A blueprint to Monitor & Evaluate the impact of sustainability solutions in redevelopment projects of the public space.

This research explores the possibilities for a system that monitors and evaluates the impact of sustainability solutions in redevelopment projects of the public space to identify the contribution to the stated sustainability ambitions.

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Master of Science Thesis

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Preface

After I finished my Bachelor of Water Management three years ago, I started working for the consultancy and engineering firm DON Bureau. I was able to further develop myself as a young professional. I started advising Dutch municipalities on how to include the sustainability transitions within their redevelopment projects of the built environment and achieve the stated sustainability ambitions for 2030 & 2050. During COVID-19, I chose to follow the two-year MSc Metropolitan Analysis, Design and Engineering program besides my job at the engineering and consultancy firm. The advantage of covid was that all work-related meetings and study lectures were online.

During the MSc program, I still collaborated and interacted with municipalities across the Netherlands. Due to the collaboration and conversation, I started recognising a trend among the municipalities I spoke with. Challenges to embracing and implementing the various sustainability transitions within the built environment should make our society more sustainable. I was interested in the concept of monitoring and evaluation to address the sustainability transitions and learn from it to implement it elsewhere. So, when the final phase of the MSc MADE program started, the thesis phase, I took the opportunity to address the above-stated knowledge gap. I knew that addressing this knowledge gap would not be feasible within the given time. Therefore, this MSc Thesis can be seen as an explorative study. The thesis and delivered product, the M&E blueprint, is relevant for both municipalities on the operational, tactical, and strategic level, the consultants advising municipalities and scholars researching the redevelopment of the public space and sustainability.

Gerd Kortuem and Aksel Ersoy supervised me during this explorative study. I want to thank them for both their supervision and advice. In addition, I would like to thank my colleagues from DON Bureau for their support and feedback while writing the thesis. During this MSc thesis, it was ‘the other way around’; municipalities were advising me on multiple matters. Therefore, I appreciate the municipalities and individuals participating in this explorative research. Most important, I would like to thank my family, friends, and girlfriend for their unconditional support during this journey.

Simultaneously working and studying took a lot of time and effort. Therefore, I am pleased that I can finish the MSc MADE program with this explorative study, which I will continue. It becomes a long but exciting adventure to realise a sustainable society, the dot on the horizon.

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Executive Summary

The built environment is among the most significant contributors to climate change and, simultaneously, the most vulnerable. In recent decades human-induced climate change instigated mitigative and adaptative sustainability ambitions, which stimulated various sustainability transitions to come into existence. Municipalities have been appointed the director role to achieve the stated ambitions by implementing the related sustainability transitions; energy transition, climate adaptation, circular economy, mobility transition and enhancing biodiversity within the built environment.

The public space provides a window of opportunity to assemble the sustainability transitions and simultaneously include these during redevelopment projects such as sewage replacement and renewal. While handling these necessary major and expensive redevelopments, an opportunity for embracing sustainable solutions as part of sustainable transitions arises. In recent years, across the Netherlands, pilot redevelopment projects in the public space were used as a breeding ground to introduce innovative solutions in the conservative municipal organisation. However, despite the window of opportunity, applying sustainable transitions within the public space encounters many difficulties and progresses slowly. The "successful" sustainable solutions in redevelopment projects are not scaled beyond pilot projects. Learning from the applied sustainable solutions, scaling up to other redevelopment projects, and competing with unsustainable solutions is limited. Causes Dutch municipalities are falling behind in achieving the stated sustainability ambitions for 2030 & 2050.

Research question

The precise causes for the limited learning and lacking comprehensive implementation of sustainable solutions beyond the redevelopment pilot projects in the public space are unknown. In addition, the concept of monitoring and evaluation is necessary to learn from these redevelopment pilot projects. Resulting in the following research question:

What is causing that sustainability transitions are not implemented in redevelopment projects, and how can a robust and effective Monitor and Evaluation (M&E) blueprint be composed to learn from pilot redevelopment projects, enabling the broader implementations of sustainable solutions?

The research question combines the two main components of the study, identifying what causes sustainable solutions part of the sustainability transitions is not implemented within redevelopment projects of the public space—and secondly composing and developing a robust, systematic, and integral Monitor and Evaluation blueprint that managers of redevelopment projects can use to monitor and evaluate applied sustainability solutions. Addressing the research question within the given time frame is not conceivable. Therefore, this study has an explorative nature, which means that the study provides preliminary results which require further verification.

Method

This explorative study practises the Design Science Research (DSR) approach to identify the causes for lacking implementation of sustainable solutions and develop a blueprint for a Monitor & Evaluation system and answer the (sub) research question(s). The DSR approach in the explorative study provides four subsequent steps to address the research question: explicate the experienced problem, Define requirements, Design & Develop an M&E blueprint, and Demonstrate & Evaluate the M&E blueprint.

Results- Explicate the problem

Via literature and interviews with municipalities, multiple potential reasons were identified for lacking implementation of sustainable solutions in redevelopment projects. These potential reasons are summarised in five main reasons; conflicting objectives within the public space, the complexity of sustainability within the municipal organisation, the applicability of sustainable transitions and related solutions, the complex municipal

organisation and the opportunity and pitfalls of pilot projects. When sustainable solutions are implemented, it often remains in these pilot projects. The indicated approach to "learn" from these pilot projects and the performance of sustainable solutions to conduct it elsewhere is via monitoring and evaluation. Municipalities have experimented with monitoring and evaluation however it was unsuccessful. Therefore, a root cause analysis is performed on literature and interviewees to identify possible causes. Ten potential root causes have been identified with multiple related causes, the most significant ones governmental/institutional cause, lacking parameters & framework and basics of monitoring.

Define requirements

The outline was stated first to determine the relevant requirements. Using literature and interviews, the outline of the M&E blueprint indicates a robust, systematic, and integral system for effective monitoring and evaluation to enable learning among municipal managers. The relevant requirements based on the outline for the M&E blueprint were inventoried via addressing the root causes in the explication of the problem, a structured literature review, three case studies and the opinion of the interviewees. The inventorying resulted in 14 essential Structural and Design requirements to develop and design the M&E blueprint. Besides, 145 Functional requirements are relevant for implementing the M&E blueprint.

Design and develop M&E blueprint

The M&E blueprint is developed using a brainstorming session, three case studies and three focus group discussions. The M&E blueprint is developed in a PowerPoint document. It provides a robust, systematic, and integral process that project managers (operational level) can use in collaboration with the tactical level to create their M&E system that effectively monitors and evaluates applied sustainability measures within (pilot) redevelopment projects. The M&E blueprint consists of ten steps that should be followed to create an effective monitoring and evaluation system. Implementing the M&E blueprint is related to the project phases of a redevelopment project. The following phases are defined, and associated steps are stated: *Initiation phase:* Step 1 (M&E start assessment & agreements), *Plan study:* 2 (Define Boundary and Key Performance Indicators), 3 (Minimal data requirements) & 4 (Selecting targets), *Plan developing/design phase, Realisation phase* and *Using/maintenance phase*: steps 5 (Monitoring), 6 (Store and Calculate), 7 (Dispatch) and 8 (Report and evaluate). Steps 9 (Sustaining the system) and 10 (Data governance & Safety) should be considered throughout the project phases. The M&E blueprint can be operated without the thesis document. All necessary information is within this blueprint.

Demonstrate and evaluate

Due to the explorative nature of the thesis project and the limited time frame, the M&E blueprint was not demonstrated nor evaluated within an existing project. However, the M&E blueprint was demonstrated via a recorded presentation. In this video, the M&E blueprint, its function, and operation in this video were explained. Based on the video presentation, interviewees and participants of the focus group discussion could fill in a survey. The survey provided insight into the opinion of the interviewees and participants regarding the M&E blueprint. It is impossible to draw any fundamental conclusions on the M&E blueprint based on the limited number of respondents to the survey. However, the survey provided some points of interest and indicated that respondents' opinions regarding the M&E blueprint are positive to explore and use the M&E blueprint beyond this explorative study.

Conclusion

Based on the defined problem, a solution is subsequently developed to tackle the identified challenges and enable the broader implementation of sustainable solutions. Since the study is explorative, each interim result requires deepening and elaboration. It can be concluded that multiple challenges need to be overcome. Although, that is part of a transition. In the coming years, the implementation of sustainable transitions and related solutions should be increased to achieve the stated sustainable ambitions in 2030 and 2050. This explorative study has indicated the potential of redevelopment (pilot) projects in the public space to include

sustainability solutions and the causes that limit the implementation of sustainability. The first version of an M&E blueprint is created, enabling project managers (operational level) to use it in collaboration with the tactical level to create their M&E system that effectively monitors and evaluates applied sustainability measures within (pilot) redevelopment projects.

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1.

Chapter 1: Introduction

Chapter 1 introduces the conducted explorative study, indicates the relevance, and starts scoping the addressed challenge. Section 1.1 will start by introducing the necessity for sustainable urban areas. Based on the necessity, the translation in Section 1.2 made toward Dutch sustainable urban areas and the various sustainability transitions which co-occur in the urban areas. The sustainability transitions are framed and extensively elaborated using the multilevel perspective. Section 1.3 clarifies that in the coming years, a Window of Opportunity arises to include these necessary sustainability transitions within redevelopment projects of the public space. However, the comprehensive implementation of the transitions, especially the public space, lacks what will be elaborated on in Section 1.4. Monitoring and Evaluation are introduced in Section 1.5 as possible solutions to overcome the various challenges. These five sections will thoroughly introduce the topic and substantiate the motivation of this explorative study in Chapter 2.

1.1 The urge for sustainable urban areas

It is evident that the planet's climate system and the unsustainable worldwide societies are inextricably connected and interdependent (Ljungqvist et al., 2020). In 1990 the Intergovernmental Panel on Climate Change (IPCC) published for the first time that climate change is occurring and that it would affect "every sector and individual" (Intergovernmental Panel on Climate Change, 1992). Although the earth's climate has encountered multiple temperature shifts throughout history, the current warming trend is significant (NASA Global Climate Change, 2021). The IPCC report in 2021 concludes that global warming is unequivocally linked to human activities and thus 'anthropogenic of nature' (Masson-Delmotte et al., 2021; Valente et al., 2022). Therefore, almost all nations have signed the Paris Climate Agreement (PCA) and stated (sustainable) ambitions to limit global warming to a max of 2°C and preferably 1.5°C by reducing the human contribution to climate change (European Commission, 2015). The most pressing human contribution is the emission of greenhouse gasses (Hsiang & Kopp, 2018; Yoo et al., 2021).

Environmental-related research widely uses the broad concept of sustainability in restraining artificial climate change, according to Ruggerio (2021). The Brundtland report (1987) states sustainability is "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Past and current generations are compromising the ability to meet their needs and induce an artificial climate change (Masson-Delmotte et al., 2021).

There is an increased focus on urban areas becoming sustainable and thus limiting global warming because the built environment and infrastructure experience a significant threat from extreme climate events (Filho et al., 2019; Lin et al., 2021). Urban areas are hubs of socio-cultural, scientific and technological innovations (Filho et al., 2019; Rosenzweig et al., 2010). Therefore, over half of the world's population lives in urban areas, increasing to nearly 70% (6.3 billion people) in 2050 (Filho et al., 2019). The increase in the urbanised population will cause even more exposure to climate-related threats (Obringer & Nateghi, 2021; Lin et al.,

2021). Simultaneously urban areas worldwide are responsible for over 70% of the global carbon emissions and 60% of international energy use while the spatial coverage of the urban areas is only 2% (UN-Habitat, 2016; Filho et al., 2019; C40 Cities, 2021). Therefore, urban areas are crucial in transiting mitigating and adapting (sustainable) ambitions for 2030 and 2050.

1.2 The Dutch transition(s) towards sustainable urban areas

Aligned with the international ambitions of the PCA, the Netherlands stated, 'The climate law' (Klimaatwet, 2018) to prevent 2°C global warming via national climate goals for 2030 and 2050 (Rijksoverheid, 2019). The Dutch government have translated the PCA and climate law into the climate agreement (Klimaatakkoord, 2019), which states sectoral measures and agreements. The climate law and climate agreement form the foundation of the Dutch Climate plan (Klimaatplan, 2021). These Dutch agreements and documents state to reduce 49% of the emission of greenhouse gasses such as CO2, CH4, N2O and F-gasses in 2030 and to be 'climate neutral' (95%) in 2050 compared to 1990 (*Figure 1*) (Ministerie van Economische Zaken, 2020).

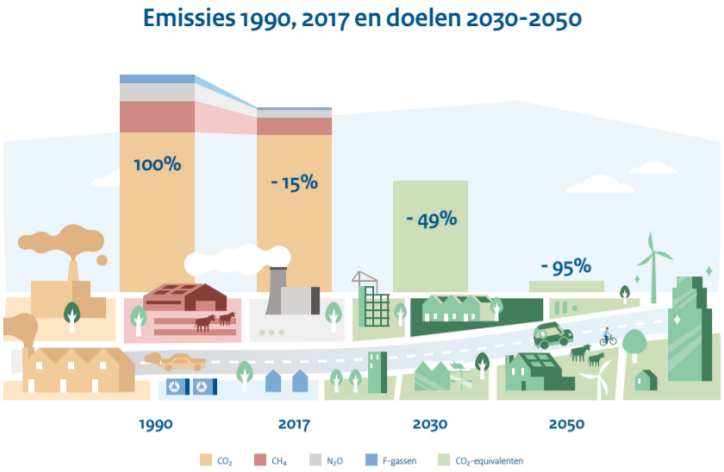


Figure 1 – Emission reduction goals (Ministerie van Economische Zaken, 2020)

On the other hand, the Netherlands have formulated adaptation policies to counter climate-related risks such as heat, drought, and pluvial- and fluvial flooding (Ministerie van Economische Zaken, 2020). By 2050 climate-related damage could accumulate to €77,5 and €173,6 billion if adaptation of the Netherlands is limited (Ministerie van Algemene Zaken, 2021). The Dutch Delta program and the national climate-adaptive strategy intentionally create a climate-adaptive Netherlands (Kennisportaal Klimaatadaptatie, z.d.). The governmental stated adaptive and mitigating ambitions triggered multiple transitions (Rijksoverheid, 2019; RIVM, 2022).

Defining transitions

A *transition* is a complex system change responding to external pressure triggered by internal innovation (Garcia et al., 2019). Structural and cultural tensions such as pollution, environmental awareness, and resource depletion ignite a transition (De Haan & Rotmans, 2011). If a current regime is inadequate in providing societal needs in the way societal needs are required to halt tensions, one speaks of stress. According to De Haan & Rotmans (2011), the final condition is pressure. The alternatives to the functioning of existing regimes can emerge and become viable competitors. Due to the accumulation of tensions such as climate change, increased pressure is created on existing arrangements and eventually causes existing regimes to transit by the pressure of viable competitors (Geels, 2005; De Haan & Rotmans, 2011). In general, a transition can relate to a manifold of societal systems, "financial systems, energy supply, healthcare

agriculture, policy systems etc.", which fulfil societal needs such as transportation, housing, communication and feeding (Geels, 2005; De Haan & Rotmans, 2011; Ernst et al., 2016).

Scoping sustainable transitions and characteristics

In addition to transitions, this study addresses sustainability transitions (Drift, 2020). Sustainability transitions are defined as a "radical transformation towards a sustainable society, as a response to several persistent problems confronting contemporary modern societies" (Smith et al., 2010). In addition to the definition provided by Garcia et al. (2019), sustainability transitions have the primary purpose of creating a sustainable system. At the same time, the definition of Garcia et al. (2019) is to innovate, which could be related to sustainability, although it is unnecessary.

In contrast to Garcia et al. (2019) that the underlying motivation for sustainability transitions recognises that environmental problems, such as climate change, loss of biodiversity and resource depletion, cannot be addressed by incremental improvements and innovations (Smith et al., 2010; Köhler et al., 2019). It requires a radical shifting to a sustainable socio-technical system, a sustainability transition (Köhler et al., 2019). Sustainability transitions have several demanding characteristics:

- *Multi-dimensionality and co-evolution*: multiple elements such as technologies, markets, user practices, infrastructure supply chains and policies. Transitions are therefore seen as evolutionary processes (Köhler et al., 2019).
- *Multi-actor process*: represented by various actors and social groups such as civil society, politics, academia, industry, and households. Each group has interests, capabilities, and resources (Köhler et al., 2019).
- *Stability and change*: Some discrepancies need to be solved. On the one hand, there are many green innovations and practices (water infiltration fields, electric vehicles, or bio-composites for pavement). While on the other hand, there is a sincere rooted system around conventional non-sustainable practices such as petrol cars, mixed sewage systems or blasting furnaces using coal or natural gas to create cobblestones (Walker, 2000). The shifting requires a stable system change (Köhler et al., 2019).
- *Long-term process*: A transition is a process that may take decades to unfold (Rotmans, 2011). This is mainly because radical 'green' innovations and practices take a long time to develop, from niche development to widespread diffusion.
- *Open-endedness and uncertainty*: Since multiple potential innovations and initiatives may fail, experience setbacks or shifts in the public agendas are creating numerous possible pathways for a sustainable transition (Rosenbloom, 2017). Causing the future is open-ended and creates uncertainties about what the future will look like (Köhler et al., 2019).
- *Values, contestation, and disagreement*: The sustainability debate is often highly contested and consists of different actors and social groups who disagree about the innovations and initiatives. Furthermore, businesses and industries are likely to protect their interest and restrain the need and speed of transitions (Köhler et al., 2019).
- *Normative directionality*: Sustainability is a public good; a private actor has limited possibilities to address it. Therefore, public policy must play a vital role in shaping the directionality of transitions through environmental regulations, subsidies, taxes, policies, and standards (Köhler et al., 2019).

Köhler et al. (2019) advocate that clarifying and determining the big picture is essential while addressing sustainability transitions. Reasonably, in contrast to other sustainability approaches, such as eco-innovation, environmental economics or industrial ecology, sustainability transitions are multi-dimensional

and multi-actor processes, consist of long-term orientation that acknowledges the systemic dimension and is not always technocratic (Köhler et al., 2019).

Framing sustainable transitions with multi-level perspective theory

The conducted explorative study draws on the multi-level perspective (MLP) theory to position the sustainable urban transitions as argued by both Geels (2002) and Smith et al. (2010). The MLP theory provides a conceptual framework for understanding transitions and the interplay between three analytical levels of niches, regimes, and landscapes (*Figure 2*). Niches are protected areas that enable the development of radical innovations (De Haan & Rotmans, 2011; Ernst et al., 2016). These (sustainable) niches may break through if the socio-technical landscape development puts pressure on the existing regime, which will provide a window of opportunity. The socio-technical regimes represent, in the simplest terms, existing ways of acting (habits). It represents the institutional structuring of present systems and the path toward desired sustainable system (De Haan & Rotmans, 2011; Ernst et al., 2016). Interactions between niches and regimes occur on multiple levels, such as technologies, regulations, markets, or cultural meanings, according to Smith et al. (2010). These interactions are promulgated by actors who all have an idea or interest in the third layer, the socio-technical landscape (Köhler et al., 2019). Regarding the sustainability transitions in an urban context, the changing societal values regarding the unsustainable urban areas which drive climate change put pressure on the existing regime. The pressure created a window of opportunity for niche-level innovations to enter (Geels, 2005).

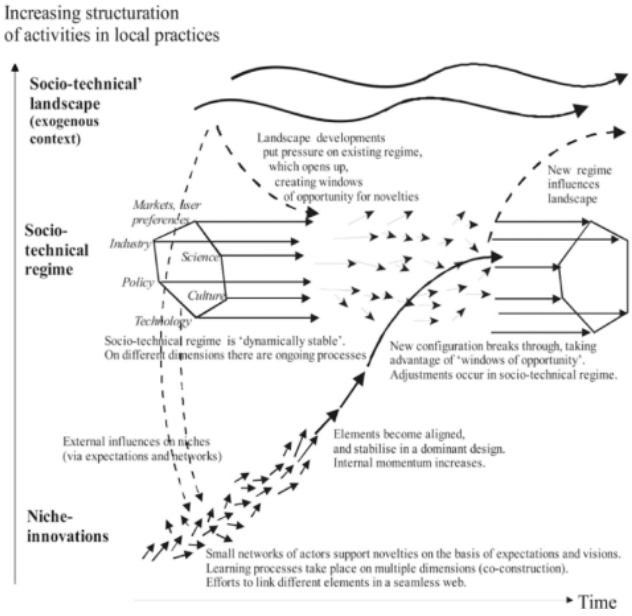


Figure 2 - structuring activities in local practises (Geels, 2005)

In addition to the MLP, according to Ernst et al. (2016) and Köhler (2019), there are different perspectives to realise sustainable urban places via transitions. The explorative study uses the perspective that realising a sustainable urban place influences the urban development regime by indicating the potential of sustainable solutions over conventional solutions (Peek & Troxler, 2014). Because this perspective, in contradiction to the other two presented views by Ernst et al. (2019), aims to change the non-sustainable system besides the urban structures. To summarise, it is advocated by Peek & Troxler (2014) and Ernst et al. (2019) that besides implementing niche-level innovations, the regime level should be altered as well.

The addressed sustainability transitions in this explorative study.

According to Köhler et al. (2019), scholars propose multiple research directions to address sustainability transitions: 1) deliberately ascertain the phasing out of existing systems due to pressure of niche

innovations, 2) determine the tipping points of, for instance, climate change that requires acceleration of transitions, 3) the interaction between various emerging and existing technologies or niches and the dynamics on the socio-technical system, 4) speed of transitions and the possibilities to accelerate, 5) assessment of path dependency and related cracks in regimes, 6) mobilise insights from other social science fields to understand transitions and lastly 7) *'zooming out' to develop a more encompassing understanding of various sustainability transitions that co-occur.*

The last research direction is especially relevant in this study because the concept of sustainability relates to multiple topics and therefore requires the 'bigger picture' proposed by Köhler et al. (2019). Including vital interactions and collaboration between numerous systems such as electricity, waste and water, heat and electricity, or mobility and biodiversity (Papachristos et al., 2013; Köhler et al., 2019). Multiple sustainable transitions co-occur within urban areas, purposely altering the non-sustainable regime levels and non-sustainable systems into sustainable ones (Grin et al., 2010; Jonker & Faber, 2018).

