

Smart Cities: Potential Analysis of Intelligent Lampposts

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Contents

LIST OF FIGURES	III
LIST OF TABLES	IV
LIST OF ABBREVIATIONS	V
1 INTRODUCTION	1
2 THEORETICAL FOUNDATIONS	3
2.1 URBANIZATION	3
2.2 SMART CITIES	5
2.2.1 European Approach.....	6
2.2.2 Assessment of Smart Cities.....	7
2.2.3 Smart Mobility	8
2.2.4 Smart Environment.....	9
2.3 INTELLIGENT LAMPPOSTS	10
2.3.1 Historical Development.....	10
2.3.2 Integrated multi-functional Humble Lamppost	11
3 RESEARCH DESIGN	14
4 POTENTIAL ANALYSIS	15
4.1 LITERATURE REVIEW BASED ON WEBSTER AND WATSON	15
4.2 SEMI-STRUCTURED EXPERT INTERVIEWS.....	23
4.3 QUALITATIVE CONTENT ANALYSIS BASED ON MAYRING.....	24
4.4 SYNTHESIS OF THE FINDINGS.....	38
5 CRITICAL EVALUATION	40
5.1 DISCUSSION	40
5.2 RECOMMENDATIONS.....	43
5.3 LIMITATIONS.....	44
6 CONCLUSION AND OUTLOOK	46
REFERENCES	VI
APPENDIX	IX
APPENDIX A. INTERVIEW GUIDELINE	IX
APPENDIX B. SUMMARIZING CONTENT ANALYSIS ACCORDING TO MAYRING	X
APPENDIX C. EXPERT INTERVIEW DR. MEYER.....	XXV
APPENDIX D. EXPERT INTERVIEW HEUSER.....	XXXI
APPENDIX E. EXPERT INTERVIEW SCHONOWSKI.....	XLII
APPENDIX F. EXPERT INTERVIEW WEIS.....	LII
APPENDIX G. EXPERT INTERVIEW GLOCK.....	LXIV
EHRENWÖRTLICHE ERKLÄRUNG	LXXIV

1 Introduction

As urbanization is advancing, city infrastructures are faced with new challenges regarding various areas of urban life, such as crowded roads and increased environmental pollution. The concept of Smart Cities is a reaction to these challenges. To meet recent demands, it is necessary to incorporate new, intelligent and efficient technologies and thereby perform a digitalization of cities. Nowadays, Smart City solutions based on the Internet of Things (IoT) are being implemented in urban infrastructures all around the world. They are supposed to make cities sustainable and viable for the future on a technical and economical as well as social and environmental level.

Although the term Smart City has long found its way into the public eye, a uniform approach and an orientation framework for the implementation of the concept are still missing to this day. One approach to implement intelligent solutions is by the means of lampposts which are utilized beyond their lighting capability.

Today, street lighting is already a cornerstone of urban life. It enables traffic at nighttime and generates safety by simple illumination. However, conventional street lighting accounts for approximately 40 percent of a cities energy bills, making it a major cost factor which implicates a need for action. A networked light-emitting diode (LED) system with the ability of adapting the illumination to the presence of road users is supposed to be implemented as part of the innovative lampposts. This is said to have great potential to reduce energy consumption and thereby costs.

Since the holistic approach combines various solutions within one hub, additional smart technologies are recently being implemented into the lampposts. On the basis of their omnipresence in cities and existing power supply, intelligent systems that are meant to generate benefits for various stakeholders are being installed. Smart Cities generally leverage a network of connected devices which are equipped with sensors and thereby feed users with smart data. This data, in turn, is to be made use of in various use cases.

While it is estimated that intelligent lampposts could play a key role in optimizing traffic by the means of analyzing the generated data, as well as reducing energy consumption and pollution, this thesis aims at evaluating and extending these assumptions further. Therefore, the research question reads as follows: *What are the greatest chances and challenges of intelligent lampposts as a part of Smart Cities?*

In order to answer this question, a theoretical framework is built in chapter 2. It includes general trends and developments that are relevant to this topic, as well as concrete approaches on evaluating the smartness of cities. Additionally, the understanding of intelligent lampposts within this thesis and an approach on standardizing them are introduced. In chapter 3, the two research methods that are being applied in order to answer the central matter and how they complement each other are explained. A literature review and semi-structured interviews with different stakeholders are subsequently executed and analyzed in chapter 4. They make up for the main part, the potential analysis, which aims at pointing out the chances and challenges of intelligent lampposts. The identified opportunities and obstacles are then critically evaluated in chapter 5. After discussing them and linking them back to the general approaches of evaluating Smart Cities, recommendations for the previously defined stakeholders are given and the limitations of this thesis are presented. Finally, a conclusion is drawn and an outlook on the potential future development is provided.

6 Conclusion and Outlook

Similar to the occurrences in the 19th century London, nowadays, city infrastructures are again facing new challenges derived from urbanization and population growth, that they have to adapt to. The Smart City concept offers the possibility to develop urban areas in accordance with the digital age we live in.

When forwarding the Smart City, it will be necessary to establish new technological solutions throughout urban areas. Public lighting is the most ubiquitous infrastructure within cities. That alone, but also the existing power supply and the possibility to incorporate technology hidden in the lamppost without disturbing the cityscape are main advantages, making the lamppost stand out over every other existing city furniture. It can be considered the most convenient carrier of Smart City solutions at present and should be chosen over installing new fixtures. In addition to the locational advantages, intelligent lampposts offer the possibility to combine a variety of solutions and added values in a single hub. The chances that stand out the most after analyzing the potential of intelligent lampposts regard mobility optimization, a more sustainable environment and overall urban safety. Furthermore, it becomes apparent that there are major synergetic effects between the individual ambits, which underlines the benefits of an interconnected infrastructure network. Accordingly, the basic assumptions of this thesis have been supported and extended. However, before those opportunities can be fully utilized, certain challenges have to be faced. They go from the cost involved in installing the new technology to a lack of awareness and guidance to the sensitivity of data. In order to overcome these challenges and successfully implement intelligent lampposts, a multi-stakeholder approach will be indispensable. Furthermore, it is necessary to consider the cities' preconditions and requirements which are as diverse as cities themselves. While the extend of the implementation must be adapted to the individual needs of the city and country, a common approach along the lines of, e.g., standardizations, can be an important guideline combining knowledge and experience.

Lastly, it is to say that there may not be only one proper way to implement the Smart City concept, which is why further research on possibilities of implementing it has to be done. The lamppost approach is considered applicable for a wide range of cities, but cannot be universally glorified or generalized. However, it can be assumed that the relevance of intelligent lampposts will be increasing, due to the rapid development and the growing number of pilot projects.

Despite all obstacles, intelligent lampposts have potential to become a vital part of globally connected Smart Cities and thereby make our future living environment smarter, safer and more power efficient.