Smart Light Concepts

D 2.2.1 Discussion paper successes and failures in feasibility studies SLIC pilots

PP3 and LP will research various aspects of feasibility and design studies of SLIC pilots, their organisation testing and final outcomes. All the partners will partake in this evaluation. With the collected information PP3 and LP will write a discussion paper and presentation addressing the relevant issues that will have to be discussed in a workshop with all the involved partners and experts. The paper describes successes, failures and topics of discussion of feasibility studies of the SLIC-pilots.

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1. Introduction

This document describes the D2.2.1 Discussion paper successes and failures in feasibility studies of SLIC pilots. Based on this report, the successes and failures of the feasibility study of pilot projects of the SLIC project will be outlined. This report might be helpful for other prospective European projects regarding what kind of issues or reasons can result in failure or success of a feasibility study since feasibility study of a project can be considered guidance during the project to finish the project successfully. For example, defining too ambitious goals, unrealistic cost estimations and timeline, unexpected events and communication problems could be a reason for the failure of a project(Radujković & Sjekavica, 2017 and White & Fortune, 2002), which will result in wasting resources. In the following subsections, the importance of discussing the successes and failures of a feasibility study and design of feasibility study of SLIC Project is defined.

In this report, SLIC pilots feasibility studies are evaluated by considering the successes and failures in the goals defined by pilot partners at the beginning of the SLIC project.

The outcome of this report will help identify what makes the SLIC pilots successful and the failure factors that should be considered to make the other projects better. The factors that have been proposed to define success and failure of a pilot will be described below.

1.1. Why measuring successes and failures of a project's feasibility study is important

Before starting the project, the successful completion of the project needs to be evaluated by analysing different factors. Therefore, the project manager, the sponsor, and the stakeholders should address several key questions when examining whether or not to proceed with a project. Some of those critical factors are (Mukherjee & Roy, 2017 and White & Fortune, 2002).

a. Technology and System Assessment.
b. Economic Viability.
c. Operational Considerations.
d. Legal Ramifications.
e. Schedule and Resource Concerns.

Even after the project passes the feasibility study, the project still can fail due to various reasons(Radujković & Sjekavica, 2017 and White & Fortune, 2002). These can be

a. Unrealistic estimations such as being too ambitious about the goals, duration and costs.
b. Project lacks structure
c. Some costs are not considered
d. Communication issues in project management.
e. Irresponsible project members.

1.2. Design of Feasibility Study of the SLIC Pilot Partners

The feasibility study of the SLIC pilots aims to evaluate whether planned pilots objectives are completed successfully. Therefore, the feasibility study mainly focuses on newly installed PL technologies. In this line, the feasibility study design covers four groups (refer to D4.5.1 Report feasibility study with analysis and selection of most suitable Public Lighting (PL) technologies and D4.5.2 Concept design of the preferred scenario and technologies). These are;

A. Pilot partner planned objectives

Pilot partners should define clearly the current PL's situation in terms of technologies currently used, the area details such as rural, park, motorway, and why new low carbon PL technologies are needed for these areas. Also, pilots need to define their targets by involving the SLIC project when the project ends. For example, the target can be achieving a specific lighting performance (clarity, intensity, colour) by applying innovative technologies and implementing a sustainable PL installation.

B. Defining Specifications of newly installed PL Systems

Technical specifications of new planned lighting installations need to be reported to assess the feasibility of these installations. These specifications can include but are not limited to cycle life, cost, who will maintain the system, applied smart techniques on lighting systems, energy consumption metering and battery-related features..

C. Defining Specifications of Lighting Control Units.

Low Carbon PL technologies can be operated efficiently when smart lighting controllers are installed on the system. These control units can be sensors, cameras that can detect movement or the outdoor lighting level; accordingly, lighting level can be adjusted. In this group, the details of applied lighting control technologies need to be reported to assess their feasibility with the SLIC project. In the report, the information can be but not limited to how the lighting control system is applied or controlled by wire or wireless, the type of sensor, the lighting units that can be switched individually, or a set of units that need to be switched by using lighting control systems.

D. Measuring energy savings after new PL Installation

In this final group, applied low carbon PL systems' success is evaluated. One of the main objectives of the SLIC project is the reduction of energy consumption and carbon emissions. The following questions should be answered to accomplish this assessment.

1. What is the estimated or measured energy consumption of the current(old) PL system?
2. What is the estimated or measured energy consumption of the newly installed PL system?
3. What is the estimated or measured energy saving due to the newly installed PL system?

