in the actual co-design phase. There the *generative* phase intends to collect new ideas, themes and concepts from the future users of the area. Finally, the *evaluative* phase will be developing prototypes in an iterative way until there is enough information to start defining the overall concept in the post-design phase.

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Figure 5: Kalasatama Co-Creation Workshop (Photo Venla Kaikkonen)

5.2.2 Smart City Lighting Scenarios

Following the participatory design phases, the identified scenarios were arranged into four different categories:

City in View
- -Outdoor Information
- -Urban Darkness

City in Move
- -Smart Street Lighting
- -Urban Safety
- -Public Traffic

City on Hold
- -Connecting Events
- -Activating Environment

City in Mind
- -Signal Lights & Stories
- -Smart Services

The City in View category describes the scenarios in the context of virtual and physical cityscape. There can be high-level scenarios like light installations that can be seen from far away and that can contribute to the image of the city.

The City in Move scenarios are related to smart street lighting and the sense of safety. The participants of the workshops frequently raised the topic of safety, especially in relation to crossroads. The experience can be even worse if the lights are dimmed down in night-time without any intelligent control to brighten them when movement has been sensed.

The City on Hold scenario attempts to create a sense of community and ways to activate residents by the use of intelligent lighting. In Kalasatama, there are venues of public happenings, including playgrounds,

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recreation areas and open space. These spaces should have an atmosphere that will encourage social interactions and be inviting in general. The lighting system can have an impact on how well the spaces are used in social gatherings.

The City in Mind scenarios focus on how knowledge could be collected and shared in the urban environments. Signal lights are good examples on ways how to give notice or warning to the people. These scenarios are typically related to services that are not necessarily part of the intelligent lighting system. The Urban Platform connectivity will then have a role on enabling such services.

5.2.3 Intelligent Lighting Conceptual Plan

The intelligent lighting concept for Kalasatama aims to ease the everyday life of the residents (Kaikkonen 2016). It aims to improve the public spaces and to create a better living environment, thus improving the quality of life. These goals are well aligned with the vision of Smart Kalasatama 25/7 – adding one "extra hour" to resident's day with an easy access to services. This also supports the city's ambition to become the most functional city.

The conceptual plan of lighting is created from the ideas and themes that emerged during the scenario work. The same four categories were used to define specific functions. The following table illustrates the aspects associated with the main categories in the concept:

Table 5: Aspects of Lighting Concept

City in View	City in Move	City on Hold	City in Mind
Outdoor Information	Smart Street Lighting	Social city, personalized lighting	Story signals
Urban Darkness	Urban Safety	Activating environment	Smart Services
	Public Traffic		

As an example, the following illustration provides more information on how the concept would cover various aspects in the City on Hold category:

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Figure 6: City on Hold concept (illustration by Venla Kaikkonen)

In the illustration, the round dots mark places and activities. The pink color refers to places that would benefit of the first level of personalized lighting. Green color is for common courtyards and second level of personalized lighting. The yellow marks the walking areas which are available for individual personalisation of lighting. The red and white dots illustrate the locations of activities with light functions.

5.2.4 Lighting Design

The lighting design phase is a hierarchical implementation of the functions of different phases. The variation of mounting height of the luminaires is used to create the sense of space and a hierarchy of spaces. The mounting height is naturally based on the functional needs of visibility on the streets with different widths and speed limits. There are also regulations related to minimum light output, illuminance levels, glare and light pollution to the sky.

The LED lights are versatile with their type of light. As an example, the light temperature is typically a bit cooler, neutral 4000K on the street and warmer 3000K on the common courtyards. Helsinki is currently

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experimenting with dual-tone lamps that can provide adjustable color temperature as an effect or as an attempt to mimic natural sunlight changes in color temperature.

A total number of 17 types of installations were defined as part of the design phase. The specification of the lamp type is detailed enough to cover all the aspects related to the relevant concept category. It is also important to define when there are areas that are not supposed to be lit: as an example, tram lanes in the middle of main street are in this concept left unlit.

For more information about the Kalasatama 2030 lighting concept plan, see Venla Kaikkonen's thesis work (Kaikkonen 2016).

6. Smart Public Lighting in Korkeasaari Zoo

6.1 Background

The Korkeasaari Zoo was established in 1889, which makes it one of the oldest zoos in the world. The mission of the zoo is to conserve biodiversity, and it participates in in-situ conservation work to protect the original habitats of various species.

The zoo is located right next to the new Kalasatama district from a short distance of the Helsinki city center. The zoo is located on an island. It is currently a home to 150 animal species and almost 1000 plant species that display the diversity of nature. The zoo is open every day of the year and most of the animals stay outdoors throughout the year.