Within this explorative study, five sustainability transitions will be specifically addressed. The reasoning for specific five sustainability transitions is based on literature and interviews with municipalities, and the argumentation is elaborated as a result in Chapter 3.1. The following sustainability transitions are addressed:

- *Energy transition*: The energy transition is characterised by shifting energy systems (electricity, heat and cold) that rely heavily on fossil fuels such as natural gas, oil or coal and inflict an anthropogenic climate change - towards an energy system that is based on energy harvested from sustainable sources like wind, solar energy, or energy harvested from water (Bompard et al., 2022). The Netherlands aims to reduce Dutch greenhouse gas emissions by 80 to 95% by 2050 compared to 1990. Often addressed concepts such as climate neutral, CO2-deficit or energy neutral all have the purpose above (Planbureau voor de leefomgeving, z.d.; Shahbaz et al., 2022)

- *Climate adaptation*: Climate adaptation aims to limit and reduce or at least manage the consequences of climate change. According to the Dutch Ministry of Infrastructure and Water (2016), it concerns shades, nuisance, diseases, premature death and adverse changes in environmental quality and ecosystems caused by pluvial and fluvial flooding, heat, and drought, which are consequences of a changing climate. Simultaneously, climate adaptation aims to benefit from the new occurring situation. The overall ambition is to create a climate-adaptive Netherlands (Ministry of Infrastructure and Water et al., 2016)

- *Circular economy:* The shift from a linear (consumption) economy to a circular economy is a necessity due to the increasing demand for raw materials and scarcity of resources: several crucial raw materials are finite, and in addition, the market is increasing due to the growth of the world population (European Parlement, 2022). The Netherlands wants to have a circular economy by 2050. The circular system is restorative or regenerative by intention and design. Based on designing out waste, introducing a differentiation between consumable and durable components of a product and the energy to complete this cycle should be based on renewables (RIVM, z.d.; Towards a circular economy, 2013).

- *Sustainable mobility system:* The mobility sector has the largest share of energy-related emissions (Melkonyan et al., 2022). Therefore, the Netherlands strives to create a sustainable mobility system. Within urban areas, this requires the reduction of non-sustainable movements, changing means of

transport and using sustainable energy sources (DRIFT - Dutch Research Institute for Sustainability Transitions & CROW, 2021).

- *Enhancing biodiversity*: Biodiversity is seen as the variability among living organisms, including marine, terrestrial (soil) and other aquatic ecosystems, including the complexes of which they are part (Halkos & Matsiori, 2022). Including the diversity within and between species and related ecosystems. In recent years habitat loss due to anthropogenic influences such as infrastructure and urbanisation has caused biodiversity degradation (Sponagel et al., 2022). Biodiversity loss affects several aspects of human well-being, such as food and energy security, vulnerability to natural disasters and access to clean water and raw materials (The World Conservation Union (IUCN) et al., 2005; European Parlement, 2021). Therefore, biodiversity should not only be enhanced within nature reserves but everywhere, according to Ministerie van Algemene Zaken (2022). With its nature policy, the national government wants to preserve and strengthen Dutch nature in urban areas and make it part of renovations within urban areas. Focuses on the conservation of biological diversity, sustainable use of biodiversity and fair sharing of biodiversity benefits among individuals (Bouwma et al., 2014).

The similarity of the above-stated transitions is that it is a long-term process of radical and structural change in the societal systems within urban areas as a response to various sustainable problems which modern societies are confronting (Grin et al., 2010: Drift, 2020). The included sustainability transitions all have the earlier stated seven characteristics by Köhler et al. (2019).

The need for a transdisciplinary approach

In recent years multiple institutes like ministries and municipalities amplified by academia indicated an urgency for a transdisciplinary or integral approach to sustainability transitions within urban areas (Esmail et al., 2020). The Ministry of Infrastructure and Water et al. (2016) and Planbureau voor de Leefomgeving (2021) indicate that transitions influence and strengthen other transitions on a solution level if implemented sufficiently, as will be shown in *1.3*. In addition, urban areas are part of the non-sustainable system and provide an opportunity to implement niche innovations or proven competitors as part of the above transitions (Maring & Blauw, 2018).

It is indicated that the public space provides an essential Window of Opportunity to simultaneously address niche innovations of sustainable transitions in urban areas during necessary redevelopment projects (Esmail et al., 2020; Duivenvoorden et al., 2021). The following section (1.3) indicates and clarifies the Window of opportunity to include the stated sustainability transitions and specifies examples of the niche-innovations part of the transitions.

1.3 The Window of Opportunity: Sustainable redevelopment of the public space

Each Dutch municipality has been appointed a director for the various transitions within its municipal domain (Programma Aardgasvrije Wijken, z.d.). This is explicitly stated for some transitions, like the energy transition, while it is not that obvious for other transitions like enhancing biodiversity. The municipality must align with the national mitigation and adaptation policies. However, implementing sustainable solutions related to sustainability transitions to commit to the ambitions is complex due to a densified built environment where space is often limited, interferences with many stakeholders and limited budgets are available (Verma & Raghubanshi, 2018). An integrated and transdisciplinary approach among various

departments and stakeholders is necessary to fit the sustainability transitions within the public space (Esmail et al., 2020). The public space has the potential to tackle the sustainability urgency.

As part of the urban places in the Netherlands, public space makes up a significant percentage of the total space (VROM-raad, 2009). Public space has a public function where people can meet and live, such as streets, squares, parks, stations and libraries. For instance, in Rotterdam, 51% is classified as public space and nationally is estimated that 2.250 km2 is urban places (VROM-raad, 2009). Annually, the Netherlands spend 15 billion euros on maintaining and renovating public spaces (Katteler & Winkels, 2002; Architecture Workroom Brussels et al., 2020). The renovation of significantly below-ground infrastructure issues a substantial cost (Maring & Blauw, 2018). Furthermore, according to Maring & Blauw (2018), the below and above-ground infrastructure is a dynamic system that feeds and transports the never-ending urban metabolism services of energy, water, waste, and food flows.

Redevelopment in the public space

Fixed cycles indicate the replacement periods of the infrastructure and associate budgets and planning (*Figure 3*). City management follows strict planning and funding to always be in the right place at the right time. As indicated in *Figure* 3, in recent years, extensive maintenance work within the public space has been tuned to other maintenance work as indicated with the red dotted line (Architecture Workroom Brussels et al., 2020).

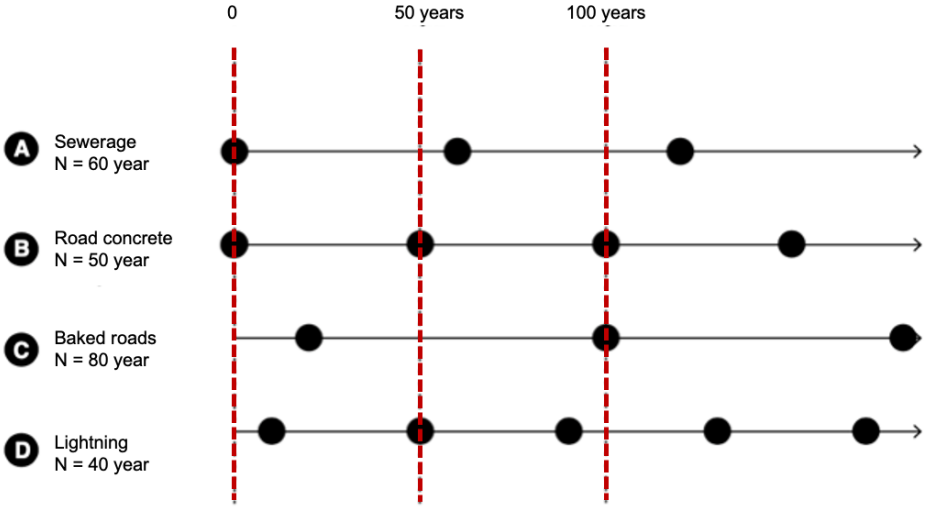


Figure 3 - indicative replacement periods (Architecture Workroom Brussels et al., 2020)

However, the cycle of redevelopment is dependent on various spatial components. Each element in the public space has its own 'real life' expectancy. The management work package is divided into three groups.

1. *Daily caring maintenance: mowing, hoeing, picking dirt, sweeping dirt*

Example of daily care maintenance: pruning hedges visualised in *figure 4*.
Figure derived from: https://www.stadswerk.nl/archief/522351.aspx?t=beheer+en+onderhoud+openbare+ruimte+uitbesteden%3F

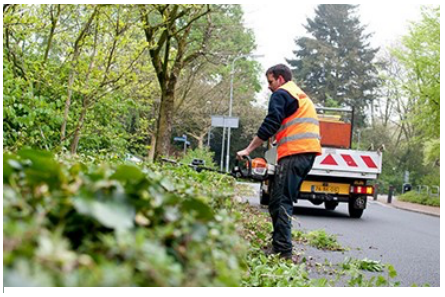


Figure 4 - Example pruning hedges

2. *Planned maintenance: sewer and bridge inspections, pest control, minor road repairs*

Example of planned maintenance: sewerage inspection with an inspection robot visualised in *figure 5.*
Figure derived from: https://www.fab-beheer.nl/camera-inspectie-riolering/

Figure 5 – Example sewerage inspection

3. ***Major maintenance**: replacement of sewers, bicycle paths, bridges*

Example of significant maintenance/renovation: sewerage replacement visualised in *figure 6.*
Figure derived from: https://www.hakbv.nl/diensten/riolering.html

Figure 6 – Example sewerage inspection

This explorative study focuses on the major maintenance and renewal (*figure 6*) or, as this study states, redevelopment projects. Especially the replacement of sewers is guiding for redevelopment because it concerns a significant operation performed in phases, and the process has little flexibility (Stadsbeheer Rotterdam, afdeling Water, 2020). Moreover, the activities are time-consuming and require multiple expensive interventions; the existing road must be removed, excavations, old sewerage removal, connection and install a new sewerage system and restructure the public space and road above it (RIONED, z.d.). This explorative research focuses on municipalities since these governmental bodies are responsible for the public space and necessary redevelopments.

Transitions in the public space

In the coming years, a window of opportunity arises since many public infrastructures are at the end of their lifecycle and about to be replaced (Duivenvoorden et al., 2021). While handling these necessary major and expensive redevelopments, an opportunity for embracing sustainable transitions arises (Maring & Blauw, 2018; Duivenvoorden et al., 2021). Including sustainability, transitions require the implementation of niche-level developments or sustainable solutions. To clarify the sustainability transitions, each transition is divided into relevant themes within the public space. Each theme is clarified with specific sustainable solutions. This clarification will outline the impact transitions will have within the public space.

1. Energy transition

The energy transition aims to reduce green is to reduce greenhouse gas emissions by generating sustainable energy like heat, cold and electricity instead of non-sustainable energy sources (Planbureau voor de leefomgeving, z.d.; Shahbaz et al., 2022). Besides, energy production also includes energy recovery, storage, transportation, and energy consumption (energieregio Noord-Holland, 2022). Specifically, multiple (radical) sustainable solutions contributing to the energy transition must be implemented within the public space.

Figure 7 – Carport of solar panels

- *Production*: The production of energy could be done by solar panels on the surface.
  Figure derived from: https://inframarks.nl/solar-carport-old/solar-carport-met-zonnepanelen/

- *Recovery*: thermal energy (heat) can be recovered from the sewerage system and used to heat the houses within the built environment (Rio thermal energy recovery).
  Figure derived from: https://www.joostdevree.nl/shtmls/riothermie.shtml

Figure 8 - Riothermal energy recovery from sewerage

- *Storage*: the produced energy must be stored locally; a solution is an aquifer with thermal energy storage. Heat and cold are stored via a heat exchanger (counter-current device, TSA) in a water-carrying sand package 90 meters deep in the ground.
  Figure derived from: https://www.wur.nl/en/show/Aquifer-Thermal-Energy-Storage.htm

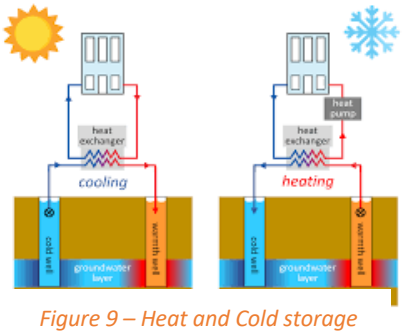


Figure 9 – Heat and Cold storage

- *Transportation*: the generated or recovered energy must be transported. The heat grid is located within the public space.
  Figure derived from: https://www.duurzaambouwloket.nl/maatregel/warmtenet

Figure 10 - Heat grid

- *Consumption:* assets in the public space require energy to function. Public lighting could use less LED than conventional lighting to reduce energy consumption.
  Figure derived from: https://nl.schreder.com/nl/openbare-verlichting-led

Figure 11 – LED lightning

2. Climate adaptation

Climate adaptation addresses the consequences of climate change and reduces the vulnerability of urban areas, specifically focussing on fluvial and pluvial flooding, periods of drought and heat stress. Within the public space, multiple solutions can be implemented to limit the vulnerability to climate change (Ministry of Infrastructure and Water et al., 2016)

- *Pluvial flooding*: to reduce the vulnerability of flooding from rivers, lakes and the sea, the public space could be elevated and excavated in specific locations to prevent direct flooding of the entire area.
  Figure derived from: https://www.provincie-utrecht.nl/sites/default/files/2021-10/Handreiking%20Overstromingsrobuust%20Inrichten%20%28Januari%202020%29.pdf

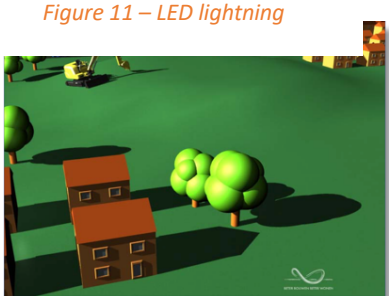


Figure 12 – Elevating and excavation of areas

- *Fluvial flooding*: to reduce the vulnerability of flooding from excessive rainwater and groundwater, water infiltration crates can be located beneath the surface of parking spaces to store water.
  Figure derived from: https://nl.urbangreenbluegrids.com/measures/infiltration-boxes-and-infiltration-drainswells/

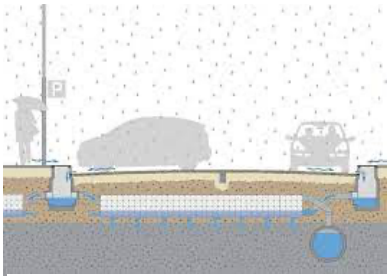


Figure 13 – Water infiltration crates

- *Drought control*: Despite the periods of excessive rainfall, there are also periods with limited rainfall. Causing the soil and greenery to dry up, impacting the living environment. Therefore, rain and groundwater need to be stored within the public space. A possible solution is a wadi. A wadi is a green ditch which holds the water and subsequently infiltrates the soil.
  Figure derived from: https://rotterdamsweerwoord.nl/tip/wadi/

Figure 14 - Wadi

- *Heat stress*: Extreme periods of warm weather can cause heat stress, especially in urbanised areas with a petrified area creating an unpleasant environment for citizens. One way of dealing with heat stress is to create shadow within the urban area via, for example, trees.
  Figure derived from: https://www.hva.nl/binaries/content/assets/subsites/kc-techniek/publicaties-klimaatbestendige-stad/hva_2020_hittebestendige_stad_online.pdf

Figure 15 – Creating shadow with trees

3. Circular economy

Promoting a circular economy does not require a single goal but a set of goals that focus on using raw materials and the effects of using raw materials (RIVM, z.d.; Towards a circular economy, 2013). It is helpful to distinguish between goals aimed at more efficient use of natural materials as such (circularity goals) and goals aimed at the environmental and socio-economic effects of raw materials use (effect goals) (Planbureau voor de Leefomgeving, 2021).

Circularity targets can be formulated for the input of raw materials, the use of materials and products and the output of raw materials in the form of waste. For the environmental and socio-economic impacts that a circular economy should deliver and for which it seems helpful to formulate headline targets, the Planbureau voor de Leefomgeving (2021) proposes to consider at least the following: contribution to climate change, biodiversity loss, pollution of air, water and soil, and supply risks of raw materials. The socio-economic goals are described since the effect goals are solution-dependent.

- *The input of raw materials*: use fewer raw materials in total (narrow the loop) by forgoing products (refuse), sharing products (rethink) or manufacturing them more efficiently (reduce)

- *Use of materials and products*: slowing down the demand for new raw materials (slow the loop) by giving products or parts a more extended life through reuse (reuse) and repair (repair and remanufacture)

- *Waste output in the form of raw materials*: closing the cycle (close the loop) by recycling materials so that less waste is created that must be incinerated or landfilled and fewer new raw materials are needed (recycle)

- *Socio-economic impacts*: substitution of finite raw materials by renewable raw materials or alternative primary raw materials with less environmental impact.

Figure derived from: https://www.researchgate.net/figure/R-ladder-of-circularity-strategies-Source-Netherlands-environmental-assessment-agency_fig2_352518011

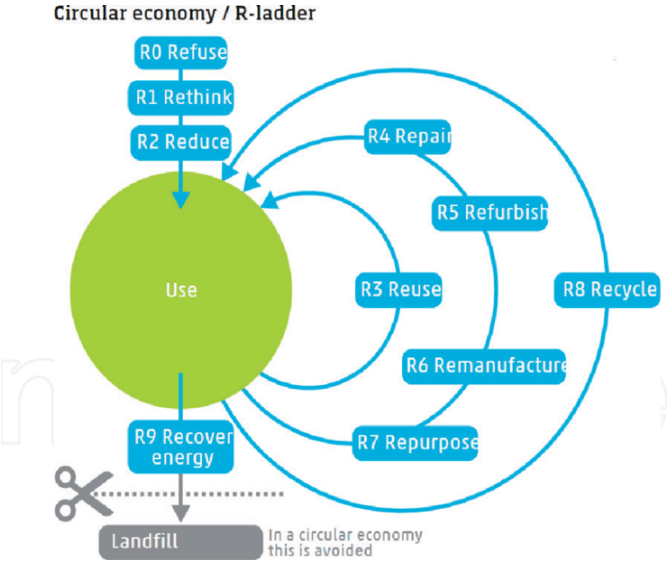


Figure 16 – Using the R-ladder approach within redevelopment

4. Sustainable mobility system

To create a sustainable mobile system within urban areas, the focus is established on reducing non-sustainable movements, changing means of transportation and using sustainable sources for transportation (DRIFT - Dutch Research Institute for Sustainability Transitions & CROW, 2021).

Figure 17 – 10-minute city concept

- *Reducing movements*: reducing the distance of needed actions. This can be achieved via urban densification of urban necessities. The concept of a 10-minute city is widely introduced to ease signs.
  Figure derived from: https://omgevingsvisie.utrecht.nl/de-koers/ruimtelijke-strategie-utrecht-2040/samenvatting/

Figure 18 – Bicycle Street

- *Changing transport means*: the purpose is to switch away from car use and stimulate other means of transportation such as cycling via a specific bicycle street.
  Figure derived from: https://indebuurt.nl/bergenopzoom/gemeente/mag-dat-met-je-auto-fietsers-inhalen-op-de-fietsstraat-in-bergen-op-zoom~117933/

- *Sustainable transportation*: Using sustainable energy sources for transportation by, for instance, city buses that use electricity instead of gas or petrol.
  Figure derived from: https://www.vdlgroep.com/nl/nieuws/archief/2018/ret-gunt-55-elektrische-bussen-voor-regio-rotterdam-aan-vdl

Figure 19 – Electric bus

5. Increasing biodiversity

The national government wants to preserve and strengthen Dutch nature in urban areas and make it part of renovations within urban areas. The focus remains on the conservation of biological diversity, sustainable use of biodiversity and fair sharing of biodiversity benefits among individuals (Bouwma et al., 2014).

Figure 20 – Green corridors

- *Conservation of biological diversity*: To maintain or improve biological diversity, a practical solution in combating the fragmentation of nature reserves within the public spaces and creating a corridor of green areas.
  Figure derived from: https://www.platformstad.nl/botsingskansen/ontwerp-groene-promenade/

Figure 21 – Urban agriculture

- *Sustainable use of biodiversity*: to maintain biodiversity in urban areas, it is necessary to use it sustainably. Urban gardening with producing various fruits and vegetables within the public space is a solution for the sustainable use of biodiversity.
  Figure derived from: https://www.urbangreenbluegrids.com/agriculture/

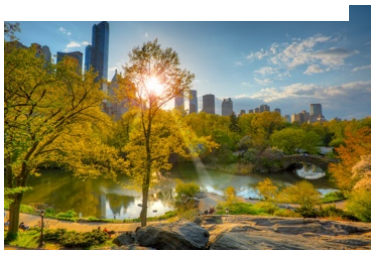


Figure 22 – public green space

- *Fair sharing of biodiversity benefits*: Biodiversity provides many benefits for urban dwellers. Therefore, each citizen should profit from the greenery and related biodiversity. It is essential to remain a public good and equally distributed in the city.
  Figure derived from: https://www.elsevier.com/connect/atlas/Urban-forests-make-megacities-more-environmentally-sustainable

Nexus of combining sustainability transitions during the redevelopment of the public space

The above-stated transitions and related sustainable solutions will require space within the packed public spaces to meet the desired ambitions. It creates immense pressure on the current available space and requires communication between the fragmented municipal departments within a municipality to organise it effectively (Esmail et al., 2020; Duivenvoorden et al., 2021). An example of these necessary implementations is visualised in *Figure 23*, a vision of the Municipality of Utrecht for the public space in 2040. It indicates the pressure below and above ground of necessarily sustainable transitions within the public space. Simultaneously substantiates the need for an integrated approach (Gemeente Utrecht, z.d.).