2. Description of success and failure in the context of feasibility studies of the SLIC pilots

For the analysis of success and failure of the SLIC pilot partners' feasibility study, the following factors have been identified.

- Technical capability
- Budget
- Legality
- Risk
- Operational feasibility
- Time
- Environmental sustainability

Technical capability: Did the Pilot have the technical capabilities and resources to undertake the installation of new PL systems?

Budget: Does the pilot have the financial resources to undertake the installing of new PL systems, and is the cost/benefit analysis of the installation of new PL systems sufficient to warrant moving forward with the project?

Legality: What are the legal requirements for installation of PL systems, and did the installation of new PL systems meet these legal requirements?

Risk: What is the risk associated with installation of PL systems? Is the risk worthwhile to the Pilot partner based on perceived benefits?

Operational feasibility: Does the SLIC project, in its proposed scope, meet the organization's needs by solving problems and/or taking advantage of identified opportunities (reduce energy consumption therefore saving energy cost)?

Time: Was the installation of PL systems completed in the timeline that is advantageous to the Pilot Partner?

Environmental sustainability: Did Pilot partners achieve CO2 emissions reduction?

Each pilot's feasibility study success and failure factors have been outlined below, where each pilot partner is evaluated with the factors described above.

2.1. PP2 - Municipality of Etten-Leur (NL)

The pilot in Etten-Leur focuses on street lighting in rural areas.

In the countryside, old lamps and fixtures will be replaced by LED lighting in various streets and paths. The existing lamp posts will be retained. Sensors are also attached to some lampposts, with which, among other things, it is possible to measure how much traffic passes. In addition to the existing lamp posts, a number of new lamp posts with solar panels will also be installed.

The new LED lighting can be dimmed continuously from bright to completely off. The pilot looks at the best dimming or light levels at different times. The sensors can be used to dynamically dim the light. The dimming and light levels depend on the number of cars, cyclists or pedestrians passing by. In some streets a static dimming schedule will be applied, in other streets a dynamic dimming schedule.

Until mid-2021, experiments will be conducted with different light levels and dimming schedules. Based on experiences, measurement data and surveys conducted among road users and local residents, a final choice will be made for the best balance between light intensity and reduction of CO2 emissions.

Table 1: Feasibility vs Realized (based on D3.13.1 and D3.13.2)

	Feasibility study	Realized per 11-03-2021	Remark
Total number of lanes	27	27	
Total number of poles included in pilot	333	333	
New poles to be installed	0	0	
# poles with upgrades	333	333	All poles retrofit with LED, 101 fitted with pir sensor.
Planned date of installation complete	N/A	-	Information not filled out in original feasibility study.
Actual date installation complete	-	Q3 2019	
CO2 reduction target[%]	53/64	11/-13	Different pct. For different scenarios.
CO2 emission baseline [t/year]	9/8 (stat/dyn)	-	
CO2 emission target [t/year]	4/3	8/9	

2.1.1. Success factors of the feasibility study of PP2

Success factors could not be composed. At the time the interviews for this document were conducted, PP2 had already finished their participation in SLIC and therefore were not able to provide this information.

2.1.2. Failure factors of the feasibility study of PP2

Failure factors could not be composed, see 2.1.1.

2.2. PP4 - Suffolk County Council (UK)

The pilot in Suffolk focuses on exploring savings based on multi-data street lighting. It combines data streams from different sensors. (traffic and pedestrian data using radar and road surface temperature sensors).

The dimming schedules can be adjusted automatically based on the traffic flows. In addition, it will be investigated whether energy can be saved by correlating traffic data on major and minor roads. If possible, the sensors can be partly omitted, while the advantages of a dynamic dimming schedule on side roads are still preserved.

In this pilot, 500 street lamps are controlled on the basis of 25 (traffic) radars. In addition, there is a road surface temperature sensor that can be used to accurately predict the need for anti-icing.