There has been two major obstacles slowing the public lighting renovation: Firstly, the Korkeasaari Zoo was separated from the city organization into a unit managed by an independent foundation in the beginning of the year 2018. This had a major impact on budgeting and the procurement processes: right after the foundation was formed, it wasn't fully clear whether the zoo was able to purchase technical services from the city departments in the same way as earlier when the city managed the facilities and the department of zoo was renting them. Later in 2018 it was confirmed that there wasn't an issue and the maintenance and construction services continued as earlier.

The second major obstacle that has slowed both public lighting and solar power initiatives was the condition of the electrical distribution network in the island where the zoo is located. Over the years new installations have been added to the electrical system without higher level planning and several bottlenecks were identified, preventing the addition of more local production or large loads. It was expected that the major upcoming constructions such as a new bridge and a new ticketing office would help to fix also the outdated electrical systems. In October 2018, the city published on request of tender for new transformer unit to the island. With this system, the electrical distribution system can be improved,

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allowing the addition of new loads and local production. It is also expected that the new transformer station would provide the housing for the new master control unit of the lighting system.

6.2 Public Lighting Requirements

The zoo is naturally not a typical target for a street lighting system. The island has no open public streets, but the pathways have similar requirements that public space in general. Some additional requirements have come up and the zoo provides a platform for piloting new solutions. Since one of the professional skills of the staff is to notice changes in the animal behavior, any unwanted characteristics of the lighting conditions will be identified. The positive effects of new lighting concepts such as circadian lighting have raised interest also for research purposes. So far, the impact of lighting to animal behavior has mostly been studied in animal production contexts, such as in poultry production for example. While in mySMARTLife, the animal behavior is not in focus, the zoo environment has brought interesting technical questions regarding the design, and expectations related to controlling the lighting glare, quality of light, flicker and color of light.

Since the zoo is open throughout of the year, public lighting has a role in safety of the visitors. The zoo requested lighting designers a map of the routes that currently cannot be deemed safe because of lighting conditions. The map is illustrated below (Figure 7).

The requirements of the zoo were collected by studying the existing plans, designs and experiences from the previous work. Workshops were held together with the staff of the zoo and feedback was used in the context of the Kalasatama living lab to draft the concept for new lighting equipment and a supporting system. This work was also done within the limits and expectations of the mySMARTLife project. In mySMARTLife, the key indicators are in energy efficiency and in the increase of “smartness” to support the project goals. In the case of Korkeasaari Zoo, these requirements are well aligned and support the future development of Korkeasaari in becoming carbon neutral by year 2030.

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Figure 7: Public Lighting in Korkeasaari

The green paths in the map are routes where current lighting conditions are not adequate. At the moment there are about 160 lampposts in the area, and the mySMARTLife project is to support the replacement of 40 of them with modern dimmable LED fixtures. Naturally the replacement of lampposts does not extend the reach of lighting network, but when at the same time central controls, energy metering and visualizations are deployed, the zoo can faster continue with the work, hopefully aiming to be fully LED powered within the next few years.

6.3 Lighting Control System

The zoo is a location that contains many of the scenarios covered in Venla Kaikkonen's concept design work for Kalasatama. The Zoo needs safe and reliable lighting for all the roads and pathways, but also would benefit from the central control of architectural and event lighting

The zoo is open almost throughout the year while naturally the summer season is the busiest one. The off-season time gives the opportunity to utilize individual lighting control, such as the lighting follows pedestrians concept that is illustrated in the following picture:

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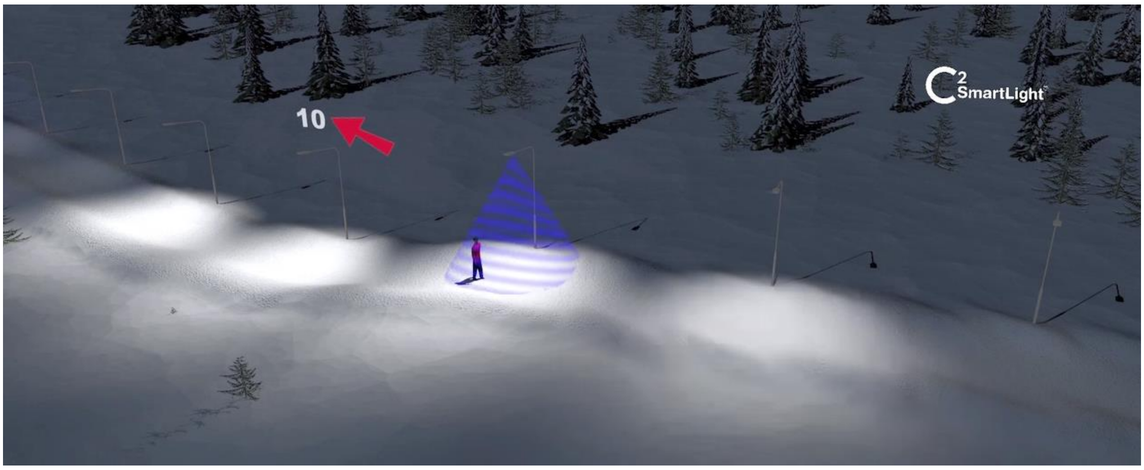