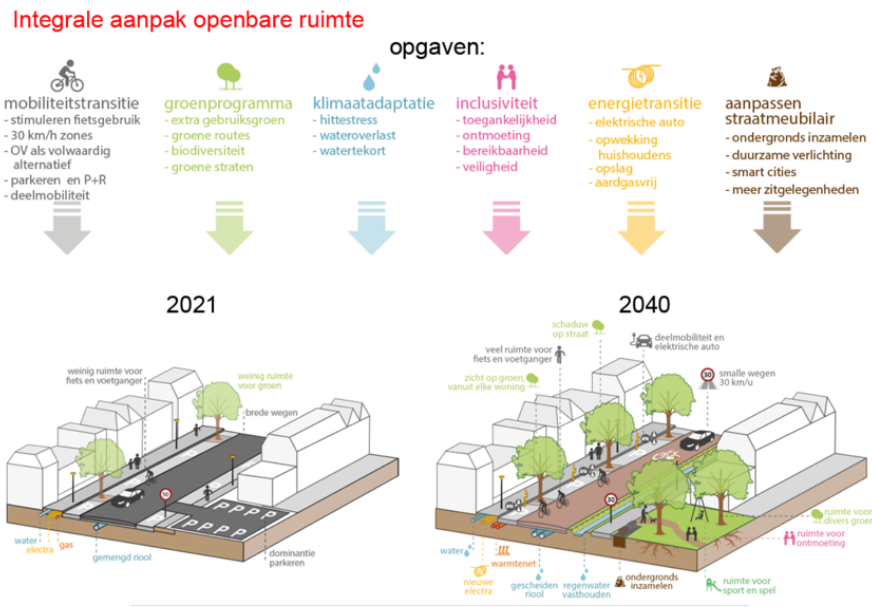


Figure 23 – Vision 2040 for integrated approach of the public space (Gemeente Utrecht, z.d.)

A window of opportunity arises to maintain the public space and include sustainable solutions. Best practices concluded that the inclusion of sustainable solutions in the renovation of the public space potentially reduces 30% of the total cost compared to when works are applied separately (Architecture Workroom Brussels et al., 2020). At this moment, public space redevelopment is often seen as a "no man's land" among buildings to fill in gaps in city planning, restoration, design transport management and other disciplines (Coisson et al., 2016). While accordingly, redevelopment projects in the public space are the nexus to considering sustainable solutions to maintain the quality of the urban space and achieve sustainable ambitions simultaneously (Maring & Blauw, 2018; Duivenvoorden et al., 2021). In addition to the Window of opportunity, the newly formulated Coalition Agreement (2021 – 2025) provided additional financial availabilities of 35 billion to implement sustainable transitions (Rijksoverheid, 2022; VVD, D66, CDA en ChristenUnie, 2021).

Niche innovations have emerged within the public space to replace non-sustainable practices and alter the non-sustainable system. It is time to implement sustainable solutions on a larger scale to meet sustainable goals. However, news articles and reports indicate that applying the transitions within the public space encounters many difficulties and progresses slowly (Leeuw, 2019; Bestuursacademie Nederland, 2020; Ministerie van Binnenlandse Zaken en Koninkrijkrelaties, 2022). Various difficulties such as the complexity of transitions cause the limited implementation of sustainability solutions, limiting the seizing of the window of opportunity available only once in decades to reach its full potential.

1.4 The problem: identification of performance

Advancing urban sustainability and altering the regime, as described by Geels (2002), Smith et al. (2010), De Haan & Rotmans (2011), and Ernst et al. (2016) requires various initiatives to shift regimes, e.g., policies, urban planning, behavioural, and technology to more sustainable one (Kissinger & Stossel, 2021). This means that the current regime needs to be altered as well, besides the implementation of niche-level innovations, also stated by Peek & Troxler (2014) and Ernst et al. (2019) in *1.2.* For the alteration of the regime level, it is relevant to state the current structure of municipalities because municipalities maintain these non-sustainable regime levels and have the opportunity to change these.

‘Implementing’ sustainability ambitions in pilot redevelopment projects.

Aligned with national sustainable ambitions, Dutch municipalities stated policies related to the ambitions on a strategic level (Rijksoverheid, 2019; Klimaatplan, 2021; Ministerie van Binnenlandse Zaken en Koninkrijkrelaties, 2022; RIVM, 2022). To endeavour the policies, strategies are formulated on the tactical level. The initiated strategies will facilitate project managers of redevelopment projects with specific attention to transition topics such as heat stress and energy production. The project manager of a redevelopment project is responsible for which sustainable solutions will be implemented alongside the renovation works. The strategic level is therefore heavily dependent on the outcome of projects on an operational level to achieve their ambitions. At the same time, the operational level is dependent on clear description and support from a tactical and strategic level to translate the ambitions and related sustainability transitions within the redevelopment project (figure 24). *For the justification of the municipality's structure, Chapters *5.2 & 5.3.*

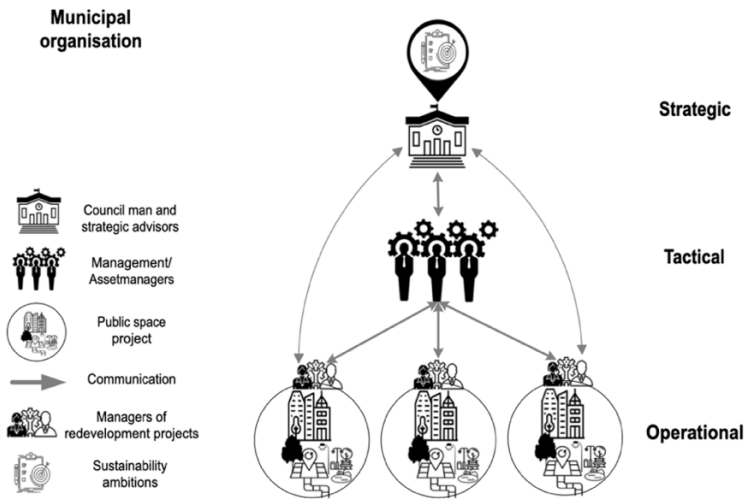


Figure 24 - the municipal organisation (author creation)

Especially, pilot projects are created as a breeding ground to introduce niche innovations (Van Winden & Van den Buuse 2017). In recent years many pilotprojects have been executed including sustainable solutions (Rijksdienst voor Ondernemend Nederland, 2021; Gemeente Amsterdam, 2022a). However, a municipality's broader implementation or upscaling is often lacking (Van Winden & Van den Buuse, 2017). According to Grin et al. (2010), to compete with the current regimes, outperform them and overtake them, the expectations of niche innovations must align with the expectations of the prevailing regime. Therefore, the impact of sustainable niches must be proven and communicated to relevant stakeholders (Grin et al., 2010). However, a knowledge gap requires attention:

It is indicated that successful sustainable solutions in redevelopment projects are not scaled up beyond pilot projects; it is stated that learning from the niche innovations, scaling up to other redevelopment projects, competing with non-sustainable solutions and eventually altering regime levels is limited.

Causing the successful sustainable solutions are limited included in other redevelopment projects within municipalities (Figure 25).

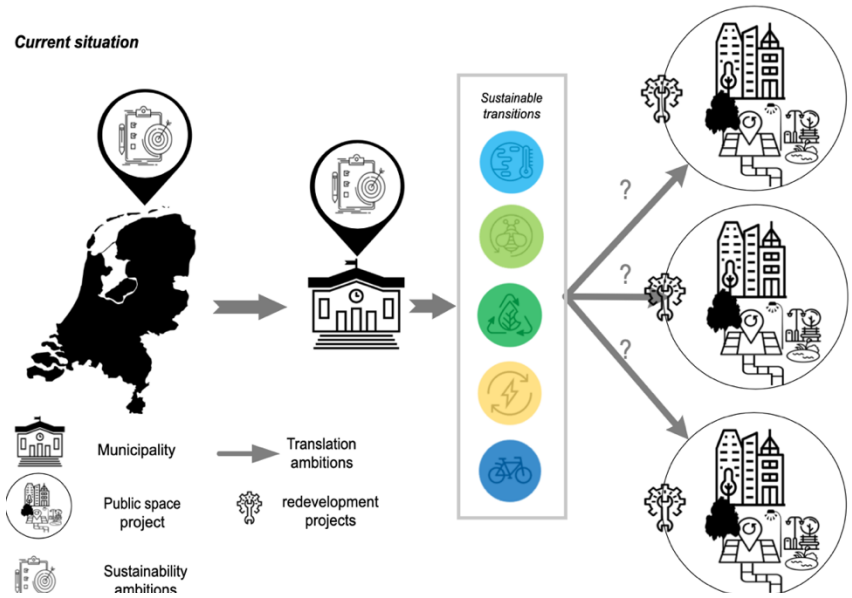


Figure 25 - missing link of performances of sustainable solutions (author creation)

To enable "learning" tracking of implemented sustainable solutions performances in redevelopment projects provides insight into the functioning of the implemented sustainable solutions. To track sustainable solutions performances, sustainability experts, planners, researchers, and decision-makers advocate adopting a robust, systematic, and integral perspective for effective monitoring and evaluation of progress during the implementation of sustainability transitions in urban redevelopment (Klopp & Petretta, 2017; Tapia et al., 2021; Papageorgiou et al., 2021). Therefore, the concept of Monitoring and evaluation is explored in this study to indicate the performance of niche-level innovations and align with the prevailing regime's expectations.

The contribution of Monitoring and Evaluation

According to Arkesteijn et al. (2007) and Vogelezang & Wijnands (2008), the words 'monitoring' and 'evaluation' are often used together. Referring to the observation activities, moments of reflection and feedback mechanisms ensure that those involved gain more insight into the progress of the innovation process. In monitoring, the project's progress is constantly monitored and planned, and unplanned effects are registered. Evaluation is a periodic assessment of a project or programme's relevance, effectiveness, and efficiency. Lessons from evaluations often adjust the strategy or render an account to the client.

While different sources indicate the relevance of Monitoring and Evaluation (M&E) in tracking the performance of sustainable solutions or sustainability in general, it is inconceivable to determine why the M&E of sustainability transitions is lacking within redevelopment projects of the public space (Klopp & Petretta, 2017; Tapia et al., 2021; Papageorgiou et al., 2021). Based on the literature, the following causes are an introduction for defining the main reasons:

1. Within academia and policy, managing public space – its maintenance and renewal - is primarily neglected (Esmail et al., 2020; Duivenvoorden et al., 2021). It results in that a scientific substantiation for implementing sustainability transitions during redevelopment projects is underexposed and possibly the attention within municipalities.
2. Literature addresses multiple problem segments; however, an up-to-date overview to connect proposed solutions and create a systemic solution is lacking.

3. There are M&E systems available such as the Handbook for Development Practitioners by the World Bank (Kusek & Rist, 2004) or "Approach and Methodology for Monitoring and Evaluation" of the +CityxChange project part of the EU Horizon 2020 innovation program (Hynes et al., 2019). And more innovative is the I Was There as a Service (IWTaaS) concept from Horizon Internet Technologies. However, these M&E systems are not operationalised within municipalities. A possible indication is that these programmes lack local pertinence (Halla et al., 2022).

It must be recognised that the real world is much more unruly and dependent on many factors, presumably not all included in this section. Therefore, additional research is required to determine the reasoning behind the missing implementation of sustainable solutions and the lack of M&E. Despite the knowledge gap, research on Monitoring and Evaluation has flourished (Acuto et al., 2018; Halla et al., 2022). The following section defines the relevant concepts of M&E used in this research via the used case studies.

1.5 Creating sustainable public spaces: Monitoring & Evaluating sustainability solutions

The concept of Monitoring and Evaluation is not new; three cases are included in this explorative study to indicate the potential of M&E. At the same time, the three cases are analysed to determine the relevant concepts that could be used in this thesis project and indicate weaknesses or gaps that cause a case study is not implemented*. The following case studies are consulted.

1. The 10-Step Model for Building a Results-Based M&E System Handbook by Kusek & Rist (2004) (Worldbank).
2. Approach and Methodology for Monitoring and Evaluation" of the +CityxChange project part of the EU Horizon 2020 innovation program (Hynes et al., 2019)
3. Horizon Internet Technologies – I Was There as a Service (IWTAAS) & Sightview

*An extensive description of the case studies can be found in *Chapter 4.2*

In this explorative study, a system is seen as a set of principles or procedures according to which something is done, consisting of an organised scheme, method, or approach. Below each case study is briefly introduced, elaborating on the description, providing a review and identifying opportunities.

Case study 1

World bank - Ten Steps to a Results-Based Monitoring and Evaluation System By Kusek & Rist (2004)

Description

Around the globe, governments are grappling with internal and external demand and pressure for improvements and reforms in public management. The increasing numbers of international initiatives are prodding governments into adopting results, including the Millenium Development Goals and, years later, the PCA goals. These agendas urge to measure aid financing to determine if initiatives have an impact and thus are a success or failure. Accordingly, monitoring and evaluation (M&E) is a powerful public management tool used to help policymakers and decision-makers track progress and demonstrate the impact of a given project, program, or policy (Kusek & Rist, 2004). Therefore, in 2004 the Ten Steps result-based M&E system was developed to track progress and provide a feedback component concerning outcomes and consequences of governmental actions.

The World Bank published the Handbook targeted to government officials to manage results via a 10-step model *(Figure 26*, below). The comprehensive ten-step model supports designing and building a results-based M&E system. Despite the outdated 10-step model, it provides sufficient insight into an M&E system.

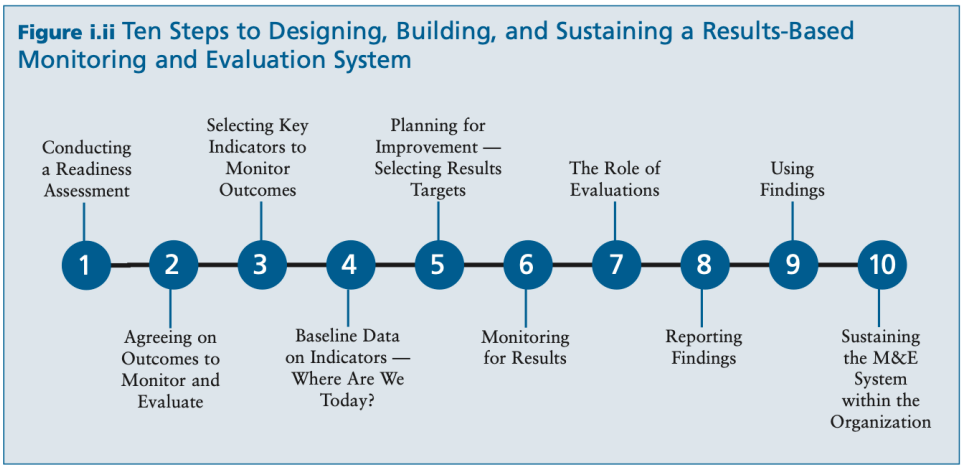


Figure 26 - overview of the 10-step model (Kusek & Rist, 2004)

Review

Despite the thorough description of the proposed M&E system, there are critical sidenotes. First, the study originates from 2004 and is possibly less accurate to the current situation. In addition, due to the focus on especially national governments around the globe, it might lack regional applicability. While the case study uses examples to describe requirements, it does not represent a way to monitor or evaluate practically in an urban environment; as a result, those practicalities are often neglected. At last, the case study proposes a result-orientated system; however, the question arises if a governmental institution should be result-based? Because a government should focus on serving the population and should focus on benefits rather than results.

Opportunities

The Ten Steps to a Results-based M&E System describes the necessary steps to develop and sustain an M&E system for governments and organisations. The case study aims to develop an M&E system that tracks progress and provides feedback concerning outcomes and consequences of governmental actions has similarities with the conducted research.

Case study 2

+CityxChange – Approach and Methodology for Monitoring and Evaluation

By William Hynes, James Sweeney, Sheryl Lynch, and Daniel Rood (2019)

Description

The purpose of the European +CityxChange project is to develop a standardised approach and methodology to Monitor and Evaluate the impact of interventions in eleven European demonstration projects. M&E is a crucial element within the +CityxChange project and simultaneously provides tools for a comprehensive policy and innovation community. The M&E approach is an evidence-based process which enables tracking

and validating the progress and performance of various interventions regarding the broader European goals.

The research document provides a framework (guideline) for how M&E in the eleven demonstration projects (DP) of the +CityxChange program should be handled. M&E defines if project interventions have the intended result, enabling an overall assessment and whether something could be done differently to achieve prescribed goals and objectives.

A standardised M&E approach and methodology were developed to execute similar M&E between all participating DP's. The standardised M&E approach and process consists of a developed KPI Framework to assess the performance and success of interventions. A standard method for monitoring and evaluating data minimises the modification needed to perform statistical analysis and report results among the various projects.

Review

The Approach and Methodology for M&E's aim are to provide a detailed technical analysis and requirements for collecting and managing data to track and validate the progress and performance of each intervention against the stated goals. The program focuses on seven urban areas across Europe. The approach and methodology primarily indicate the relevant aspects of an M&E system instead of providing the (minimum) requirements. However, it is feasible to distract the rather general conditions.

Opportunities

The Approach and Methodology for M&E provide opportunities, especially on the Data Governance aspects and how to handle sensitive data adequately. In addition, it is interesting to consider the existing research and results under European Union's Horizon 2020 innovation program and Smart Cities Information System. The executed research and profound results might support overcoming practicalities.

Case study 3

It Was There as a Service (IWTAAS) & Sightview
Horizon Internet Technologies

Description

Successful companies require diverse data to assist in business decisions in a data-driven world. However, collecting the relevant data from company activities can be challenging, often requiring a complex system integration with specific competencies and skills. It Was There as a Service (IWTaaS) is a platform offered by Horizon Internet Technologies. It allows a company to collect, convert, and dispatch data from any data source to any application. IWTaaS is an easy-to-use, no-code platform that serves as a universal connector between multiple data sources and applications for companies to collect the necessary data for business decisions. One of the features of IWTaaS is that the integrity of the information is secured by blockchain technology to validate the integrity of data.

Horizon Internet Technologies offers a solution composed of their It Was There as a Service (IWTaaS) platform and the SightView application built for the construction industry. The platform collects data from sensors, mobile apps, and open data sources and provides this data in the correct format needed for the SightView application. The application detects and transparently visualises for all stakeholders if the project

requirements have been fulfilled, which can be evaluated for further action. This service allows stakeholders to view the same information to increase trust, reduce disputes, decrease on-site audits, and minimise payment process times.

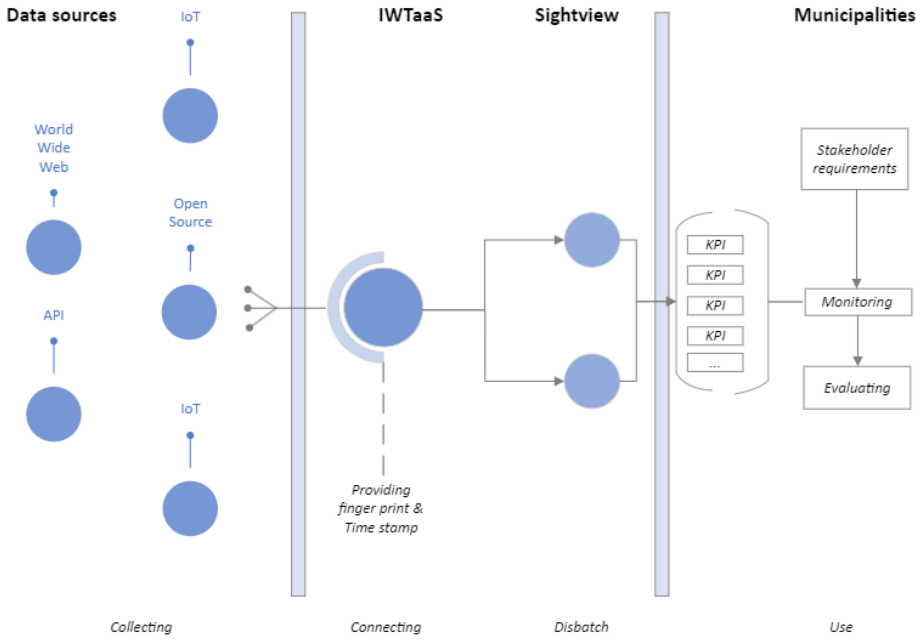


Figure 27 – *Overview IWTaaS, author creation based on feedback information from Horizon Internet Technologies*

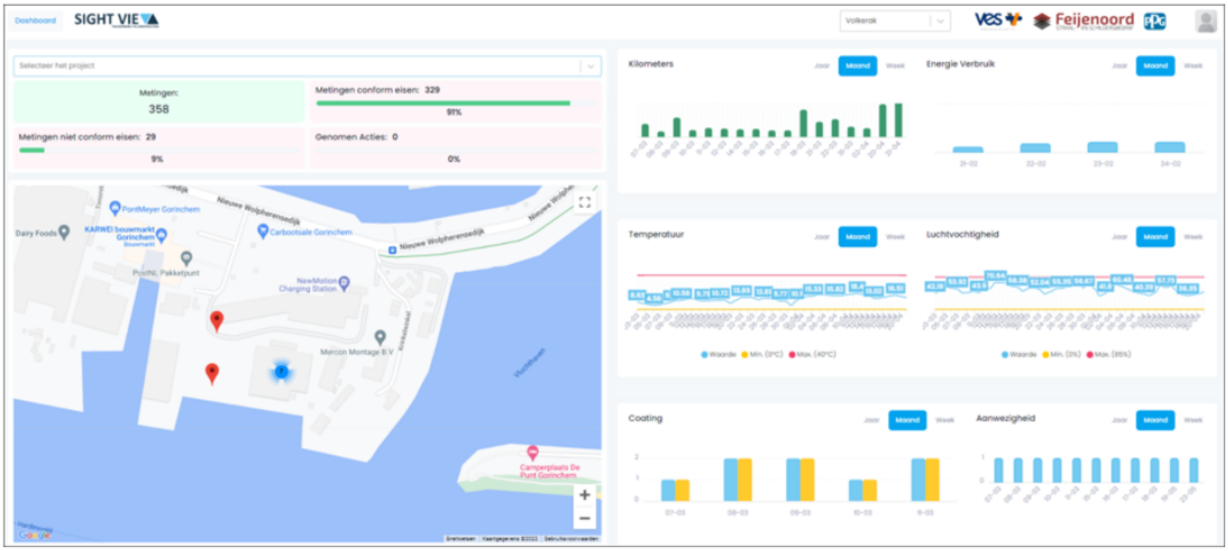


Figure 28 – Sightview application – Received from Horizon Internet Technologies

Review

The IWTaaS is a technological solution which has proven its value in renovation projects. It is relevant to include such a case since it has the potential to bypass or resolve current challenges that interfere with M&E within municipalities from occurring. In addition, IWTaas has proven its value within projects. It easily collects data sources quickly, converts the data into the correct format and visualises the results in dashboards. This case is therefore illustrated to indicate what such technological innovations offer to the desired goal. Simultaneously, it urges the need for a comprehensible description of the system functioning for all involved and how it can align with the existing steps.