Table 2: Feasibility vs Realized (based on D4.5.1 and D4.5.2)

	Feasibility study	Realized per 11-03-2021	Remark
Total number of lanes	2	2	
Total number of poles included in pilot	733	733	
New poles to be installed	0		
# poles with upgrades	25	>25	Extra radars were installed later
Planned date of installation complete	N/A	-	Information not filled out in original feasibility study.
Actual date installation complete	-		Information not provided
CO2 reduction target [%]	10	30	
CO2 emission baseline [t/year]	61	-	
CO2 emission target [t/year]	54,9	42,7	

2.2.1. Success factors of the feasibility study of PP4

- **Technical capability**
  - Partner has all technical knowledge capability to carry the project (internal employee with relevant know-how)
- **Budget**
  - SLIC project enabled the installation of radar and accordingly energy saving.
  - Project provided additional fund to install smart systems
- **Legality**
  - Local regulations overrule national and EU regulations regarding light levels. This gives tremendous freedom to PP.
  - (Radar) Data anonymised that will not create legal issues.
- **Risk**
  - Installation doesn't involve any risk. Installed using default installer, own personnel always on site to supervise installation.
- **Operational feasibility**
  - Close proximity to partners (installers) is key to success for the project.

- **Time**
  - PP was unable to discern success factors related to Time
- **Environmental sustainability:**
  - The SLIC project accelerated the plans for CO2 reduction and helped to gain extra savings.
  - Sensor installation and replacing with LEDs help to save energy.

2.2.2. Failure factors of the feasibility study of PP4

- **Budget**
  - Budget arrangements and moving budget in SLIC was problematic.
  - Buying equipment with correctly allocated SLIC budget still problematic
- **Time**
  - Paperwork slows down project implementation. The procedure for acquiring equipment from SLIC funds was (too) lengthy.

- **Technical capability**
  - PP was unable to discern failure factors related to Technical capability
- **Risk**
  - PP was unable to discern failure factors related to Risk.
- **Operational feasibility**
  - PP was unable to discern failure factors related to Operational feasibility.
- **Legality**
  - PP was unable to discern failure factors related to Legality.
- **Environmental sustainability**
  - PP was unable to discern failure factors related to Environmental sustainability.

2.3. PP5- Metropole of Amiens (FR)

In the Amiens pilot, some 200 existing LED lamp posts will be equipped with controls based on IR, radar and optical sensors. This pilot includes 2 main roads, 2 parallel bicycle streets and a bus/bicycle tunnel that is permanently lit. This pilot is experimenting with the placement and quantity of bicycle/pedestrian sensors and the control of the lighting based on this data (traffic and pedestrian data). The aim is to save more energy and increase safety and reliability.

The installation of these new sensors will take place in October 2020.

Table 3: Feasibility vs Realized (based on D3.9.1 and D3.9.2)

	Feasibility study	Realized per 11-03-2021	Remark
Total number of lanes	8	8	
Total number of poles included in pilot	200	200	
New poles to be installed	0	0	
# poles with upgrades	200	200	DALI ctrl per pole, 6 doppler, 8 optical sensors
Planned date of installation complete	N/A	-	Information not filled out in original feasibility study.
Actual date installation complete	-	N/A	Information not provided.
CO_2 reduction target	45%	-	
CO_2 emission baseline [t/year]	5.9	-	
CO_2 emission (target) [t/year]	3.2	N/A	Data collected is not sufficient to draw conclusions regarding CO_2 emissions

2.3.1. Success factors of the feasibility study of PP5

- **Technical capability**
  - All plans are done by pilot partner employees internally, but implementation was done externally.
- **Budget**
  - The SLIC project introduced sensors and smart techniques.
  - Budget was enough to carry on the project.
- **Legality**
  - PP was unable to discern success factors related to Legality
- **Risk**
  - Risks are identified by the pilot partner after camera installation, risks were then quickly mitigated.
- **Operational feasibility**
  - LED replacement was already planned before start of SLIC
  - Communication with other SLIC partners especially with Suffolk and Brugge made the whole process quick.
- **Time**
  - Even with COVID affecting some plans, the project as a whole ran as expected in its time frame.
- **Environmental sustainability**
  - PP was unable to discern success factors related to Environmental sustainability

2.3.2. Failure factors of the feasibility study of PP5

- **Operational feasibility**
  - Coordinating external providers is found to be a challenge.
- **Time**
  - COVID effected implementing the feasibility plan.
  - Disagreements on how to process compliance checks of the project in the team delayed taking action.
- **Risk**
  - Installation compliance is not checked yet this could create a risky situation in the future.
  - Perception from the public in terms of the new PL system remains a risk.
  - The action plan is not clear when communication failure between installed systems and main controller
- **Legality**
  - Legality of new installation checked after project started.
- **Budget**
  - PP was unable to discern failure factors related to Budget.
- **Technical capability**
  - PP was unable to discern failure factors related to Technical capability.
- **Risk**
  - PP was unable to discern failure factors related to Risk.
- **Environmental sustainability**
  - PP was unable to discern failure factors related to Environmental sustainability.