Figure 8: Lighting Follows Pedestrians (Image by C2 Smartlight)

In this concept, every lamp post has a motion sensor and based on the direction of the pedestrian, the control system will brighten up the next lamp in the route. The smooth dimming will reduce energy consumption, and prevent glare and light pollution to the sky. In a location such as the zoo, dimming also keeps the illumination minimal so that it doesn't disturb the animals.

The motion sensors can also be used to count people passing the lamppost when the traffic is slow. This method will be tested first in recreation parks to set up an API and study the requirements for the data. The data will be entered on urban platform and can provide more information of the usage of the facilities.

The lighting control system in C2 Smartlight is based on the wireless SigFox. The lampposts form a mesh network that interconnects wirelessly. As addition to the permanent lampposts, the same wireless controls can be used on temporary installations such as effect lighting on special events. The effect lighting can be battery operated, making it easy for the staff to operate because of no cabling required. The energy saving will also be significant when a 30-Watt LED effect light can replace a 1.000-Watt PAR64 fixture.

The visualizations of the lighting control system are mostly based on standard product that is configured for the Korkeasaari setup. The visualization product, LumoManager was deployed in September 2019 to support the future lighting renovation also after the mySMARTLife actions are completed. The tool supports the provisioning of the smart lighting components, displays their status on the map and provides a feature to group the lights with specific lighting profiles. At the basic level, this already supports the energy efficiency needs, but to limit the light output, further lighting output is also controlled by using the combination of motion detectors, ambient light sensors and temperature sensors. It is expected that in the future the control system could support the zoo also in other energy-intensive functions, such as heating the pipelines to provide drinking water to animals.

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6.4 Urban Platform Connection

Prior to the new lamp installation, the data connection to street lighting system is piloted in the system operated by the city. A single API will provide access to the complete system, covering not only the Kalasatama district but also the whole city. Because of that, existing smart features can be utilized as a part of the API connection testing. When the data connector is created and data transformed into ISO TC211 compliant format, the data from the new lamp drivers and lamp post sensors anywhere in the city will be available on the platform for third party services.

At the moment, the following functions are seen useful to be implemented:

- Lamp-specific status and energy consumption, with location information to be visualized in the 3D city model
- Lamp-specific malfunctions, possibly in Open311 format, visualized in the 3D city model
- Feature to call power saving mode as part of the smart grid demand side management

6.5 Lamp Replacements

The lamppost replacements are not part of the mySMARTLife project budget, but some components in lampposts, like intelligent drivers and sensor units, are included. In some cases, the manufacturers provide a retrofit module that contain the smart driver and led luminaire for an easy replacement of lamp component. Parallel to the project, the zoo has already replaced about 20 lampposts with newer, LED-driven model with conventional control.

The following image shows a typical replacement lamppost with a LED luminaire but conventional control technology. With the mySMARTLife contribution, the light's dimming rate can be controlled based on ambient lighting levels and the lampposts can be used for other sensors and cameras. The actual savings will be calculated during the monitoring phase. Since the baseline energy consumption is unclear, the monitoring phase will include energy monitoring setup for better understanding the saving potential when the replacement solution has LED light sources and is dimmable.

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Figure 9: Typical lamppost by Louis Poulsen

7. Conclusions

The planned work on Korkeasaari Zoo is based on thorough analysis on current state of the systems and innovation available on the market. This task benefits from the previous studies made on both city and the district level. The next steps include enhanced focus on the smart street lighting system upgrade in the Korkeasaari Zoo (on Korkeasaari island) including focus on the design issues in the power distribution system of the whole island, data integration and further planning and testing of connectivity activities. Complementary benefits will also be sought from data from the existing C2 smart light system of the city of Helsinki.

In Korkeasaari, several lamps have been already replaced during the project time and the issues related to the distribution system and central control are being tackled as a joint effort. While the actual installation work of new lamps and lampposts is ongoing, the plan and design are now advanced in many ways and the possible technical risks are much lower than they would have been without this phase. Eventually the project will support the replacement of 40 lampposts of the 160 in total. It is therefore expected, that the project can complete the remaining tasks prior to the monitoring period and can already provide useful input to the follower cities working on similar challenges.

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