Opportunities

The IWTaaS platform can collect and convert all types of data into the required format, which can then be routed to one or more applications. The IWTaas and Sightview application are usable as a technological solution to overcome difficulties or complexities during the redevelopment projects.
The case studies are analysed in Chapter 4.2.

The essential elements of Monitoring and Evaluation

The ten-step model is specifically discussed and criticised by practitioners, scholars and experts and based on their feedback, at least the following concepts are essential, according to Kusek & Rist (2004):

- Formulate outcomes and goals
- Select outcome indicators to monitor
- Gather baseline information on the current condition
- Set specific targets to reach and dates for achieving them
- Regularly collect data to assess whether the targets are being met
- Analyse and report the results

These essential topics are described below from a theoretical perspective relevant to the research.

Indicators & framework

Urban sustainability indicators are essential for measuring the performance of sustainable projects in urban areas (Papageorgiou et al., 2021; Liu et al., 2022). According to Tapia et al. (2021), literature provides two performance evaluation methods. The first method frames metrics from environmental sciences (e.g., urban metabolism) to emphasise totality and precision by displaying urban areas as complex systems. The second approach introduces the development of indicator-based decision-support tools. The advantage of the indicator-based decision-support tool over the first approach is simplifying complex information. Allowing that information is accessible to relevant persons with lack specialised knowledge. An indicator-based decision-support tool contributes to designing sustainable systems integrated into urban development.

Definition of an indicator is a quantitative or qualitative variable that provides a simple and reliable means to measure achievements and reflect on adjustments (Papageorgiou et al., 2021). Each indicator can provide specific insights about an entity that is measured. Ideally, indicators are part of an indicator framework, an integrated system of indicators. Using the definition as proposed in Papageorgiou et al. (2021), the indicator framework conveys a broader purpose to separate indicators and provides a complete overview of an entity or, in this case, transition. The determining indicators and created framework need to be tailored to a transition in a local context to be pertinence for users (Halla et al., 2022). However, Hák et al. (2016) state that many experts called for increasing the theoretical and methodological work to create consensus among users instead of formulating new indicators.

Ideally, indicators are part of an indicator framework, an integrated system of indicators. Using the definition as proposed in Papageorgiou et al. (2021), the indicator framework conveys a broader purpose to separate indicators and provides a complete overview of an entity or, in this case, transition. The determining indicators and created framework need to be tailored to a transition in a local context to be pertinence for users (Halla et al., 2022). Therefore, this study will focus on the potential users and create an iterative relevant outline for indicators and frameworks part of a Monitor and Evaluation system.

Monitoring

Monitoring is a continuous activity that uses systematic collection of data on specified indicators to provide management and the main stakeholders of an ongoing development intervention with indications of the extent of progress and achievement of objectives and progress in the use of allocated funds (Kusek & Rist, 2004).

Monitoring sustainability is essential to indicate progress (Saidani et al., 2019). Periodically monitoring of indicators will predict trends in the measure's phenomenon. Therefore, a monitor approach should include performance measurements of indicators over time (Huovila et al., 2019). A pivotal element is the identification of targets among the indicators. Therefore, an indicator framework should define what to measure and how to measure it (Hák et al., 2016). Different studies have consolidated and demonstrated the added value of monitoring the built environment and supporting decision-makers in formulating strategies to reduce environmental impact (Malagnino et al., 2021).

Evaluation

Evaluation is a systematic and objective assessment of ongoing or completed projects, programs, or policies, including the design and implementation. It determines the relevance and fulfilment of objectives, development efficiency, effectiveness, impact, and sustainability. An evaluation provides credible and valuable information, enabling the incorporation of lessons learned into the decision-making process of stakeholders (Kusek & Rist, 2004).

Data observations about indicators are collected and stored to demonstrate and evaluate the accomplished impact of project interventions (Hynes et al., 2019). A trustworthy evaluation would require a large amount of gathered information before, during, and after the redevelopment projects must be collected, filtered, stored, and available (Huovila et al., 2019). Louis & Dunston (2018) expect that the collection and generation of extraordinary data volumes require domain-specific processing and analysing methods to produce actionable insight due to the increasing number of sensors.

It is essential that governmental decision-making is based on evidence and supports long-term goals (European Commission, 2018; Saidani et al., 2019). The monitored data from redevelopment projects can facilitate transparency to evaluate the accomplished impact. An Italian program to create greener cities, leading to 4.4 billion euros in fraud, is an example of vulnerability to manipulation (Bertacche & Rotondi, 2022). The possibility of manipulation urges a solid monitoring and control system to control the implementation and effectiveness of sustainability measures.

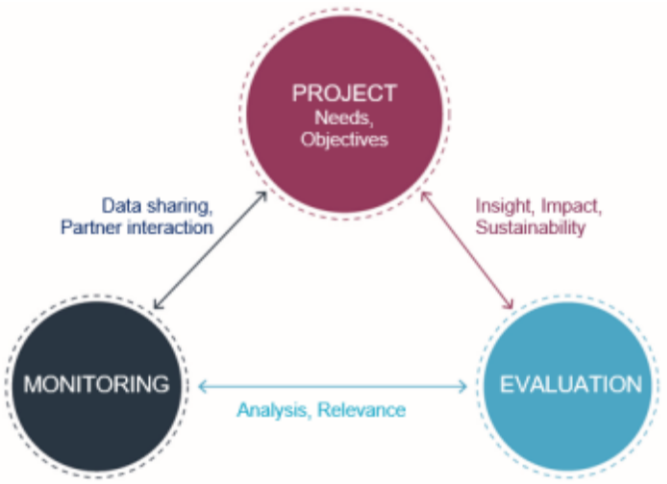


Figure 29 - Relation between project, monitoring, and evaluation (Hynes et al., 2019)

Concluding Introduction

The introduction described the urge and related Dutch ambitions to strive for sustainable urban areas. These governmental stated adaptive and mitigating ambitions triggered multiple transitions to arise. The transitions are framed as sustainability transitions and provide a radical transformation towards a sustainable society, responding to several persistent problems confronting contemporary modern societies. The explorative study considers the following transitions: climate adaptation, energy transition, circular economy, mobility, and biodiversity.

Redevelopment projects in the public space provide a Window of Opportunity to combine necessary renovations and implement sustainable solutions (niche innovations) that are part of sustainable transitions. In recent years multiple sustainable solutions have been implemented, especially pilot projects. However, a municipality's broader implementation or upscaling from these pilot projects is often lacking. For sustainable solutions to compete with the current regimes and outperform and replace them, the expectations of niche innovations must align with the expectations of the prevailing regime. Therefore, the impact of sustainable niches must be proven and communicated to relevant stakeholders. However, this does not occur yet.

Both successful and less successful implemented sustainable solutions in redevelopment projects are not scaled up beyond the pilot project; it is stated that a learning curve from the niche innovations, scale up to other redevelopment projects, compete with non-sustainable solutions and eventually alter regime levels does not occur. Causing those successful sustainable solutions are not included in other redevelopment projects within municipalities.

To enable the tracking of niche innovations performances, it is advocated to adopt a systemic, nested, and multi-dimensional perspective for robust and effective monitoring and evaluation of progress while implementing sustainability transitions in redevelopment pilot public space projects. Three cases are introduced to determine relevant concepts of this explorative study. The current knowledge gap of how non-sustainable regime levels can be altered using the concepts of Monitoring and Evaluation of implemented sustainable solutions in pilot projects is described. The following chapter proposes how the knowledge gap can be addressed.

2.

Chapter 2: Research method – Design Science Research

Chapter 2 clarifies the used research approach to address the stated knowledge gap in Chapter 1. Section 2.1 formulated the aim of the research and related research question. Section 2.2 describes the study's explorative nature and purpose to provide a "bigger picture" regarding monitoring and evaluating sustainability transitions in the public space. The used research methodology for Design Science Research is explained in Section 2.3. The translation of the provided research methodology to the implementation of the explorative study is stated in Section 2.4 – the Methodology approach. Lastly, the used data collection methods are clarified in Section 2.5.

2.1 Research aim & Research question

Research Aim

The aim of this explorative research by design is to explore the following knowledge gap stated in Chapter 1 initially:

It is indicated that successful sustainable solutions in redevelopment projects are not scaled up beyond pilot projects; it is stated that learning from the niche innovations, scaling up to other redevelopment projects, competing with non-sustainable solutions and eventually altering regime levels is limited.

Project managers of the public space often choose familiar conventional solutions. Causing the speed of implementing the transitions to be lacking and limiting the regime levels to alter since contributions remain unknown and repeatedly are chosen for the traditional solutions. The stated adaptive and mitigating ambitions of 2030 & 2050 will not be met. To enable "learning", tracking implemented sustainable solutions performances in redevelopment projects provides insight into the functioning of the implemented sustainable solutions. It is advocated by sustainability experts, planners, researchers, and decision-makers to adopt a robust, systemic and integral perspective for robust and effective monitoring and evaluation of progress while implementing sustainability transitions in redevelopment pilot public space projects.

Therefore, this explorative study aims to:
Clarify why the implementation of sustainability transitions among project managers of municipalities is lacking and develop a robust, systematic, and integral system for robust and effective monitoring and evaluation to enable learning.

Since developing a system for monitoring and evaluation that applies to all Dutch municipalities is not feasible within the given time, a Monitoring and Evaluation (M&E) blueprint will be developed. The M&E

blueprint offers a structured approach with guidelines with which municipalities can develop their monitoring and evaluation systems. The M&E blueprint will substantiate the system's necessary 'monitoring and evaluation' steps during the redevelopment projects, the specific users, the minimal requirements and elaborate on the ideal completion of the system. After the completion of the system, it can be used for monitoring and evaluating the performance of sustainable solutions, accelerating sustainability transitions within the public space and contributing to the dot on the horizon of closing the sustainability gap between 2022 – 2030 & 2050 to create a sustainable urban area.

Beyond the scope of this research is:

- The completion of the Monitoring and Evaluation system with, for instance, indicators and KPI
- The testing/demonstration of the blueprint in a project.

Research question

The following main research question addresses the aim of this research.

What is causing that sustainability transitions are not implemented in redevelopment projects, and how can a robust and effective Monitor and Evaluation (M&E) blueprint be composed to learn from pilot redevelopment projects, enabling the broader implementations of sustainable solutions?

The addressing of the main question requires research on intermediate sub-questions:

1. What is causing that sustainability transitions are not implemented in redevelopment projects, and why is it important?
2. What are the essential requirements to compose the Monitor and Evaluation blueprint?
3. How should a Monitor and Evaluation blueprint, architectural and functional, be developed?
4. What are the users' (municipalities) opinions regarding the developed M&E blueprint?

The following section *2.2* clarifies the explorative nature of the study.

2.2 Explorative nature of the study

The purpose of the thesis project is to clarify why the implementation of sustainability transitions among project managers of municipalities is lacking and explore, develop and build the first version of a Monitoring and Evaluation Blueprint that municipalities can use to shape the process of tracking the performance of sustainability solutions within redevelopment projects of the public space. To accelerate the implementation of sustainability transitions within the public space. The explorative study includes various transitions, addresses no specific municipality, and the development of an M&E blueprint that supports all (Dutch) municipalities. Therefore, the study could be seen as a long shot and not achievable within the given time. The reasoning behind the explorative and broad research has been a multi-reasoned choice.

Academia and municipality officials pledge to provide a bigger picture and an integrated approach to address the various sustainability transitions (Maring & Blauw, 2018; Köhler et al., 2019; Esmail et al., 2020; Duivenvoorden et al., 2021). Because providing the bigger picture and transdisciplinary approach to sustainability within urban areas is essential to provide emphasised choices for the crowded public space. The thesis project can therefore be seen as an explorative study, exploring the various challenges which cause that the implementation of transitions and, more specifically, sustainable solutions are lacking behind. Furthermore, a transdisciplinary approach (monitoring and evaluation) to develop a product (M&E blueprint) for tracking the performance of sustainable solutions within redevelopment (pilot) projects is

subsequently developed. The transdisciplinary approach indicated many benefits and potentials (Maring & Blauw, 2018; Esmail et al., 2020; Duivenvoorden et al., 2021). However, a side effect of providing the bigger picture means less clarity, and the specific result could remain artificial. However, as the study will indicate, public space redevelopment is scientifically and practically underexposed. In addition, sustainability transitions within the public space require attention. Ideally, this explorative study will provide new insight for municipalities and academia.

Within the given time, it is not feasible to explain the various challenges addressed in this thesis and develop a flawless monitoring and evaluation blueprint. Besides, the reality is often more unruly than how it is approached within this explorative study. Nevertheless, exploring the potential causes for lacking of monitoring and evaluation of the performance of sustainable solutions and designing and developing an M&E blueprint is feasible. The degree of feasibility inflicts with the clarity of presented results in this thesis project.

2.3 Design Science Research Methodology

This explorative study practises the Design Science Research (DSR) approach to identify the causes for lacking implementation of sustainable solutions and develop a blueprint for a Monitor & Evaluation system and answer the (sub) research question(s). DSR, part of Design Science, is a scientific study to solve practical problems or general interests (Johannesson & Perjons, 2014). The DSR approach aims to develop artefacts that have both practical and theoretical relevance (Johannesson & Perjons, 2014). The outcome of design research provides an artefact, an M&E system blueprint, and contextual knowledge about the artefacts that support people in some way. Design Science Research and its fundamentally problem-solving paradigm have generated a surge of interest in the last twenty years. This is mainly due to the potential to stimulate organisations' innovation capabilities, the necessary advance for sustainable transformation of society and innovative information systems research (vom Brocke et al., 2020).

However, there is a primary concern regarding the proposed Methodology submitted by Johannesson & Perjons (2014) and visualised below. A vital principle of DSR is to improve through an iterative process of observing and understanding the needs of municipalities and flexibly developing an artefact that meets the users' needs (Teperi et al., 2021). However, within the MFDSR methodology, the iterative process is limited, and evaluation only occurs within the last step. It is causing that the users may not desire the result of this thesis project, which would be indicated afterwards. Therefore, it is essential to include evaluation during the design and development of the artefact.

Besides, there is a possibility that the artefact may fail to meet the users' desires because the delivered artefact deviates too much from what stakeholders are used to. Shrestha et al. (2018) state that the artefact development must be validated using existing theories and guidelines to counter this shortcoming. Therefore, the introduced case studies will be further evaluated and exploited for relevant information.
As part of Design Science Research, Johannesson & Persons (2014) developed a Method Framework for Design Science Research (MFDSR). The MFDSR is "a structured process of research activities to develop artefacts based on the scientific knowledge base for rigour as well as empirical data for relevance" (Kofos et al., 2022). The MFDSR methodology (*Figure 30*) describes five consecutive activities to formulate artefacts and answer questions about them and their environment.

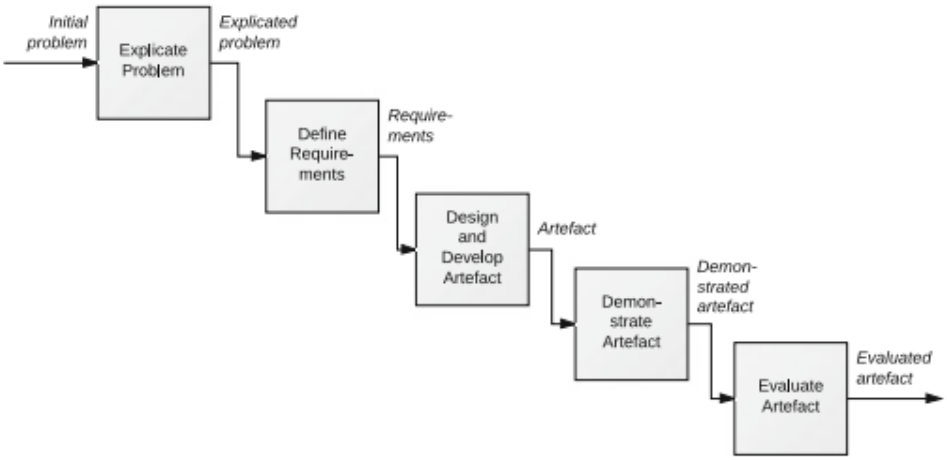


Figure 30 - MFDSR Methodology (Johannesson & Perjons, 2014)

Within the MFDSR methodology, it is feasible not to undertake all five activities in depth. It is possible to focus on a couple of activities in depth. There are at least five typical cases of design science research. A relevant approach for this study is the Requirements- and Development-Focused Design Science Research. The focus relies on requirements definition and artefact development within the approach. In general, this approach will not perform an in-depth explication of the problem but focus on defining requirements rigorously. On the contrary, this study will perform an explicate problem analysis since the problem is relatively new and incompletely understood. For the development of the blueprint, research and creative methods will be used. The viability of the M&E system blueprint is demonstrated and evaluated in a lightweight version.

The sub-questions align with the Requirements- and Development-Focused Design Science Research (*Figure 31*, below). The size of the steps in *Figure 8* indicates the focus of the specific approach.

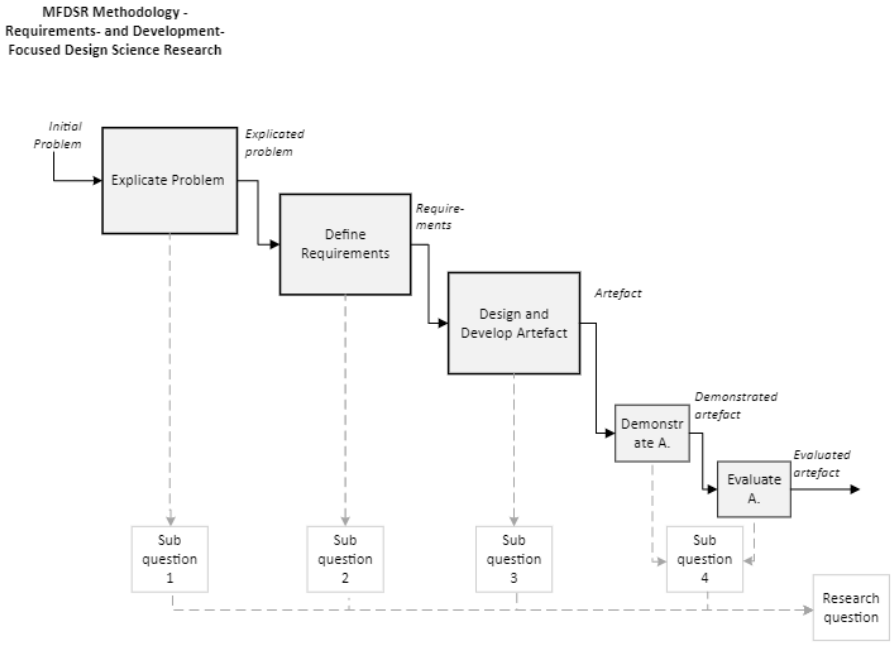


Figure 31 - MFDSR Methodology adjusted based on (Johannesson & Perjons, 2014, author creation)

Using an IDEF0 Diagram (Figure 32), each step is decomposed into activities, which can be decomposed into further sub-activities. Each activity consists of multiple channels which transfer objects or data to each activity. There are four channels: input, output, controls, and resources.

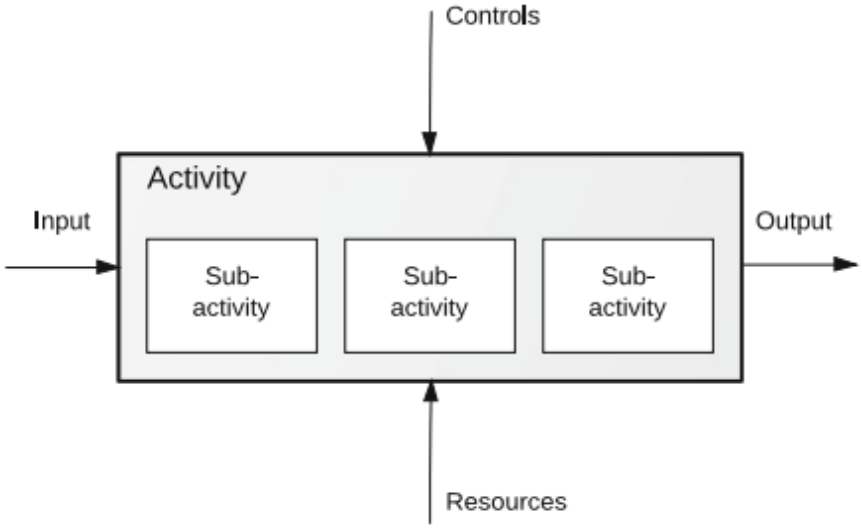


Figure 32 - An overview of the activity diagram (IDEF0) proposed by Johannesson & Perjons (2014)

The input refers to what knowledge or object is relevant to an activity. Output refers to the knowledge or entity that is output from an activity. Controls elaborate on what knowledge governs an activity, research strategy and (creative) methods. The resources describe the supporting knowledge, such as models and theories. Altogether, using IDEF0 Diagram, the method framework (figure 33, below) provides a comprehensive overview of the Design Science Project.