2.4. PP6 - City of Bruges (BL)

The SLIC pilot project in Bruges, called Brugse Lantaarn, involves the replacement of about 2,700 street lamps in the center of Bruges. Bruges therefore chooses to renew all lanterns in the city center to LED fixtures with the same look-and-feel. In addition to the LED lighting, the city of Bruges will also experiment with dimming the lighting at places and times to be determined.

By making this smart choice, maximum energy is saved in the field of public lighting. A CO2 reduction is a logical consequence of this. The renewal of the Bruges lanterns in the city center will start in the spring of 2020.

For PP6 no feasibility study deliverable was defined. A comparison between feasibility study and realized results is therefore not possible.

2.4.1. Success factors of the feasibility study of PP6

- **Technical capability**
  - PP was unable to discern success factors related to Technical capability
- **Budget**
  - SLCI budget enabled the partner to hire an external expert to solve some technical issues.
- **Risk**
  - PP was unable to discern success factors related to Risk
- **Legality**
  - Collaborated with another pilot partner(Fluvius) for checking legal requirements.
- **Time**

    - LED installation was completed after planned time because of COVID-19 conditions.
- **Environmental sustainability**
    - Before the SLIC project the pilot partner already had a plan. SLIC added dimming option on PL installation
- **Operational feasibility**
    - PP was unable to discern success factors related to Operational Feasibility

2.4.2. Failure factors of the feasibility study of PP6

- **Technical capability**
    - Feasibility study was not conducted due to missing technical capability
- **Risk**
    - Residents were not aware that a new PL installation would be a risk factor because of uncertainty regarding how they will perceive the new installation and dimming scheme.
- **Operational feasibility**
    - Energy saving measurement is not conducted yet.
    - Dimming scheme has not been applied yet.
- **Legality**
    - PP was unable to discern failure factors related to Legality.
- **Budget**
    - PP was unable to discern failure factors related to Budget
- **Time**
    - PP was unable to discern failure factors related to Time
- **Environmental sustainability**
    - PP was unable to discern failure factors related to Environmental sustainability.

2.5. PP7 - West Flanders Intermunicipal Association (WVI) (BE)

The pilot in Veurne will be realized on an old sugar factory site, where a combination of nature, residential and industrial areas will be constructed in the future. The pilot focuses in particular on the different ways of lighting for these different parts of the area.

In the nature reserve, the focus is on 'animal and bicycle-friendly' lighting, LED lighting along bicycle paths that is dimmed in the evening and extinguished at night to minimize disruption to nature. Follow-up lighting is also used with a 'smart camera' that can distinguish a person from an animal or other movement, to only switch on the lighting at night when a cyclist or walker passes, but also to increase safety.

In the residential area, the lighting will be dimmed in the evening and at night, in addition, different light colors will be used near intersections in order to make cyclists more noticeable.

In the industrial zone, the lighting will be dimmed based on the light levels of the companies already present. In addition, a dimming schedule will be used that is adjusted to the usual work shifts in the industrial area.

Table 4: Feasibility vs Realized (based on D4.1.1 and D4.1.2)

	Feasibility study	Realized per 11-03-2021	Remark
Total number of lanes	4	0	
Total number of poles included in pilot	52	37	37 existing poles
New poles to be installed	15	0	New poles in new zone

# poles with upgrades			37 (existing poles retrofit with LED +controller)
Planned date of installation complete	Q4 2019		
Actual date installation complete	-	Not yet started	
CO2 reduction target		-	
CO2 emission baseline [t/year]	5.5	-	
CO2 emission target [t/year]	N/A	N/A	Information not filled out in original feasibility study.

2.5.1. Success factors of the feasibility study of PP7

- **Technical capability**
    - Collaborating with other pilot partners in terms of technical knowledge and installation
- **Budget**
    - Having enough budget.
- **Risk**
    - On going evaluation phase for risk factors
- **Environmental sustainability**
    - Achieved planned energy saving with smart sensors and lighting strategy.
- **Operational feasibility**
    - PP was unable to discern success factors related to Operational feasibility
- **Time**
    - PP was unable to discern success factors related to Time
- **Legality**
    - PP was unable to discern success factors related to Legality

2.5.2. Failure factors of the feasibility study of PP7

- **Technical capability**
    - Depending on other institution/partner for knowledge
- **Budget**
    - PP was unable to discern failure factors related to Budget
- **Time**
    - Project plan delayed due to depending other pilot partner (Fluvius) for installation and technical knowledge.
    - Building infrastructure caused delays but LED replacement was on time.
- **Risk**
    - PP was unable to discern failure factors related to Risk.
- **Legality**
    - PP was unable to discern failure factors related to Legality.
- **Operational feasibility**
    - PP was unable to discern failure factors related to Operational feasibility.
- **Environmental sustainability**
    - PP was unable to discern failure factors related to Environmental sustainability.