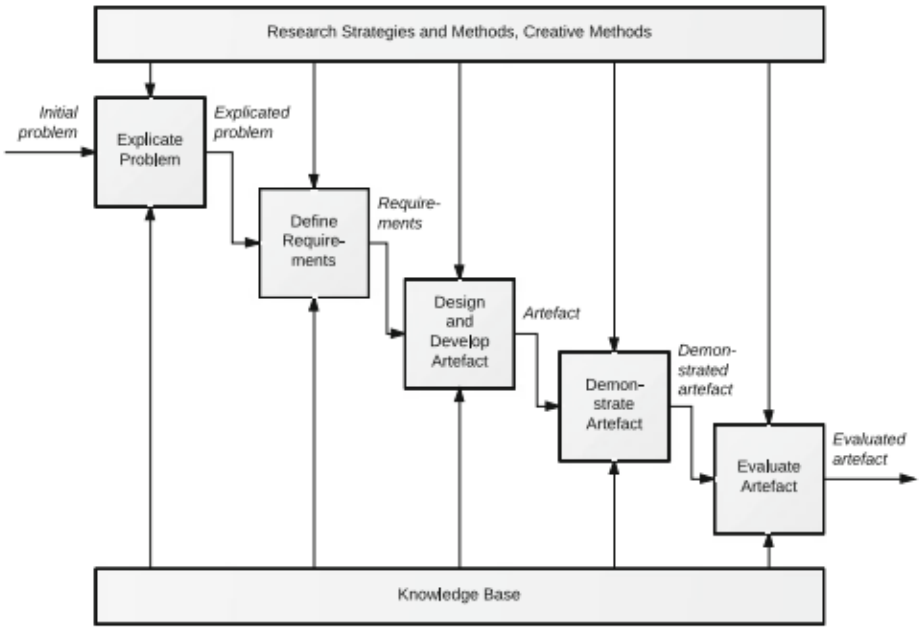


Figure 33 - An overview of the Methodology framework (Johannesson & Perjons, 2014).

It is conceivable that the developed artefact is eventually not usable. Nevertheless, the risk is acceptable since it is an explorative study and can therefore be seen as the first iteration addressed within this thesis

project. Moreover, lessons could be learned from the explorative study. The following sub-activity elaborates on the Methodology approach specific to this research.

2.4 Methodology Approach

The methodology approach specifies how the proposed artefact, an M&E system blueprint, will be researched. Multiple sub-questions are stated to constructive create the artefact. It is relevant to mention that the process of answering sub-questions and related activities is organised flexibly. This flexible execution of the sub-activities is necessary since the result of each sub-activity will be input for the following sub-activity causing that it is not possible upfront to specify how each sub-activity will be executed.

In addition, it might be possible that additional knowledge of previously executed sub-activities is concluded during the execution of the sub-activities. The insight into additional knowledge that might strengthen or weaken the arguments of the previous sub-question and related sub-activities will require a review of prior results. The process will create understanding over time, especially when stakeholders (municipalities) are involved in the developing process. Besides, additional insights facilitate an opportunity to clarify information regarding the introduction or results of sub-activities. These in advance unspecified reviews create unstructured feedback loops within the thesis project, improving the credibility and reliability over time and limiting the artefact failing to meet desires.

2.4.1 Explicate problem

According to the methodology framework, the first step is explicating the problem. Therefore, sub-question 1 states:

Sub question 1
What is causing that sustainability transitions are not implemented in redevelopment projects, and why is it important? (Explicate problem)

The purpose of explicating the problem is to identify what municipalities, especially municipal project managers, face during the redevelopment projects in the public space. Addressing what is causing sustainable alternatives part of the transitions are limited included in redevelopment projects despite the window of opportunity - allowing a precise problem definition that can be positioned and justified within an environment to understand it from different perspectives. The underlying causes of the problem will be inventoried and used to clarify the situation. To identify the current situation, three sub-activities are performed.

- *1.1 - Define precisely:* Despite the author's efforts in this research proposal. The problem should be defined as precisely as possible from the perspective of the municipalities and academia to reduce how it can be interpreted and understood. Conducting interviews amplified with literature used in the introduction will provide a first insight into the problem. The problem definition will be clarified via scoping from municipalities' broad challenges to define what is relevant for redevelopment projects in the public space and verify the potential problems that need to be encountered by project managers.
- *1.2 - Position and Justify:* Firstly, the problem definition is framed into the broader environment to understand it from different perspectives. Is the problem experienced elsewhere? The positioning will include an elaboration on the general interest and ethical, scientific, and societal consequences to justify the need for this research project. In addition, the research purpose of focusing on redevelopment projects in the public space will be justified.

- *1.3 - Find Root Causes*: To understand what is causing the current state, root causes will be comprehensively inventoried via literature and interviews. Inventorying the root causes will create an understanding of the underlying causes presented in 1.1 & 1.2, implying that the current state is a problem. The perception is that addressing the suggested causes will produce better results than treating the symptoms. Therefore, an Ishikawa diagram (a graphical tool) will support the investigation and represent the potential causes of the problem.

The accumulation of sub-activities will provide an answer to the stated sub-question. The result is a problem definition, a positioning into the wider environment and justification, and root causes that potentially can be treated.

2.4.2 Inventory Requirements

The second step of the framework is to identify and outline an artefact that can address the pre-stated problem and elicit requirements on the artefact. This step addresses artefact outlining the final desired solution and the essential requirements for stakeholders. This step provides an answer to the following stated sub-question:

Sub-question 2:
What are the essential requirements to compose the Monitor and Evaluation blueprint? (Requirements)

Via multiple methods, the requirements of the artefact and used for the design and development of the artefact. It can concern the structure, function, or environment. It is possible to define Functional requirements and Non-functional requirements.

- *2.1 - Outline artefact:* The first sub-activity determines the type of artefact that will be developed. Based on the introduced case studies and interviews, the outline of the developing solutions is determined. The outline is the first expectation/imagination of what the artefact will look like. However, iterations from sub-activities later in the process determine if the planned outline is desired.
- *2.2 - Elicit Requirements:* The second sub-activity aims to determine the requirements for the selected outline in *2.1.* The requirements can be seen as the building blocks of the developing artefact. However, a significant difference will be identified between *structural & functional-related* and *content-related* requirements.
    - The structural/system requirements relate to the architecture and general functioning, apart from content-related matters.
    - At the same time, content-related requirements should provide information on the desired information within the artefact, e.g., what are mandatory aspects with which KPIs can be determined.
    - The requirements will be elucidated via addressing the root causes, a literature study on M&E requirements, analysing the three case studies on requirements, and the interest and opinions of stakeholders. The sub-activity provides guidelines for defining relevant requirements.

The accumulation of sub-activities will provide a structured overview from multiple perspectives on the requirements of the desired artefact. Furthermore, the result of the sub-question offers insight into the essential requirements for a Monitor and Evaluation system blueprint.

2.4.3 Design and Develop Artefact

The third step of the framework is the design and development of the desired artefact, which addresses the explicated problem and uses the requirements of the previous step. This step generates descriptive knowledge regarding the design decisions of the artefact and the rationale. This step provides an answer to the following stated sub-question:

Sub-question 3:

How should a Monitor and Evaluation blueprint, architectural and functional, be developed? (Design and Develop Artefact)

In contradiction to the previous activity is chosen to adjust the MFDSR approach. The original second sub-activity is absorbed in the combination of the sub-activities 3.2 & 3.3. Because the original *Assess and Selecting* described in the MFDSR approach are included within the sketch development and justification by stakeholders. During the interviewees with municipalities, it was hard for municipalities to imagine how sustainable solutions should be monitored and evaluated in the desired future situation. Therefore, the author chose to perform a solo imagination and brainstorming on the architecture and functional design. The generated ideas are optimised using the feedback from municipality managers, consultants, and developers to build a prototype. The arguments are weighed against previous statements during the various sessions and are substantiated why they are refuted or accepted. Thus, simultaneously the sketch optimised multiple times to prototype was justified and reflected. Removing the *assess and selecting* sub-activity and replacing it with activities that optimise an idea to a sketch, via multiple sessions to a prototype and finally to a first version of the artefact.

- *3.1 - Imagine and Brainstorm*: The imagination and brainstorming determine the desired situation and how the developing artefact can fulfil that role.
    - The sub-activity starts with imagining the desired situation based on literature, interviews and case studies. This will provide input for the brainstorming via a MIRO board using the structural/system-related requirements *(2.2),* formulating the main takeaways for the artefact's structure.
    - The brainstorming continues to determine the relevant topics that are part of the concept monitoring and evaluation and should be addressed within the artefact. Again, this will be done in MIRO using the three case studies to provide information.
    - The result will be a sketch of both the structure and content.
- *3.2 - Elaborate prototype from the sketch*: The artefact will be further developed into a prototype based on the sketch. The sub-activity starts with multiple focus group discussions to iteratively optimise the sketch into a prototype using feedback from the sessions. In total, three sessions will be held, and each session will discuss the functional description and architecture-related matters. Each session will provide feedback which allows for further optimising of the artefact. Simultaneously, adjustments and optimisations are justified.
- *3.3 - Justify and Reflect:* Arguments provided in the focus group discussion will be weighed against previous statements, literature or interviewees. This will result in a substantiation if arguments are refuted or accepted within the artefact. Sub-activities *3.2 and 3.3* co-occur.
- *3.4 - Build Artefact:* After optimising the prototype, the final version (within this thesis project) will be built. The sub-activity explains the functioning and how it should be operated.

The outcome of this sub-question is an M&E blueprint that needs to be further demonstrated and evaluated.

2.4.4 Demonstrate and Evaluate artefact

The last step in this research project will combine the two activities of demonstration and evaluation from the MFDSR approach. Since this research has a limited time frame, the aim is to design and develop an M&E blueprint. Demonstration and evaluation within an existing project are beyond this research's scope. Nevertheless, the purpose is to demonstrate the built artefact to the interviewees and use the provided feedback to evaluate the functioning, usability, and improvements. To answer the following sub-question:

Sub-questions 4:

What are the users' (municipalities) opinions regarding the developed M&E blueprint? (Demonstrate & Evaluate)

- *4.1 - Demonstrate:* A video will be recorded where the artefact is demonstrated. The recorded video will be sent to the interviewees and focus group discussion participants on this thesis project. Including a survey that the interviewees and participants can use to provide feedback.
- *4.2 - Evaluate:* The generated feedback will evaluate whether the M&E blueprint meets the users' desires and how to improve the M&E blueprint. Besides, this sub-activity will be used to reflect on the research question.

This sub-question provides insight into whether the M&E blueprint meets the users' wishes to tackle the problem.

2.5 Data collection methods

The previous section described the activities of the DSR approach within the thesis project, including an indication of the data collection methods. The data collection methods section elaborates on the used methods, including the application per sub-activity and mapping of possible exposures and related countermeasures. The result section will address in-depth how each data collection method is used per sub-activity. This research uses exclusively qualitative research methods.

2.5.1 Data collection framework

The Data-collection framework provides an overview of the used research methods per sub-activity. As indicated, research methods are combined to offer different perspectives on the same phenomenon. The purpose of the mixed-methods approach is to increase the reliability of outcomes.

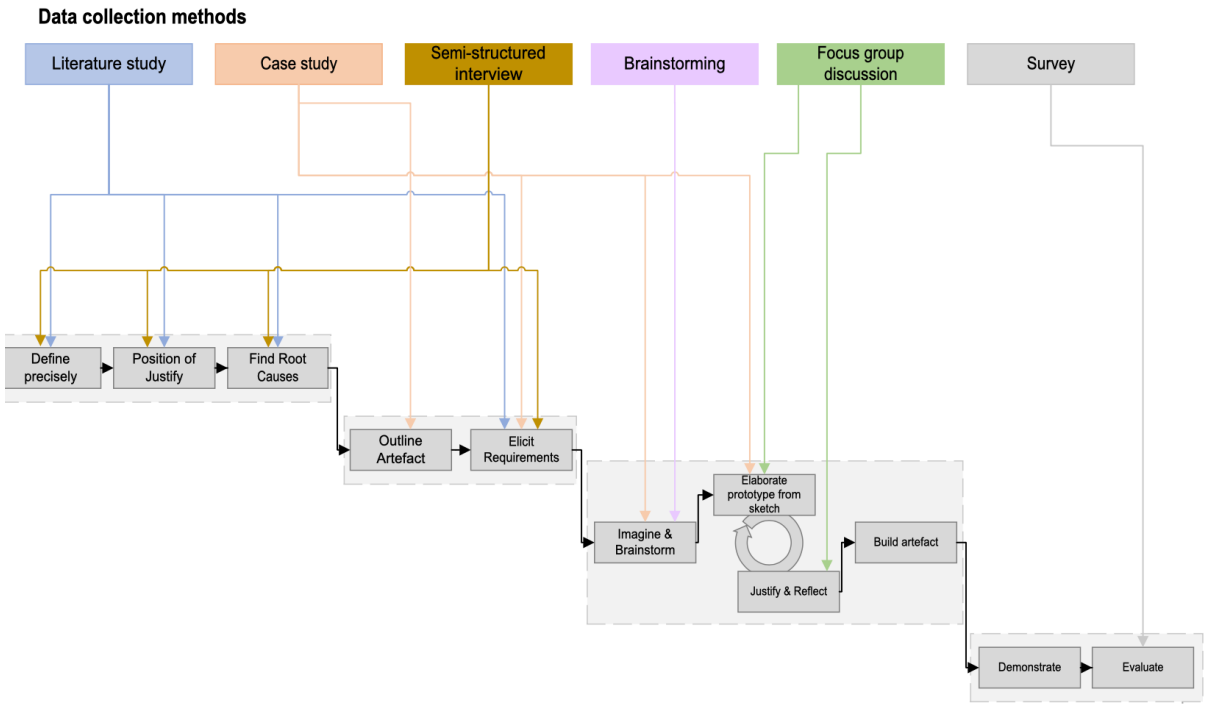


Figure 34 - An overview of the used data collection methods per sub-activity (author creation)

The qualitative data collection methods are further elaborated in the following sections.

2.5.2 Data collection methods

Literature review

The literature review is a systematic methodology approach in the thesis project. According to Wee and Banister (2015), the literature review provides an up-to-date and well-structured overview of available literature, in this case, regarding topics of monitoring and evaluation of sustainability. Wee and Banister (2015) provide a systematic approach for collecting and reviewing academic papers. The literature review consists of four straightforward steps: Identification, Screening, Eligibility and Inclusion. The four steps subsequently lead to the inclusion of research articles which formulate relevant arguments related to the research topic. The interpretation of the literature review is described thoroughly in the sub-activities, including a literature review.

- In Sub-question 1 (*3.3*), the literature review aimed to identify (root) causes) which led to the lack of monitoring and evaluating sustainability during redevelopment projects in the public space.
- The literature review in Sub-question 2 (*3.5*) aimed to define the minimal requirements for the Monitoring and Evaluation system and approach, which need desperately be included in the M&E blueprint.

Both literature reviews identified how this research is embedded and positioned in the broader scientific literature concerning the Monitoring and Evaluation of sustainability transitions in an urban context and minimal requirements to M&E adequately (Hennink et al., 2020). Visit Appendix 2, for an overview of the used research papers.

Case Study

The research is based on a combination of concepts used in real-life projects and products. These real-life projects, case studies and outcomes were analysed to identify the system, functioning and results in real-

life projects and products. These real-life projects, case studies, and effects were analysed to determine the system, functioning and results. The analysis gave an in-depth insight into the potential concepts exploited in creating the artefact. The case studies aim to produce a rich and detailed description of the used products and can therefore be classified as descriptive case studies. Three cases studies are executed:

1. The 10-Step Model for Building a Results-Based M&E System Handbook by Kusek & Rist (2004) (Worldbank).
2. Approach and Methodology for Monitoring and Evaluation" of the +CityxChange project part of the EU Horizon 2020 innovation program (Hynes et al., 2019)
3. Horizon Internet Technologies – I Was There as a Service (IWTAAS) & Sightview

The first two case studies were found via articles that address the concept of monitoring and evaluation. The third case study was contacted directly. The first case study provides a handbook with appropriate steps, the second case study evaluates the monitoring and evaluation in European cities, and the third case study proposes a technical innovation. The diversity of the case study operation will provide insight from different perspectives on the same topic. A fourth case was initially contacted. This case focused on the Monitoring and Evaluation of infrastructure materials within Dutch provinces; however, the owners of the M&E system could not share information since the product was still under development. The case studies are analysed to determine how it solves and contributes to tackling challenges. Specifically:

- In consideration of the outline of the artefact
- The case studies deliver input for potential requirements
- Comparison to developed artefact
- Potential technical solutions

The common criticism must be that case studies only apply to a specific environment and thus possibly particular problems. Therefore, solutions cannot be generalised and must be seen from their environment, which allows a translation to another domain. A case study provides a deeper understanding of more complete and relevant requirements due to the reduced impact on stakeholders. Nevertheless, case studies are time-consuming, and the outcome heavily depends on the competence of researchers and their bias towards the desired result.

The deeper understanding provided by a case study and the reduced dependency on stakeholders can result in the identification of more complete and relevant requirements. However, case studies are time-consuming, their outcomes depend heavily on the competence of the researchers, and their interests and preconceptions can also bias them. Furthermore, a case study is always carried out in a single local practice, limiting the generalisability of the results.

Visit the introduction (1.5) for a description of the case studies and the result section for an extensive elaboration of the Case Studies (4.2)

Semi-structured interview

Semi-structured interviews are communication sessions between a researcher and respondents. Interviews effectively gather complex and sensitive information (Johannesson & Perjons, 2014). To meet the standards of qualitative research large sample size is not predominantly necessary. The focus should be on the richness of the data. According to Hennink et al. (2020), the common guiding principle is saturation (Recurring) which refers to the point when no more new issues are identified. This occurs when data starts to repeat itself with no added understanding of the issue. The vital aspect of saturation with in-depth interviews is an inductive process of data collection whereby recruiting participants, collecting data and

reviewing data to assess continuous until saturation has been achieved. The collected information from interviews is amplified with additional research methodologies such as literature review or case study to complete the information saturation. In addition, the elaboration on results indicates how often certain statements or results are recurring and by which interviewee. Research by Hennink et al. (2020) indicated that saturation could be already reached between 7 – 12 in-depth interviews.

In total, nine interviews with both scholars and municipal managers were conducted. All the interviewees have at least a background or five-year experience with implementing/managing, advising or researching sustainability in the public space. Five interviewees were contacted because these specific persons are part of the Lectern Managing Public Space (Leerstoel MPS), as indicated in the table below. This is reasonable because this lectern was founded in 2020, is part of the Wageningen University, and aims to strengthen public space management's scientific working and knowledge level. Sustainability within the public space is a regular addressed topic. Via the connection of the Engineering firm where this explorative study is conducted is part of this lectern, I contacted four individuals that are part of MPS and work for municipalities and two academia. Since these individuals are all part of the lectern, there could be some bias towards the described challenge and addressing these challenges. Therefore, an additional seven individuals were contacted from other municipalities in the Netherlands who are not part of the MPS. Four individuals were willing to participate. These individuals are managers of the public space or (strategic) advisors for sustainability. These individuals were contacted since they were familiar with the engineering firm this thesis project is part of.

All interviewees: municipal managers and advisors, and scholars operate within the public space and address the sustainability transitions in the following way:

- Researching the management of the public space and sustainability transitions
- Advising from a tactical level the municipal managers on an operational level and managers on a strategic level on how to include sustainability or address redevelopment projects
- Managing the public space and including the sustainability transitions within it

In this thesis project, only municipalities and academia are interviewed. While sustainability transitions, according to transition theories described in the introduction, are multi-actor processes. However, due to the explorative nature of the research and limited time frame, these stakeholder groups are left out of the thesis project. Resulting in that relevant parties such as citizens and contractors of public space renovation projects or infrastructure/asset owners being left out of the scope. This results in that certain stakeholder groups with relevant arguments and knowledge were included in this study and developed the M&E blueprint. This will be a limitation of the result.

Table 1 – List with interviewees

References	Function	Organisation
Personal communication, I1, 2022	Assistant Professor	Wageningen University & Research and Lectern Managing Public Space
Personal communication, I2, 2022	PhD-candidate	Wageningen University & Research and Lectern Managing Public Space
Personal communication, I3, 2022	Strategic advisor urban management and maintenance	Municipality Zoetermeer and Lectern Managing Public Space

Personal communication, I4, 2022	Strategic advisor urban management and maintenance	Municipality Rotterdam and Lectern Managing Public Space
Personal communication, I5, 2022	Policy Advisor public space	Municipality Zoetermeer
Personal communication, I6, 2022	Advisor sustainability	Municipality Breda
Personal communication, I7, 2022	Project leader maintenance and sustainability	Municipality Dordrecht
Personal communication, I8, 2022	Advisor Sustainability	Municipality Amsterdam
Personal communication, I9, 2022	Director physical environment	Municipality Haarlem and Lectern Managing Public Space

The questions in the in-depth interview were open and straightforward. Most importantly, they focus on one issue at a time. Furthermore, the question should include a series of topical probes which can be identified as related issues and could be defined as follow-up questions. Ideally, the topical probes are derived from problems in the literature review. Good quality interviews will produce additional ideas and concepts besides the literature review.

The in-depth interviews were semi-structured and therefore based on a set of questions. However, these questions were discussed in a flexible order, and the respondents were allowed to formulate answers in their own words. During the interviews, techniques such as *prompting (nudging the respondent to start speaking), probing (asking for more details) checking (making sure the respondent understood the question)* were used. Since the interviews were semi-structured, the interviewees were encouraged to bring in their concerns or ideas regarding the topic or off-topic.

The interviews were prepared, executed, transcribed, summarised and applied within the addressed sub-activity.

Figure 35 - An overview of the handling of interviews (author creation)

The results of the interviews are used to substantiate or state arguments in sub-questions 1 and 2 and, more specifically, in sections *3.1, 3.3, 4.1 and 4.2.* Visit Appendix 1 for an overview of the questions and main arguments during the interview.

Brainstorming

Brainstorming is a broad but sufficient attempt to generate possible and encourage original ideas. Besides, it discourages criticism and allows the integration of existing ideas. In general, it is assumed that groups produce more ideas compared to individuals working alone. However, research does not support this assumption (Johannesson & Perjons, 2014). Since the interviews indicated that discussing the functioning

and architecture of an M&E blueprint with lacking examples is not effective, solo brainstorming is used to generate ideas instead of group brainstorming. In this situation, the researcher starts a soloistic brainstorming on the possible solutions, which can be discussed in focus groups afterwards.

Johannesson & Perjons (2014) argue that it is relevant to consider both existing and new ideas for generating ideas. Since brainstorming potentially causes a certain amount of randomness within the generation of ideas and thus limits the repeatability and validity of the research. Therefore, the solo brainstorming included various steps that subsequently visualised the creation of ideas. A MIRO board is used as a tool to subsequently and iteratively brainstorm to create new and merge existing ideas. Approach to structure the brainstorming:

Structure of the artefact

- Step 1: Divide essential requirements between Structure & Design and Functional purpose.
- Step 2: In combination with the formulated *desired situation,* the Structure & Design requirements are used to formulate ideas that will contribute to creating the structure of the blueprint. The ideas are concluded in main takeaways.
- Step 3: Determine tips and tops on the structure of case studies and conclude these recommendations into main takeaways.

The functionality of the artefact

- Step 4: Consult the case studies to determine the relevant topics for the M&E blueprint. Clustering is made, including the topics that are addressed.
- Step 5: The collected requirements from activity *2.2* are connected to the topics derived from the clustering.

Visit Chapter 5.1 for an overview of the used MIRO board.

Focus Group Discussion

With the results of the solo brainstorming, three focus groups were subsequently organised (Johannesson & Perjons, 2014). A focus group is a structured discussion with a group of respondents participating and discussing specific topics (Johannesson & Perjons, 2014). The added value of a focus group over starting with a group brainstorming session is purposely creating an interaction between the present respondents. The respondents know about the topic, enabling creativity and a critical review of the addressed topic and ideas. An in-depth discussion becomes feasible because the subject is already structured and provided with ideas. The researcher was the moderator during the session to encourage participants and guide the session and discussion.

The disadvantage of a focus group is that the session results are highly dependent on the interpretation and analysis of the researcher. Furthermore, vital participants in the group could influence the rest of the participants and drive the discussion in a specific direction. To counter these disadvantages, the session was recorded and transcribed afterwards, and during the session, the participants were equally addressed and asked for their opinions.

Three sessions were organised on the prototype's functional and architectural aspects. The prototype was optimised based on provided feedback and concerns during the discussion. The input for optimisation was included in the following session. The figure below visualises the process and conducted focus group sessions.

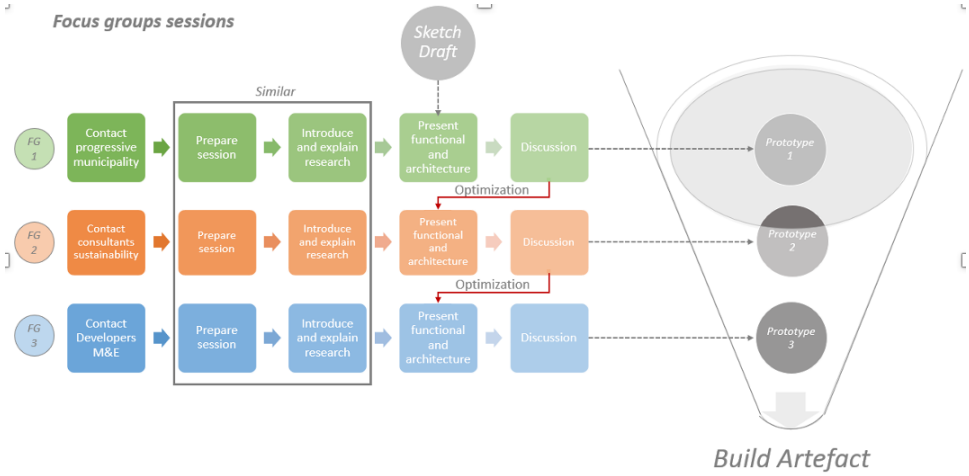


Figure 36 - An overview of the M&E blueprint prototype optimisations via focus group discussion, Author creation

Three sessions were conducted, starting with municipalities. Municipal feedback on the sketch artefact was vital since the artefact was developed for municipalities. In this way, municipalities will have prior control over the development of the artefact. Secondly, consultants from an advisory/engineering firm advise municipalities regarding sustainability in the public space. Based on interviews, the consultants expected to have an advanced overview of the municipal needs and provided additional information to the sketch. Lastly, a focus group was held with developers from a case study. To include technical solutions within the artefact.

While the artefact is developed for municipalities, only one municipality is included within a focus group. This is a limitation on the results. Due to the limited time frame, only one municipality was chosen. The municipality was chosen because the interviews indicated that this specific municipality invests in Monitoring and evaluation. It was therefore expected to deliver better feedback to optimise the blueprint. *Visit Chapters 5.2 & 5.3 for an overview of the session and results.*

Survey

The final used data collection method was the survey. The survey is a research methodology to collect information that is often intangible or hard to measure perception from individuals. In this thesis project, the survey was used to obtain insight into the perception of the interviewees and participants regarding the potential use of the M&E blueprint. The first step is determining the survey type, analytical or descriptive. The survey is descriptive since it serves the data collection among the interviewees and participants to create a general understanding and possibly identify a trend in the provided results.
In contrast to an analytical survey, a descriptive survey does not assume a hypothesis. In addition, the relevant themes and related questions must be established. The questions revolve around the following topics:

- Does the M&E blueprint address the problem(s) experienced by municipalities?
- Are both the architectural and functional aspects desired?
- If the provided arguments during the interviews and discussions on requirements are included? – Are the provided inputs used within the M&E blueprint.

According to Kelley-Quon (2018) and Day et al. (2022), multiple requirements must be included when formulating the survey questions. In general, questions must be unbiased (objectively), understandable,

and answerable. Furthermore, the sequence of the questions is relevant as well. The initial question should be broad and easy to answer. Therefore, the first question will focus on the job function of each participant in the survey. The used questions are chronologically arranged and clustered around the same topics. Complicated terms are avoided as much as possible. When stating complicated terms or questions, an explanation is provided. Unfortunately, an essential element of pretesting the survey was not feasible for a limited period.

The survey is in Dutch since all interviewees and participants are Dutch. In addition, the questions were predetermined multiple-choice questions to encourage the interviewees and participants to fill in the survey. However, this requires that the provided options represent all outcomes. The participant in the survey should have the option to formulate his answer to a question. Therefore, each question could provide its answer. To increase the response rate, Day et al. (2022) state to indicate the importance and propose incentives. Therefore, the relevance of their input is indicated in the email, including the survey. Additionally, it is proposed to the interviewees and participants of the focus group that they will receive a presentation on the M&E blueprint.

Chapter 2 indicated the research aim and approach used in this explorative study to address the knowledge gap. The approach describes how the research question is answered and how the M&E blueprint is developed using multiple data collection methods. The following chapters will elaborate on the results. Starting by addressing the first sub-question: Identifying what is causing sustainability transitions are not implemented in redevelopment projects and why is it important.

3.

Chapter 3: Explicate the experienced problem

Chapter 3 elaborates a profound description and analysis of the practical problem encountered by municipal project managers of redevelopment projects in the public space. Section 3.1 aims to define municipal project managers' experienced problem(s) to implement sustainability solutions in redevelopment projects. After the problem(s) are defined, it is positioned in the broader context to understand it from multiple perspectives and justify the need for this explorative research. In the last section, 1.3, the potential root causes for the defined problem are inventoried and described to potentially indicate the origin of the experienced problem(s).

3.1 Precise problem definition

In addition to the problem statement in the introduction, which mainly uses literature, the precise problem statement is backed and strengthened with arguments from interviews with various municipal administrators and scientists. The aim is to use literature to identify and frame a problem on a large scale. In addition, arguments from municipalities and scholars will verify and link the framed high-scale problem to a project level. The mixed-methods aim to increase the reliability and credibility of the identified results.

The substantiation of the municipal officials (managers and advisors) and scholars interviewed can be found in 2.4.1.

Scoping

It is widely accepted that human activities trigger worldwide climate change and affect "every sector and individual" (Filho et al., 2019; Lin et al., 2021; Masson-Delmotte et al., 2021; Valente et al., 2022). The built environment is among the most significant contributors to climate change and, simultaneously, the most vulnerable (Filho et al., 2019; C40 Cities, 2021; Lin et al., 2021; Hadfield & Coenen, 2022). In recent decades human-induced climate change has affected the societal values related to the interaction between humans and the environment, according to Smith et al. (2010), De Haan & Rotmans (2011) and Ernst et al. (2016). It results in mitigating and adaptive ambitions on international and national levels. Aiming to limit the human contribution to climate change and, on the other hand, reduce the impact of climate change (Ministerie van Economische Zaken, 2020; Kennisportaal Klimaatadaptatie, z.d.).

These sustainability ambitions based on changing values within the socio-technical landscape triggered transitions to come into existence and put pressure on the existing regimes (Geels, 2005; Smith et al., 2010;

De Haan & Rotmans, 2011; and Ernst et al., 2016). The pressure on existing regimes opens a window of opportunity for niche innovations (sustainable solutions) to replace the non-sustainable solutions (Personal communication, I1, 2022).

Defining

This research project addresses specifically sustainability transitions (Drift, 2020). The underlying motivation for sustainability transitions is that it recognises that environmental problems, such as climate change, loss of biodiversity and resource depletion, cannot be addressed by incremental improvements and technological fixes (Smith et al., 2010; Köhler et al., 2019). It requires a radical shifting of socio-technical structures encompassing technologies and related policies, cultural discourses, governing institutions, and market changes to realise sustainable urban places (Geels, 2005; Smith et al., 2010; Coenen et al., 2012; De Haan & Rotmans, 2011; and Ernst et al., 2016). According to Personal communication I1, I2, I3, I4, I5, I6, I7, I8 & I9 (2022), multiple transitions co-occur within the built environment. Based on the results from the interviews with the municipalities, the mentioned transitions are stated in Table 2, below.

Table 2 – Identification of transitions within municipalities

Interviewees	*Stated transition 1*	*Stated transition 2*	*Stated transition 3*	*Stated transition 4*	*Stated transition 5*	*Stated transitions 6*
I3	Energy transition	Biodiversity	Climate adaptation			
I4	Energy transition	Mobility transition	Circular economy	Biodiversity	Climate adaptation	
I5	Circular economy	Climate adaptation	Digitization	Biodiversity	Mobility	Energy transition
I6	Climate Mitigation	Climate adaptation	Circularity	Biodiversity	Mobility	
I7	Climate adaptation	Energy transition	Circular economy	Mobility	Biodiversity	
I8	Energy transition	Raw materials & materials	Biodiversity	Water	Mobility	
I9	Energy transition	Circular economy	Biodiversity	Climate adaptation	Mobility	

Based on these results stated in *Table 2*, the following transitions are relevant within the urban areas* (extensive elaboration in the introduction):

1. *Energy transition (or climate mitigation)*: The energy transition is characterised by shifting energy systems (electricity, heat and cold) that rely heavily on fossil fuels such as natural gas, oil or coal and inflict an anthropogenic climate change - towards an energy system that is based on energy harvested from sustainable sources like wind, solar energy, or energy harvested from water (Bompard et al., 2022).
2. *Climate adaptation (Water)*: Climate adaptation aims to limit and reduce or at least manage the consequences of climate change. According to the Dutch Ministry of Infrastructure and Water (2016), it concerns shades, nuisance, diseases, premature death and adverse changes in environmental quality and ecosystems caused by pluvial and fluvial flooding, heat, and drought, which are consequences of a changing climate.

3. *Circular economy (Raw Materials & Materials)*: The shift from a linear (consumption) economy to a circular economy is a necessity due to the increasing demand for raw materials and scarcity of resources: several crucial raw materials are finite, and in addition, the market is increasing due to the growth of the world population (European Parlement, 2022).
4. *Mobility transition:* Within urban areas, this requires the reduction of non-sustainable movements, changing means of transport and using sustainable energy sources (DRIFT - Dutch Research Institute for Sustainability Transitions & CROW, 2021).
5. *Enhancing Biodiversity:* The enhancement of biodiversity focuses on the conservation of biological diversity, sustainable use of biodiversity and fair sharing of biodiversity benefits among individuals in urban areas (Bouwma et al., 2014).

The five urban sustainability transitions are based on interviews with municipalities. Digitisation is mentioned; however, based on the lack of significance among other municipalities on this topic, no reason was found to consider this topic as relevant within the thesis project.

Municipalities have been appointed the role of director to achieve the stated ambitions and implement all transitions and related sustainability solutions within the built environment and specifically the redevelopment projects of the public space (Klimaatplan, 2021; Ministerie van Binnenlandse Zaken en Koninkrijkrelaties, 2022; Programma Aardgasvrije Wijken, z.d.). Even though sustainability is a public good, a private actor has limited possibilities to include sustainability solutions within the public space without the support and authority of the municipality (Köhler et al., 2019). Therefore, municipalities must play a vital role in shaping the directionality of transitions through environmental regulations, subsidies, taxes, policies, standards, and public contracts (regime level) and implementing sustainable solutions (niches) (Köhler et al., 2019; Klimaatplan, 2021; Personal communication, I3, 2022).

As the introduction comprehensively explained, studies have indicated that the public space provides a Window of opportunity to assemble all the sustainability transitions and include the transitions simultaneously (Maring & Blauw, 2018; Esmail et al., 2020; Duivenvoorden et al., 2021; Personal communication I1, I3, I9). This explorative study focuses on significant maintenance like sewage replacement and renewal or, as this research states, redevelopment projects. In the coming years, many public infrastructures are at the end of their lifecycle and are about to be replaced or renewed (Duivenvoorden et al., 2021). While handling these necessary major and expensive redevelopments, an opportunity for embracing sustainable transitions arises (Maring & Blauw, 2018; Duivenvoorden et al., 2021). Combining redevelopment and implementation of sustainable solutions is an attractive financial moment. The total cost of renovations and sustainable solutions decreases when collaborative activities (Architecture Workroom Brussels et al., 2020).

Verify the problem

Despite the window of opportunity, news articles, reports and interviews with municipal managers and advisors indicate that applying the transitions within the public space encounters many difficulties and progresses slowly (Leeuw, 2019; Bestuursacademie Nederland, 2020; Ministerie van Binnenlandse Zaken en Koninkrijkrelaties, 2022). The interviewees stated the various difficulties regarding implementing sustainability transitions and related solutions.

Conflicting objectives within the public space

Multiple conflicting objectives must be achieved within the densified public space with existing infrastructure and functions (Personal communication, I1, I3, I4 & I9, 2022). Implementing sustainable solutions requires consideration of multiple possibilities for public area management, according to Personal

Communication, I3 (2022). At this moment, considerations cannot be weighed against each other in a substantiated manner.

An example that is being given by Personal Communication, I3 (2022)
'The sewage system within the public space was at the end of its life cycle. There was a possibility to replace the sewage system with a new one and implement additional climate adaptive measures to store, retain and infiltrate rainwater. The non-sustainable alternative was to reline (placing a hose – a pipe in a pipe-within the existing sewage pipe). The advantage of relining is that, in general, it costs 75% less than sewage replacement making it a much more attractive solution. The disadvantage is that water discharge capacity is reduced tremendously, which may cause water nuisance in the neighbourhood during periods of excessive rainfall. The municipal managers could not sufficiently substantiate the strategic level to replace the sewage system and create a climate-adaptive street instead of relining because of the lack of proof of the benefits of these costly measures.'

This example argues the need for sufficient information on the performance of sustainable solutions to substantiate sustainable solutions over less-sustainable solutions. According to Personal Communication, I2 (2022), sustainability is just one of the values pursued within the public space.

In addition, on a strategic level, objectives for the five transitions are formulated abreast. In the public space, on an operational level, these objectives are conflicting (Personal communication, I4, 2022). To achieve these objectives, various sustainable solutions must be implemented. Within a densified public space, this causes tensions concerning which objective should be prioritised. Again, it lacks information on the sustainable solution to substantiate a specific choice.

The complexity of sustainability within the municipal organisation

Since the concept of sustainability is broad, everyone has a slightly different perspective. This causes that when transitions, objectives and solutions are not elaborated on specifically with examples, it will remain unclear, and everyone will have a different idea (Personal communication, I1 & I3, 2022). This may come from the fact that sustainability, besides CO2 reduction, which is part of the energy transition, and related ambitions are relatively new within the municipalities (Personal communication, I9, 2022).

According to Personal communication I4 & I6 (2022), ambitions are formulated for each transition at a strategic level, for instance, "50% less use of raw materials by 2030 in all municipal projects in the public space". However, a zero-measurement is missing, so 50% less use of raw materials of what? Furthermore, the formulated ambitions are abstract, vague and lack conciseness on an operational level. The essential indicators on the operational level related to the ambitions are missing (Personal communication, I4 & I6, 2022).

Applicability of sustainable transitions and related solutions

Table 2 indicates that five sustainable transitions are relevant among the interviewed municipalities. However, the significance of each transition may vary per municipality (Personal communication, I4). In the provided example, climate adaptation receives much more attention in municipalities below sea level or higher ground that encounter climate-related challenges such as severe droughts or problems with water discharge.

It has been stated that the municipality has the director's role in implementing transitions within the public space; however, they depend on other stakeholders (Personal communication I3, 2022). For instance, the network administrator is responsible for the electricity cables or the existing natural gas network. At the

same time, municipalities are not reliant on other stakeholders to implement greenery like a tree to enhance biodiversity (Personal communication I3, 2022). In addition, locating trees is much more straightforward than implementing a heat grid throughout the public space (Personal communication I2, 2022). These difficulties cause the implementation speed of sustainable solutions is varying significantly. At the same time, coordinating the various activities is vital (Personal communication I7, 2022).

According to Personal communication, I6 & I8 (2022), the transitions are often introduced too late within a redevelopment project after the designing phase. While according to Personal communication I2 (2022), the five transitions have significant physical implications for the public space, making it complicated to implement sustainable solutions while the entire public space is already designed. During the design phase, the implementation of sustainable solutions is not considered, causing fewer possibilities to implement sustainable solutions in the implementation phase (Personal Communication I8, 2022).

Complex municipal organisation

As Personal Communication I2 (2022) indicated, not all municipal managers can think strategically, making it hard to determine in the long term if ambitions are achieved without sufficient monitoring and evaluation.

The municipal managers are often quite conservative and do not like to experiment with new sustainable solutions, especially if sustainability is not obligated from strategic or tactical levels (Personal communication I3 & I6 (2022). According to Personal communication I6, "Sustainability is still too non-committal". It requires specific attention from a strategic level to address the transitions within the public space (Personal communication I3, 2022). Otherwise, the choice will often be on cheaper non-sustainable solutions.

Another stated challenge is the fragmented municipal (matrix) organisation, which all speak a different "language". Each department has its ambitions and indicators. And transitions are organised in separate programmes that are sometimes neglected by the departments (Personal communication I3, I4 & I6, 2022). It is stated that "within the public space is a lost child regarding sustainability". Guidance is missing to address sustainability within the public space, and as long this is accepted on a strategic level, it is expected that nothing will change (Personal communication I6, 2022)

The opportunity and pitfalls of pilot projects

At the same time is underexposed that the Dutch municipalities try to implement sustainability solutions in various projects. In recent years, many pilot projects framed as experiments and living labs came into existence to address sustainability transitions. As indicated by Personal communication, I1, I6, I8 & I9 (2022), pilots provide insights into the functioning of sustainable solutions or niche innovations within projects. A pilot project's safe environment can identify sustainable solutions' performance. However, as stated by Personal communication I1, I6, I8 & I9 (2022), no lessons are learned from these pilot projects. Causing the implemented niche innovations to remain niche innovations and not alter the regime level (Personal communication, I1, 2022).

An identified approach to "learn" from these pilot projects and the performance of sustainable solutions to conduct it elsewhere is via monitoring and evaluation, according to Arkesteijn et al. (2007), Vogelezang & Wijnands (2008), Gemeente Amsterdam (2021), Personal communication I7 & I8 (2022) and Gemeente Amsterdam (2022). According to Arkesteijn et al. (2007) and Vogelezang & Wijnands (2008), M&E refer to the observation activities, moments of reflection and feedback mechanisms to ensure that, in this case, municipalities gain more insight into the performance of sustainable solutions implemented in pilot

projects. The gained knowledge can be used elsewhere. However, this is where a problem arises, as described in the precise problem definition.

Stating problem definition

The Monitoring and Evaluating sustainable solutions in pilot redevelopment projects could support and indicate the potential compared to conventional solutions. Contribute to broader implementation of sustainable solutions and altering the regime levels. In addition to the formulated knowledge gap in Chapters 2 & 3. The following precise problem definition specifies the defined knowledge gap:

Municipalities are unaware of the impact of implemented sustainable solutions in pilot redevelopment projects due to the lack of monitoring and evaluation. Causes municipalities cannot learn from sustainable solutions, scale-up beyond pilot projects, compete with non-sustainable solutions, and eventually alter regime levels.

The coherence of niche innovations, regime levels and sociotechnical landscape and relevancy of the Monitoring and Evaluation is visualised below framed within the multi-level perspective theory as elaborated in the introduction.