2.6. PP9 - Province of West-Flanders (BE)

The pilot in Roeselare focuses on researching and rolling out an autonomous lighting system based on a nano-grid. The lighting system is applied on a cycle path along a residential area/sports park with 31 lampposts fitted with LED lighting along it. In order to feed the autonomous system, 10 kWp of solar panels will be installed on adjacent business premises. A battery storage of 14.4 kWh will also be realized here. From this building, the lampposts are supplied with energy via a nano-grid. To guarantee operational reliability, the grid will be provided with a grid connection for backup energy supply.

Important parameters in the research into the autonomy of this system include the lighting regime used (dimming based on trailing lighting), the time of year and the weather conditions. The influence of these parameters will be investigated. The dimming schedules are determined by surveys conducted among road users and local residents and historical data.

Table 5: Feasibility vs Realized (based on D4.9.1 and D4.9.2)

	Feasibility study	Realized per 11-03-2021	Remark
Total number of lanes	1	1	
Total number of poles included in pilot	31	23	
New poles to be installed	31	23	Unclear why number was reduced
# poles with upgrades	0		
Planned date of installation complete	N/A		Information not filled out in original feasibility study.
Actual date installation complete		02-2020	
CO2 reduction target	N/A		Information not filled out in original feasibility study.
CO2 emission baseline [t/year]	N/A		Information not filled out in original feasibility study.
CO2 emission target [t/year]	N/A	N/A	Information not filled out in original feasibility study/not enough data to draw conclusions.

2.6.1. Success factors of the feasibility study of PP9

- **Technical capability**
  - Collaborating with an external partner for technical consultant and tender is managed by another partner(Fluvius).
- **Budget**
  - Budget was enough to implement the project goals
- **Legality**
  - Legal requirements identified by an external partner (Fluvius) with expertise in this area.
- **Risk**
  - System reliability was secured and this was identified as the key risk factor.
- **Operational feasibility**
  - Limited number of involved organisations for the project help quick decision making and progress
- **Time**
  - The planned work was completed within the time frame.
- **Risk**
  - PP was unable to discern failure factors related to Risk.

2.6.2. Failure factors of the feasibility study of PP9

- **Technical capability**
  - Feasibility study before SLIC project was not well planned and executed.
- **Environmental sustainability**
  - No energy saving comparison is conducted yet.
- **Budget**
  - PP was unable to discern failure factors related to Budget.
- **Technical capability**
  - PP was unable to discern failure factors related to Technical capability.
- **Risk**
  - PP was unable to discern failure factors related to Risk.
- **Operational feasibility**
  - PP was unable to discern failure factors related to Operational feasibility.
- **Legality**
  - PP was unable to discern failure factors related to Legality.
- **Time**
  - PP was unable to discern failure factors related to Time

2.7. PP10 - Fluvius System Operator (BE)

The future housing project 'Grote Heide' in Bonheiden is one of seven pilot projects within SLIC. An energy-efficient, dynamic system for public lighting will be provided in this residential project.

Together, IGEMO and the municipality of Bonheiden want to reduce CO2 emissions related to public lighting in the residential area by at least 20%. This is done with the help of innovative “smart LED” lighting, motion sensors, remote dimming and extinguishing of lighting and the use of reflectors and fluorescent paint.

Due to delays in the realization of the project, this will no longer be realized within the project period and with European resources. Instead, a new pilot project in Mechelen has been included in the project.

In this 'replacement' pilot, Fluvius in the municipality of Mechelen will focus on (automatically) generating the correct dimming schedules for a certain road section, depending on the time of year and traffic conditions. The existing lighting infrastructure (including management system) is used for this purpose. The following main question is central here: how much light is needed at a particular time and place to guarantee safety and maximum energy savings.

This pilot is in 3 phases:

-Phase 1: offline data analysis based on historical traffic data. Generation of dimming schedules based on patterns from this data. Manual entry of the dimming schedules

-Phase 2 : Transfer of the algorithms from step 1 to an online platform, automatic dimming schedule generation and visualization of estimated energy savings.