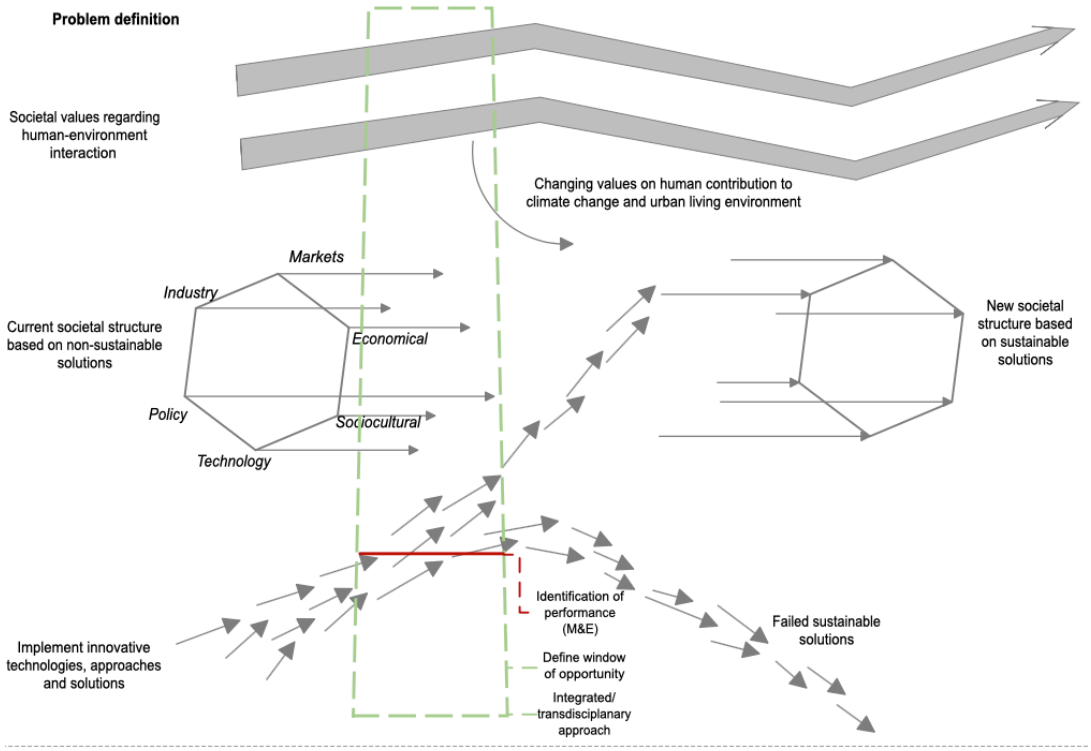


Figure 37 – Framing precise problem definition within MLP – Author creation based on Geels (2005)

The precise problem definition is used as a theorem within this explorative study. However, it is essential to consider the following limitations. In adopting the problem definition, merely a tiny fraction of seven municipalities it interviewed. It is therefore unreasonable to represent all 345 Dutch municipalities within the problem statement. Additionally, it is relevant to emphasise that reality is often much more unruly and complex than stated in this explorative study. It is plausible that there are many more aspects/challenges relevant which have not been considered in the definition of the problem. The justification will provide elaboration on this limitation. The following section will position the defined problem into a broader perspective and justify this thesis project's need.

3.2 Positioning and Justification

This sub-section aims to position the earlier mentioned problem into a broader perspective to indicate and determine its significance and reasoning to address within this thesis project. The positioning will include an elaboration on the general interest and ethical, scientific, and societal consequences to justify the need for this thesis project.

Positioning

Within the Climate plan of the Dutch national government, there is specific attention to five domains; electricity, mobility, industry, built environment and agriculture (Klimaatplan, 2021). The built environment consists of private property and public space. Within the Klimaatplan (2021), there is specific attention to properties like house owners and companies. Conflicting enough, the public space is not mentioned within this plan. In contrast, multiple interviewees and literature have indicated the window of opportunity and necessity to address the sustainability transitions within the public space during redevelopment projects (Maring & Blauw, 2018; Esmail et al., 2020; Duivenvoorden et al., 2021; Personal communication I1, I3, I9). In addition, the public space includes a significant surface within urban areas. The total surface area of the Netherlands is 4.2 million hectares, including inland and outdoor water (CBS, 2020). In 2015, agriculture included about half the total amount—about a third for nature, water, or recreation. A relatively small part of the Dutch surface (13% - 526.407 ha) is intended for the urbanised area and is used for living, working, shopping, entertainment, culture and public facilities. According to Katteler & Winkels (2002) and Remkes et al. (2002), approximately 2.250 km2, equivalent to 225.000 ha, is public space. The result is that about 43% of the built area is public space, which is significant and complementary to the percentage mentioned in the introduction (1.3) by VROM-raad (2009).

Note: within the calculations, the rural public space beyond the municipal boundaries, at a greater distance from the urban core, is not included, such as agricultural areas, forest areas and water bodies (VROM-raad, 2009). The figure below visualises the execution of calculations in a legitimate urban situation. The orange areas propose the public space areas within the municipality of Waalwijk and are retrieved from open data source ESRI Nederland BGT – Topographical information.

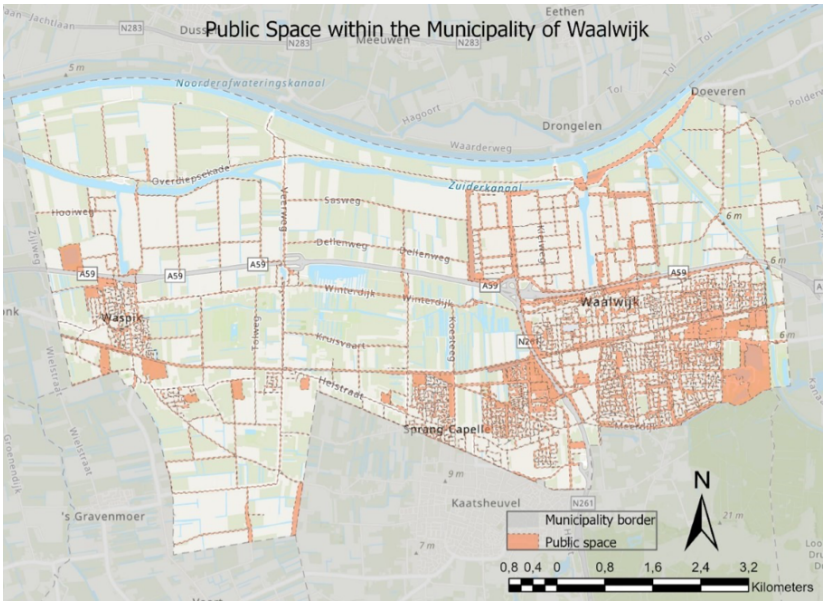


Figure 38 - public space within Waalwijk (Data retrieved from ESRI Nederland, author creation)

The orange indicated above and below ground of the public space will be under immense pressure in the coming years, according to Esmail et al. (2020) and Duivenvoorden et al. (2021). The visualised vision of the municipality of Utrecht confirms the assumption of increasing relevancy and pressure of the public space (Gemeente Utrecht, z.d.) (also shown in the introduction).

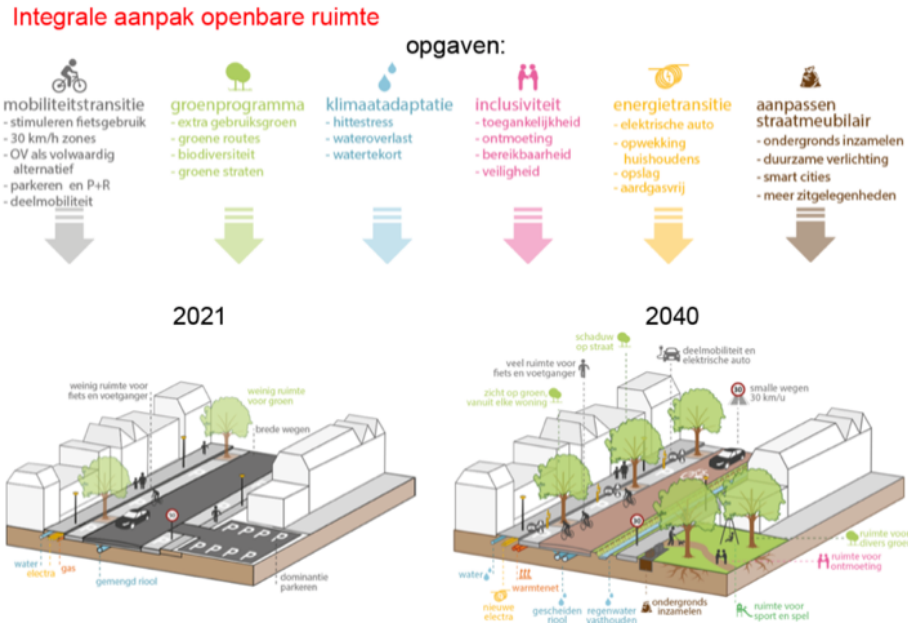


Figure 39 – Integrated approach to public space mentioning visualising multiple sustainable themes and related solutions (Gemeente Utrecht, z.d.)

The mobility transition, enhancing biodiversity, climate adaptation, social inclusivity, energy transition and circularity are addressed from left to right. What is striking is that social inclusiveness is also an important theme within the public space (Gemeente Utrecht, z.d.; Personal communication I1 & I2, 2022). As indicated by Personal communication I2 (2022), it is possible to address and include the social aspects within the other five transitions. However, as Personal communication I1 (2022) indicates, the social side of the transitions is often neglected or receives limited attention during the redevelopment of the public space.

Scientific relevance

According to Duivenvoorden et al. (2021), many public spaces in the Netherlands will end their life cycle in the coming years. These public spaces require management and maintenance. Although, this is where a scientific knowledge gap exists. As Personal communication I1 and I2 (2022) indicate, managing public space is a blind spot within urban and regional planning and design. Illogical because the public space is essential for the quality of life and simultaneously provides an opportunity to govern the substantial, sustainable transitions such as energy transition, circular economy, climate adaptation, mobility, and biodiversity but also social aspects and governance (Personal communication, I3, 2022). Because public space management is scientifically underexposed, public space managers have uncertainties regarding the most efficient way of implementing transitions and related sustainable solutions. The scientific field cannot formulate substantiated answers and provide solutions yet, according to Personal communication I1 (2022). While managing the public space over a long period encompasses excessive budgets and potentials in which management and maintenance occur (Katteler & Winkels, 2002; Esmail et al., 2020; Duivenvoorden et al., 2021).

This thesis project explores the scientific knowledge gap within public space management and sustainability. First, examine the reasoning behind the lacking comprehensive implementation of

sustainable solutions. In addition, explore the opportunity to Monitoring and Evaluate (pilot) redevelopment projects to define the performance of the implemented sustainable solutions and learn from the project to conduct is elsewhere. Also, creating a resilient process by monitoring and evaluating the process and outcome would make municipalities and involved actors less susceptible to crisis and more responsive to changing demand (Schrenk et al., 2021).

Social relevance

Besides the public space being a significant segment of the urbanised area and involving excessive budgets and potential, it also has a primary function. Perhaps even the most crucial function within the urban areas. According to Personal communication I2 (2022), a public space is a place that serves the functioning of society. The public space is a location to move people around and stay and adds value to other goals society has. Literature amplifies the statement with the ideology that public space defines the identity of a city, is a part of citizens, a reflection of historical development and an open-air living room (Katteler & Winkels, 2002; CABE, 2004; VROM-raad, 2009). It is hard to imagine that public space was hardly a topic of discussion forty years ago. It was not even on the agenda. According to VROM-raad (2009) and Katteler & Winkels (2002), the abundance of discussion on public space was because it was seen as 'residual space' with the limited required attention. Since the 1980s and 1990s, public space has become relevant to more and more municipal agendas. A significant change of perspective concerning the public space occurred (Van Melik, 2008). Justifiably because, in addition to the public perception, public space is essential for cities' functioning and quality of life (UN-Habitat, z.d.; CABE, 2004; Van Melik, 2008; Duivenvoorden et al., 2021). A high-quality public space has:

- Significant impact on the economic life of urban centres
- Significant impact on the physical and mental health
- Benefits for children and people
- A decreasing impact on crime and fear of crime
- Impact on improving social dimension
- Impact movement between spaces
- Implications for biodiversity and nature

As mentioned before, five transitions are addressed within this thesis project. These sustainable transitions aim to limit the impact of climate change and create a better living environment for the society. However, a concern stressed by Personal communication I1, I2 & I3 (2022) is that the focus of the transitions is regularly rather technical. In comparison, these transitions' social domain and related aspects remain underexposed. Less tangible, like social cohesion or governance transitions, are missing. Referring to the definition of sustainability (1.1), becoming sustainable should focus on climate systems, including social aspects of groups and individuals, and consider that not one person or organisation receives 'profit' (referring to People, Planet, Prosperity). Therefore, it is also relevant to consider the social side of the (socio-technical) transitions.

At last, if the impact of sustainable solutions is made transparent for citizens, it can potentially empower citizens to verify municipal spending in redevelopment projects of the public space. It could even empower citizens to pursue municipalities if they accelerate enough to achieve their stated ambitions. This empowerment is justified because the public space is a 'public' matter.

Relevant dilemmas for the explorative study

Multiple dilemmas must be considered during the thesis project. The social side of the transitions is often neglected within the public space (Personal communication, I1 & I2, 2022). Unjustified since the public

space is in the interest and serves residents. Therefore, the comprehensive implementation of sustainable solutions is not primarily a technical difficulty of performance and space but also a social one. "The public space should serve the values we as a society want to aspire to" (Personal communication I2, 2022). Since the precise problem definition in the previous sub-activity is monotonously formulated, it is debatable if the solution that is strived for in this study will be fully addressed. This shortcoming requires justification.
The performances of sustainable solutions in a specific location are dependent on various circumstances and must consider multiple potential, influential factors. Personal communication, I7 (2022) experienced that if Monitoring and Evaluation do not occur "properly", a resistance against Monitoring and Evaluation develops among municipal managers or, for instance, residents.

The impact realised in a redevelopment project in the public space could positively or negatively influence the surrounding private properties. If sustainable solutions do not deliver the desired result and even cause a nuisance in any possible way, it can impact private properties (Personal communication I2, 2022). For instance, if a climate-adaptive solution in the public space to store rainwater does not function, it could cause flooding in nearby private properties. Causing damage, and a house value could potentially decrease. It is indicated that municipal organisations are not ready to organise Monitoring and Evaluation, and it could be misused. Due to inappropriate use of M&E, the results could be used in the wrong way. Results in a strategic level person do not desire to implement sustainable solutions since the performance was not adequately monitored or evaluated. Therefore, Personal communication, I4 (2022) advocates keeping it out of the administrative winds.

Justification

The study explores the topic of sustainability within the public space using a window of opportunity provided by redevelopment projects. The potential of the public space and redevelopment projects is seriously underexposed within the scientific and governmental fields, such as policies and strategies. Therefore, it is plausible to conclude that the problem definition is a knowledge gap that requires attention even though the precise problem definition lacks verification by most municipalities. This explorative study can increase both awareness and knowledge of the addressed topic. Contributing with potential insights on challenges and developing an M&E blueprint to accelerate sustainability transitions via monitoring and evaluating performance.

The concept of monitoring and evaluation, as proposed by Arkesteijn et al. (2007) and Vogelezang & Wijnands (2008) M&E, refers to multiple observation activities, moments of reflection and feedback mechanisms to ensure that, in this case, municipalities gain more insight into the performance of sustainable solutions implemented in pilot projects. Demanding communication between multiple departments and (sustainability) programmes. The acquired knowledge in redevelopment (pilot) projects on sustainable solutions must be used elsewhere to ignite and accelerate the application of sustainable solutions and alter regime levels.

The discussion will elaborate on the advantages, disadvantages, and potential dilemmas of an M&E system. The following sub-activity will dissect the challenge and elaborate on the root cause, which substantiates the disadvantages of the current situation and pledges a shift towards a new situation.

The following sub-section addresses possible causes why municipalities, specifically municipal managers, do not operate the concept of monitoring and evaluating sustainable solutions in redevelopment (pilot) projects.

3.3 Identify possible root causes

Exploring and identifying possible causes for lack of monitoring and evaluation within redevelopment (pilot) projects are relevant to understanding the current situation. In addition, these causes can be addressed in the developing M&E system. Ideally, the system will contemplate the stated causes. To explore causes, an analysis of literature is performed, and interviews with municipalities and scholars are conducted.

Academic literature review on monitoring and evaluation of sustainability in urban areas

In recent years significant in-depth research has been executed to formulate monitoring and evaluation systems. The scientific literature on the assessment of urban sustainability has flourished. The current study provides insight into the current status quo, and therefore a literature review is performed to analyse the available information. The literature review aims to provide critical challenges in monitoring and evaluating sustainability during redevelopment projects in the public space. The literature search consists of four steps: Identification, Screening, Eligibility, and Inclusion. As indicated in Figure 40 (below).

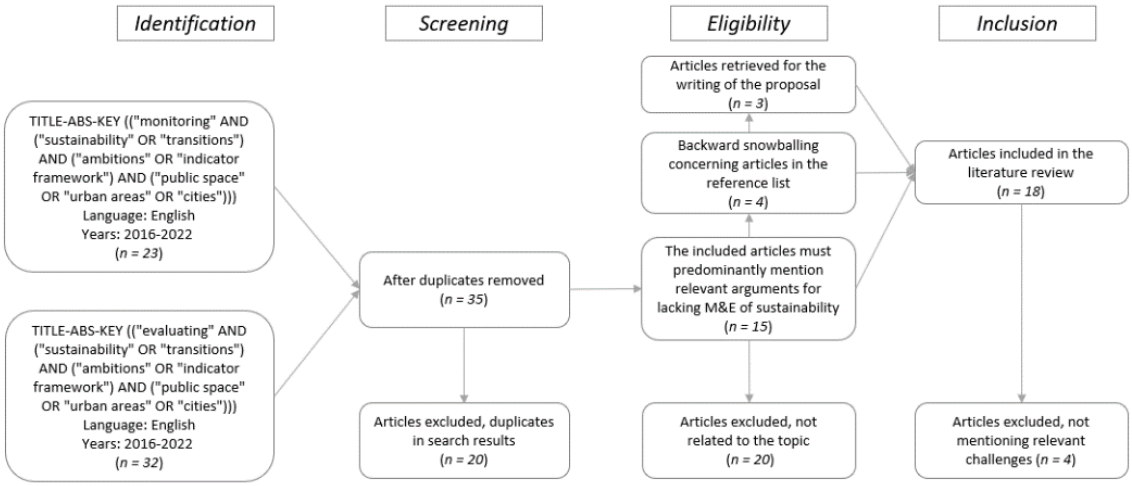


Figure 40 - literature review on root causes

Step 1 Identification

The relevant articles were collected from Science Direct using the keywords "monitoring", "evaluating", "sustainability", "transitions", "ambitions", "indicator framework", "public space", "urban areas" and "cities". Searching for single or multiple keywords resulted in many articles (10.000+). Therefore, the first filter was to select the articles between 2016 and 2022 because the Paris climate agreement was formulated in 2015, and it is less relevant to search before signing the agreement. The second filter was to select only articles written in English. The third filter was a Boolean operator: TITLE-ABS-KEY. The Boolean operator has been used to combine search terms and generate accurate outcomes. The combination of words and operators resulted in the following search semantics.

TITLE-ABS-KEY (("monitoring" AND ("sustainability" OR "transitions") AND ("ambitions" OR "indicator framework") AND ("public space" OR "urban areas" OR "cities"))) Language: English Years: 2016-2022

*-> n = 23 articles**

TITLE-ABS-KEY (("evaluating" AND ("sustainability" OR "transitions") AND ("ambitions" OR "indicator framework") AND ("public space" OR "urban areas" OR "cities"))) Language: English Years: 2016-2022

*-> n = 32 articles**

The next step was to remove 20 duplicates from the list with 55 articles.
In total *n = 35 articles*
**Results on 04-04-2022*

Step 2 & 3 screening & eligibility

In the combined second and third steps of the literature search and selection process, the collected 35 articles were screened for eligibility. The included studies must predominantly describe challenges for lacking monitoring and evaluation of sustainability transitions in preferably urban areas in some way. The screening was done by reading the title, keywords, and abstract and scanning the introduction and topics of each article. It resulted in 15 articles mentioning relevant arguments for lacking M&E of sustainability. In addition, unstructured backward snowballing (4 articles) and unstructured article search from the research proposal (3 articles) was applied to include relevant articles.
In total *n = 22 articles*

Step 4 Inclusion

After reading the 22 articles, 18 provided insight into possible challenges for Monitoring and Evaluating sustainability/transitions in urban areas. The results likewise apply to the more specific public space area redevelopment projects. The below-stated challenges are categorised. In Table 2, the results are stated. **Point of discussion, challenges are based on a specific context and may provide a distorted picture of reality.*

Table 3 - Causes for lacking M&E according to literature

	Category	References	Description of challenges
1)	Lacking parameters & framework	(Moallemi et al., 2020); (Bauwens et al., 2022); (Martek et al., 2019); (Poponi et al., 2022); (Karjalainen & Juhola, 2021); (Hák et al., 2016); (Klopp & Petretta, 2017); (Saidani et al., 2019); (Papageorgiou et al., 2021); (Huovila et al., 2019)	The identification of the most suitable indicators, KPIs, criteria or frameworks is difficult due to: A) The overwhelming amount of available information B) Widely varied quality standards on indicators and frameworks C) Indicators are ambiguous D) Lacking harmonized indicator systems that suit equally all cities and communities E) Indices are often defined for one specific aspect within a single transition and therefore do not have a multifunctional use. There is a limitation of indicators.
2)	Governmental / institution	(Hamdan et al., 2021); (Verma & Raghubanshi, 2018); (Papageorgiou et al., 2021); (Miola & Schiltz, 2019)	There is a lack of support for policies, governmental interests, or governmental actions due to: A) Unawareness of the essential specific policies and targets B) Lacking the knowledge to formulate specific actions or targets C) General ignorance to monitor and/or evaluate sustainability in (re)development projects D) The concerted scope and role of all concerned departments related to policymaking are not considered

			E) The highly political nature of sustainability influences how it is defined and the potential solutions that are offered and therefore verified per municipality
3)	Inclusion of stakeholders	(Karjalainen & Juhola, 2021); (Verma & Raghubanshi, 2018)	The inclusion of local groups and bottom-up initiatives resulting in active engagement is essential for indicator development, monitoring, and evaluation, although the inclusion is often lacking. A) Contemporary frameworks or monitoring hardly occurs in collaboration with diverse local stakeholders, while bottom-up approaches are essential to meet stated goals B) The utilised assessment methods and indicators often lack comprehensive coverage of the sustainability concept, and they are rarely developed in cooperation with diverse stakeholders
4)	Complexity of transitions	(Hamdan et al., 2021); (Susur & Karakaya, 2021)	The accumulation of the relatively new sustainability transitions is complex and cause A) That monitoring and evaluation are defined as wicked problems and therefore lack effective monitoring and evaluation system
5)	Research gap	(Theodoraki et al., 2022); (Werners et al., 2021); (Verma & Raghubanshi, 2018); (Saidani et al., 2019)	Since sustainability is relatively new in urban development, scholars have only recently started to examine the impacts and challenges. Additional research is to select interdisciplinary indicators scientifically. A) There is still a lack of in-depth investigation on their completeness, classification, possible complementary and applicability
6)	Failing of assessment tools	(Hamdan et al., 2021); (Werners et al., 2021); (Verma & Raghubanshi, 2018)	The current assessment tools are failing because: A) There is a lack of standardization of assessment tools to judge monitoring results. B) The assessment tools lack local applicability since it misses the local context C) "Localization" - the uptake and context-specific application of the goal by diverse actors in widely different cities. D) Sustainability assessments do not consider the urban environment concerning local, regional and global interactions, but only the environment within the city limits (e.g., quality index) of the local-global interactions (e.g., carbon footprint).
7)	Lacking consensus and perspective	(Tapia et al., 2021); (Verma & Raghubanshi, 2018); (Saidani et al., 2019); (Papageorgiou et al., 2021); (Miola & Schiltz, 2019); (Huovila et al., 2019)	Between scholars, there is a lacking consensus about a couple of matters: A) There is no long-standing consensus on which indicators are more 'suitable' or 'relevant' to assess sustainability and how to measure it. B) The presence of a plurality of frameworks, possible interpretations and the selection of indicator variables preclude a consensus on a "right" or "objective" method for measuring transition performances. C) It is often neglected that a sustainability problem is not expected to have one "single, correct, optimal solution."
8)	Basics of monitoring	(Martek et al., 2019); (Poponi et al., 2022); (Karjalainen & Juhola, 2021); (Tapia et al., 2021); (Klopp & Petretta, 2017); (Verma & Raghubanshi, 2018); (Saidani et al., 2019);	There are multiple reasons for the missing of an adequate monitoring system: A) Quantitative parameters (e.g., energy usage) lend themselves to scientific (independently replicable) results. However, measuring qualitative parameters (e.g., equity or well-being) is more contentious. B) A homogeneous way of measuring is lacking due to assessment methods and indicators lacking comprehensive coverage of the sustainability concept.