-Phase 3: Verification of the algorithm and the traffic data by placing (traffic) sensors. Automatic adjustment of the generated dimming schedule in deviating conditions (traffic, event, etc.)

2.7.1. Success factors of the feasibility study of PP10

- **Technical capability**
  - Fluvius is an expert on PL installation and operating and has all relevant knowledge within the organisation.
- **Legality**
  - Lighting level requirements were satisfied by EU rules in all implemented PL installations. Fluvius has this knowledge internally.
- **Time**
  - PP was unable to discern success factors related to Time
- **Budget**

    - PP was unable to discern success factors related to Budget.
- **Risk**
    - GDPR is checked for installed cameras.
- **Operational feasibility**
    - Fluvius already planned to use LED and smart techniques in PL installation before the SLIC project, but the SLIC project introduced smart technologies earlier than they planned to Fluvius.
- **Environmental sustainability**
    - Motivation is to see the benefit of installing smart technics over only installing LEDs

2.7.2. Failure factors of the feasibility study of PP10

- **Risk**
    - Information security remains a big risk.
- **Time**
    - GDPR checking for cameras caused delaying on camera installation
- **Environmental sustainability**
    - Energy savings after installation are not measured yet.
- **Budget**
    - PP was unable to discern failure factors related to Budget.
- **Technical capability**
    - PP was unable to discern failure factors related to Technical capability.
- **Operational feasibility**
    - PP was unable to discern failure factors related to Operational feasibility.
- **Legality**
    - PP was unable to discern failure factors related to Legality.

3. Overall Success and Failure Factors of Feasibility Studies, Discussion and Future Recommendations

3.1. Overall Success and Failure Factors of Feasibility Studies

To evaluate the success and failure factors of the SLIC pilot partners, a meeting with each pilot partner was conducted. In the meeting, the identified questions in Section 2 were asked, and their answers were noted. Based on the above overview of collected information regarding success and failure factors of the feasibility study, it can be observed that SLIC project either contributed to pilot partners' current PL installation by funding external partners or providing funds to buy new equipment to enhance PL installation with smart technologies (sensors, cameras, radars etc.). Moreover, the lack of technical knowledge of pilot partners is not a reason for conducting a feasibility study. It is observed that this issue was solved by collaborating with another pilot partner or hiring external experts. However, this can be considered as one of the reasons. For delays on planned work on a feasibility study in some pilot partners. Even though there were delays, most of the pilot partners completed the planned works. Another observation is that having enough budget is the main factor for success in applying feasibility study. Most of the pilot partners reported that the budget was enough to run the project. Only Suffolk mentioned that re-arranging budget spending areas requires much effort in terms of communication and formal procedures. Furthermore, based on the reported answers, communication between pilot partners and lead partners is considered a success factor for pilot partners' feasibility study.

It is observed that some pilot partners have a lack of knowledge regarding the legality of new PL installation, this caused some confusion, and they were required to collaborate with other partners to solve the unclarity. Furthermore, some pilot partners have not measured the operational feasibility of PL installation; only Suffolk reported a precise saving energy percentage after smart techniques are installed. The reason for this might be not having enough technical knowledge and depending on other pilot partners. Also, due to different reasons (Covid-19, external organisation dependency), some delays in installing new systems were reported. Accordingly, they need to have some time to observe the energy consumption savings after the new installation. Finally, some pilot partners identified risk factors of new PL installation. However, even though risk factors are identified, most pilot partners have not assessed these risk factors with relevant stakeholders yet.

3.2. Discussion and Future Recommendations

Having an expert staff on the organisation related to the project domain might be a vital element to benefit from the project by improving the efficiency and speed of the project implementation. Another critical point is that some pilot partners did not have a feasibility study before the project started. This brings delays and uncertainty regarding project plan, target and requirements. This could be a consequence of not having an expert team for public lighting in the pilot partner. Also, projects' risk factors on residences and approval procedures of PL installation compliance should be addressed before the project starts.

Furthermore, communication between pilot partners and lead partners remains an essential factor in the feasibility study's success. Consequently, the project leader needs to create a healthy communication network opportunity between pilot partners. Finally, one of the main goals of the project is to reduce energy consumption. However, not comparing energy consumption before-after smart PL technics installation causes some questions regarding whether the project accomplished its goal or not. Therefore, as mentioned at the beginning of this part of the document, when a project starts, an expert team needs to be employed in the pilot partner related to the project that may prevent delays on the implementation of the feasibility study plan and measure the project's feasibility contribution.

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