		(Papageorgiou et al., 2021); (Miola & Schiltz, 2019)	C) Monitoring and evaluation components include indicators that require significant levels of technical knowledge and may be challenging to collect in a real-life setting. D) The lack of solid data collection institutions at the city scale to support monitoring. E) Monitoring requires comparable in-depth information about the social, economic, and environmental aspects of urban machinery

Literature provides a first understanding and identification of potential causes from a scientific point of view. These challenges are summarised in eight categories. The categories are technical, governmental, and scientific related.

A common all papers share is evading a 'bigger picture' including all relevant aspects for monitoring and evaluation. The focus relies on one transition, indicators and framework, monitoring or evaluating. The combination of monitoring and evaluating impact during redevelopment projects is flawed. The outcome confirms the statement of Personal communication I1 & I2 (2022) that the management/redevelopment of the public space is scientifically underexposed. The interviews will define the challenges from the perspective of researchers, advisors within the municipality and municipal managers responsible for redevelopment projects in the public space.

Interviews with municipal managers, advisors, and scholars

In addition to the literature review, within the same interviews of *3.1,* multiple municipalities and scholars have identified possible causes for the lack of monitoring and evaluation within municipalities. The semi-structured interview with open, short, and straightforward questions provided additional insight. Each interview received the same introduction and questions. However, the sequence of questions varied during the interview based on the answers to questions. The interviews stated multiple causes for a lacking monitor and evaluation. Table 4 below indicates the addressed causes and by whom it is mentioned.

The substantiation of the municipal officials (managers and advisors) and scholars interviewed can be found in 2.5.2.

Table 4 - shows potential causes for lacking M&E according to municipal managers, advisors, and academia.

	Problem causes	**Reference**	**Challenge**
1)	Lacking parameters and/or framework	*(Personal communication, I4, I6, I7 & I2, 2022)*	At a generic or strategic level, there are many goals stated while these do not match operational requirements: A) Although these goals are too abstract and cannot be used on an operational (local) level. B) there are various objectives for the sustainability theme/transitions. However, they are vague, lack concreteness and are not precise indicators. C) Lack of consensus among indicators
2)	Basics of monitoring	*(Personal communication, I4, I7, I6 & I2, 2022)*	A couple of requirements are not met to monitor adequately: A) A baseline or zero measurement is missing, causing the progress to be unknown. B) Monitoring occurs only for a limited period C) Due to a poor experience with monitoring, managers are against monitoring their projects

			D) Unknown what data to collect and how to evaluate E) Monitoring does not only include quantitative results but qualitative as well
3)	Governmental / institution	*(Personal communication, I4, I7, I3, I6, I8, I5, I2, I1, I9, 2022)*	Municipalities often consist of a matrix structure and other challenges: A) Sustainability programs are often separate because it is impossible to integrate them into existing teams. B) Especially in large municipalities, the contact between municipalities is lacking C) The fragmented organization causes each department starts collecting its data D) The size of the municipalities is relevant. In a larger municipality, it becomes difficult to arrange monitoring due to all the persons and departments that need to be involved. E) Each department has its language F) Integrated approach of managers is missing G) It differs whether municipalities want to approach and measure from a liberal view, egalitarianism, and social justice. The design criteria are again grouped or interpreted from a particular political perspective. H) Too many people involved I) Sustainability ambitions lack priority J) There is no obligation for municipalities to report their progress regarding sustainability only for CO2
4)	Complexity of transitions	*(Personal communication, I4, I3, I6, I1 & I9, 2022)*	The defining and implementation of transitions result in complexity due to the following reasons: A) Not all transitions have straightforward solutions to implement within a redevelopment project. causing that monitoring results cannot be distracted from a single measure (e.g., add more greenery) B) The implementation rate of each transition is different due to technical, political and stakeholder aspects C) The extent to which the objectives are stated varies considerably per transition. The concept of sustainability is broad, causing various interpretations. D) There is a variety in the influence municipalities have on the different transitions (e.g., energy transition and climate adaptation) E) The implementation and monitoring of transitions oppose each other F) Different perspectives on sustainability
5)	Inclusion of stakeholders	*(Personal communication, I7 & I9, 2022)*	Communication with stakeholders is lacking A) Due to lacking communication, different perspectives exist regarding the management of the public space B) In much development, people invoke “not in my backyard.” C) Within redevelopment projects, emotions could cause monitoring and evaluation to be interrupted.
6)	Financial	*(Personal communication, I7 & I3, 2022)*	If conventional non-sustainable solutions are less expensive than sustainability solutions, sustainability is the first thing that is forgotten. A) Monitoring equipment is too expensive to implement citywide
7)	Practicalities	*(Personal communication, I6, I8, I5 & I8, 2022)*	While implementing M&E during redevelopment projects in the public space, the following aspects cause it to be rushed or not completed A) It is too time-consuming B) No control over the implementation and interpretation

			C) Each redevelopment project is different; therefore, difficult to determine a fixed system

The interviews provide additional insight into the potential causes of the defined problem in *3.1*. There are multiple similarities between the outcome of the literature review and the discussions provided two other root causes: financial and practicalities. According to the interviewees, the reason why M&E is lacking is mainly due to governmental/institutional challenges rather than technical reasons.

The Ishikawa Diagram summarises the result of the literature review and interviews. Identifying root causes leads to an artefact that will treat not just the symptoms but also the root causes.

Visualising root causes - Ishikawa diagram

The Ishikawa diagram is a simple graphical instrument that schematically illustrates the relations between a specific result and the potential causes that create obstacles (Liliana, 2016). The possible causes are derived from the literature review and interviews and visualised in the Diagram below. The categories are defined based on general topics that challenges evolve around. The Diagram highlights a division between categories derived from Interviews, Literature review or both methods.

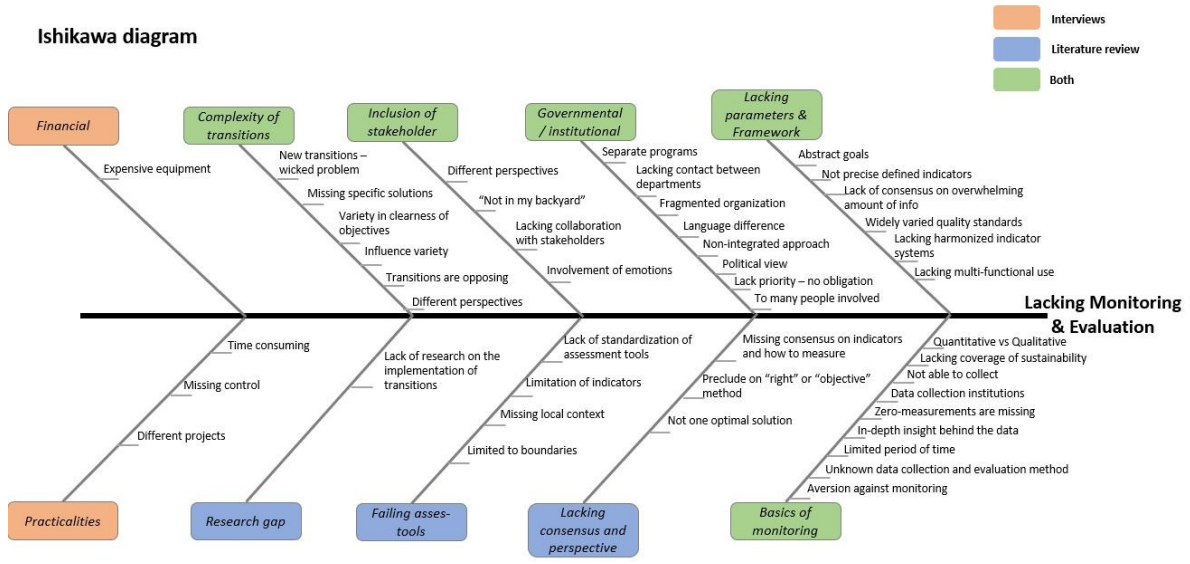


Figure 41 – Ishikawa diagram for visualising root causes (author creation)

The mixed-method provides insight into the potential causes. However, it is difficult to determine which category and cause are decisive; this would require additional research - Identifying the causes in other municipalities and verifying the stated causes by the interviewed municipalities. Nonetheless, based on the interviews and literature, challenges from three categories were frequently mentioned: Governmental/institutional, Lacking parameters & Frameworks and the Basics of monitoring.

Before concluding the explored and inventoried causes, it is critical to emphasise that municipalities do not experience all challenges. Factors such as the municipal size, political perspective, relevancy of transitions and physical environment potentially influence the challenges for a specific municipality.

Governmental/institutional

The existing matrix structure of a municipality causes difficulties with including the transitions during redevelopment projects. The sustainability transitions are organised in separate programs of the matrix structure, causing the integration of transition programmes in redevelopment projects (Personal communication, I7 & I9, 2022). Furthermore, the same matrix structure causes municipalities to have various fragmented departments (Personal communication, I4, 2022). There is a language difference between the departments, and each has its own goals (Personal communication, I6 & I8, 2022).

Another potential cause is the political interest that might vary due to the political perspective of the chosen city council (Verma & Raghubanshi, 2018; Personal communication, I2, 2022). From the city council, part of the strategic level is within the four-year coalition agreement determined where the focus and related finance should be established (Personal communication, I6, 2022). If the coalition parties are not progressive on sustainability topics/transitions, new initiatives such as monitoring and evaluation become challenging. If the strategic level does not prescribe or obligate that Monitoring and Evaluation should occur, the chance it will happen is relatively small (Hamdan et al., 2021; Personal communication, I5 & I6, 2022).

In addition, the political view of a municipality towards various matters such as sustainability is based on the formed coalition and, therefore, might differ per municipality. According to Personal communication I2 (2022), it varies per municipality whether the monitoring and evaluation should occur from a liberal, egalitarianism or social justice perspective. Relevant criteria to monitor and evaluate must be related or interpreted from a particular political perspective (Personal communication, I2, 2022). According to Personal communication I2 & I9, municipal managers' impact is underexposed, and the specific interpretation of an area should depend on the political perspective. Personal communication provides the following example:

- In a Social Justice design, everyone is entitled to the same quality public space; therefore, a green area should be the same throughout each public space.
- With utilitarianism, green areas are located where the areas have the highest value for the entire society.
- From a liberal perspective, a green area should be located on a particular main structure, the right of the strongest.

These political perspectives create a varying understanding of how the public space should look and cause a different interpretation of evaluated results.

Lacking Parameter & framework

The size of the municipality and the necessary involvement of different departments makes it difficult to reach a consensus on the ideal indicators and KPIs to track the progress of transitions within redevelopment projects (Hák et al., 2016; Klopp & Petretta, 2017; Tapia et al., 2021; Personal communication, I3, I5, I6, 2022). As Martek et al. (2019), Poponi et al. (2022), and Bauwens et al. (2022) describe Personal communication I4, I5 & I6 (2022) confirm, the generic and abstract ambitions are formulated at a strategic level. It is complicated to translate these ambitions and goals to a tactical and even operational level (Martek et al., 2019; Bauwens et al., 2022; Poponi et al., 2022). The described situation is causing specific indicators and parameters related to the sustainability transitions in redevelopment projects to be missing (Personal communication I4, I5 & I6, 2022).

The fact that scholars have not reached a consensus confirms how difficult it is (Tapia et al., 2021; Poponi et al., 2022). A plausible reason for the lack of consensus regarding indicators or/and frameworks is that

each urban area or municipality differs slightly from the neighbouring municipality and plenty of indicators and parameters are available (Hák et al., 2016; Saidani et al., 2019; Tapia et al., 2021; Personal communication, I4, I6 & I7, 2022). Although, the parameters must be accepted and used throughout the entire organisation and by stakeholders (Personal communication I4, I7 & I8, 2022; Karjalainen & Juhola, 2021). Personal communication I4, I8 & I9 have indicated that they are working on a framework that includes ambition, goal, KPIs and parameters. It is relevant to mention that both interviewees work for large municipalities, and both operate on the tactical level where they have resources and knowledge available to address this challenge. However, they have difficulties introducing it at an operational level in the correct phase (before the designing phase starts), especially since it is difficult to track the performance of sustainable solutions. At the same time, Personal Communication I7, municipal manager in a smaller municipality, indicates that they started experimenting with monitoring onCO2, Nitrogen, infiltration capacity and biodiversity within their redevelopment projects. Among the interviewed municipalities, an unambiguous approach does not exist.

Basics of monitoring

In this thesis project, monitoring is seen as the clarification of sustainable solutions performances within a redevelopment project, which is constantly monitored and planned, and unplanned effects are registered (Arkesteijn et al., 2007; Vogelezang & Wijnands, 2008). Currently, there are many open gaps around this topic within municipalities.

First, not all interviewed municipalities have clarified what goals, KPIs and parameters are relevant for their stated sustainability ambitions within the public space redevelopment projects (Personal communication I3, I4, I6 2022. Monitoring is thus not even relevant at this stage. At this moment, there is no pressure from a strategic level to start monitoring sustainable solutions within the redevelopment project (Personal communication I3 & I9, 2022). Only the CO2 emissions or groundwater levels are relevant in redevelopment projects since it is obligated or causes nuisance (Personal communication, I6 & I7, 2022). It is indicated that tracking CO2 emissions takes a lot of time and effort to establish values, let alone other indicators (Personal communication I6, 2022).

Each municipality has stated sustainability ambitions such as "in 2030 we should emit 49% less CO2". However, a zero-measurement was never conducted, making it impossible to compare the 49% to a specific amount in the past (Personal communication, I4 & I6, 2022). Besides CO2, there are many more indicators and parameters. However, it is unknown what is relevant data for the stated ambitions. In addition, should it be technical data, or is social data derived from citizens also applicable? And other questions that need to be addressed. What is sufficient and appropriate data, and how to collect it? For what period should sustainable solutions be monitored? Who is responsible for managing all data? (Personal communication, I1 & I2).

In general, guidance is missing to address monitoring within redevelopment projects—lack of knowledge (Personal communication, I2, 2022). While simultaneously, the added value of monitoring is also indicated; it can substantiate specific choices better and record progress or transparency towards citizens (Personal communication, I4, I5, I7 & I8). Therefore, arguably the focus must be established on a procedure to define sustainability and transitions where the ambitions, goals, indicators, and KPIs can be selected instead of providing them as standard.

Summarisation and conclusion of sub-question 1

Chapter three used a combination of literature and interviews to provide substance to the first sub-question:

What is causing that sustainability transitions are not implemented in redevelopment projects, and why is it important?

Causes of limited implementation of sustainability transitions in redevelopment projects

The broad challenge of climate adaptation and mitigation led to the formulation of sustainability ambitions that triggered transitions into existence scoped to Dutch Municipalities. The relevant, sustainable transitions for the public spaces, energy transitions, climate adaptation, circular economy, mobility, and biodiversity, are defined. Municipalities have been appointed the director role to achieve the stated ambitions and implement all transitions and related sustainability solutions within the built environment and, specifically, the redevelopment projects of the public space. Despite the window of opportunity, news articles, reports and interviews with municipal managers and advisors indicate that applying the transitions within the public space encounters many difficulties and progresses slowly. The sustainability transitions are not implemented due to:

- Conflicting objectives within the public space
- The complexity of sustainability within the municipal organisation
- Applicability of sustainable transitions and related solutions
- Complex municipal organisation
- The opportunity and pitfalls of pilot projects

When sustainable solutions are implemented, it occurs within the safe environment of a pilot project. However, as multiple interviewees indicate, the lessons learned are limited. Causes that municipalities cannot learn from sustainable solutions, scale up beyond pilot projects, compete with non-sustainable solutions and eventually alter regime levels. The indicated approach to "learn" from these pilot projects and the performance of sustainable solutions to conduct it elsewhere is via monitoring and evaluation. It is indicated that the monitoring and evaluation process will also support the other encountered challenges.

Lacking Monitoring and Evaluation

Municipalities have experimented with monitoring and evaluation however is lacking implementation. Therefore, a root cause analysis is performed on literature and interviewees to identify possible causes. Ten potential root causes have been identified with multiple related causes. In this explorative research, it is impossible to conclude which root causes are decisive. However, three causes were repeatedly notified: Governmental/institutional cause, Lacking Parameter & Framework and Basics of monitoring.

Thus, five identified reasons are causing that sustainability reasons are not implemented in redevelopment projects. Significantly, the learning from pilot projects conducted anywhere else seems vital in addressing the sustainability transitions. Monitoring and evaluation are indicated as approaches to address the learning from pilot projects. However, this does not occur yet due to possibly ten root causes.

Importance to address the redevelopment of the public space and monitor and evaluation

It is crucial to address the stated challenges that limit the implementation of redevelopment projects in the public space. The potential of the public space and redevelopment projects is seriously underexposed within the scientific and governmental fields, such as policies and strategies. Therefore, it is plausible to

conclude that the problem definition is a knowledge gap that requires attention even though the precise problem definition lacks verification by most municipalities. For instance, it is not even mentioned once in the Climate Plan of the Netherlands, while the sustainability transitions require incremental adjustments to the public space to include all transitions. In addition, around 43% of the urban area in the Netherlands, equivalent to 225.000 ha, is public space. The above and below-ground public space will be under immense pressure in the coming years due to necessary redevelopment, simultaneously providing a window of opportunity to include sustainability transitions. Besides the scientific and political relevance, there are social relevance and dilemmas in the public space.

This explorative study can increase both awareness and knowledge of the addressed topic. Contributing with potential insights on challenges and developing an M&E blueprint to accelerate sustainability transitions via monitoring and evaluating performance.

Side conclusion

Since each municipality (345 municipalities) differs in some way due to size, political perspective, physical perspective, and relevancy of transitions, it is illogical to formulate a framed and completed system to monitor and evaluate. Therefore, ideally, an M&E system should support and guide municipalities through the necessary steps to create systematic monitoring and evaluation approach.

The problem definition and root causes are input for the second sub-question outline of the artefact (4.1) and eliciting requirements (4.2).

4.

Chapter 4: Define the outline of the M&E blueprint and inventory requirements

In chapter 4, the outline of the M&E blueprint and requirements are determined. Section 4.1 will address the pre-stated problems and define root causes in determining an M&E blueprint. In addition to the outlining, in section 4.2, the relevant structural and design requirements and functional requirements for the M&E blueprint are inventoried via multiple data collection methods and structured.

4.1 Outline Artefact

The common all artefacts have is that they support people encountering problems in some practice (Johannesson & Perjons, 2014). The following encountered problem by municipal project managers on an operational level and advisors on the tactical level is addressed in this research

Municipal project managers are unaware of the impact of implemented sustainable solutions in pilot redevelopment projects due to the lack of monitoring and evaluation. Causes municipalities cannot learn from sustainable solutions, scale-up beyond pilot projects, compete with non-sustainable solutions, and eventually alter regime levels.

The first step in designing a solution for the problem is determining an outline of an artefact that will engage the causes and fit essential requirements. As described in *2.1*, this explorative thesis project aims to clarify why sustainability transitions among project managers of municipalities are lacking and *develop a robust, systematic, and integral system for robust and effective monitoring and evaluation to enable learning*. By monitoring and evaluating the performance of sustainable solutions (niche innovations) in pilot redevelopment projects, the potential in comparison to conventional solutions could be indicated. The insight in pilot projects could contribute to the broader implementation of sustainable solutions and alter the regime levels. Although the performance result of sustainable solutions must be indicated to municipal managers of the redevelopment project, the blueprint can help throughout the different layers of a municipality (strategic – tactical – operational).

The outline of the M&E blueprint

Since developing a system for monitoring and evaluation that applies to all Dutch municipalities is not feasible within the given time, a Monitoring and Evaluation (M&E) blueprint will be developed. As

interviewees and literature advocates, the outline should be a *robust, systematic, and integral* system for robust and effective monitoring and evaluation. A sequenced approach includes guidance and minimal requirements that a municipality can follow. In turn, municipalities provide substance to the system with an approach for each step relevant to their policies with stated ambitions and existing strategies. Figure 42 visualises the positioning of the M&E blueprint.

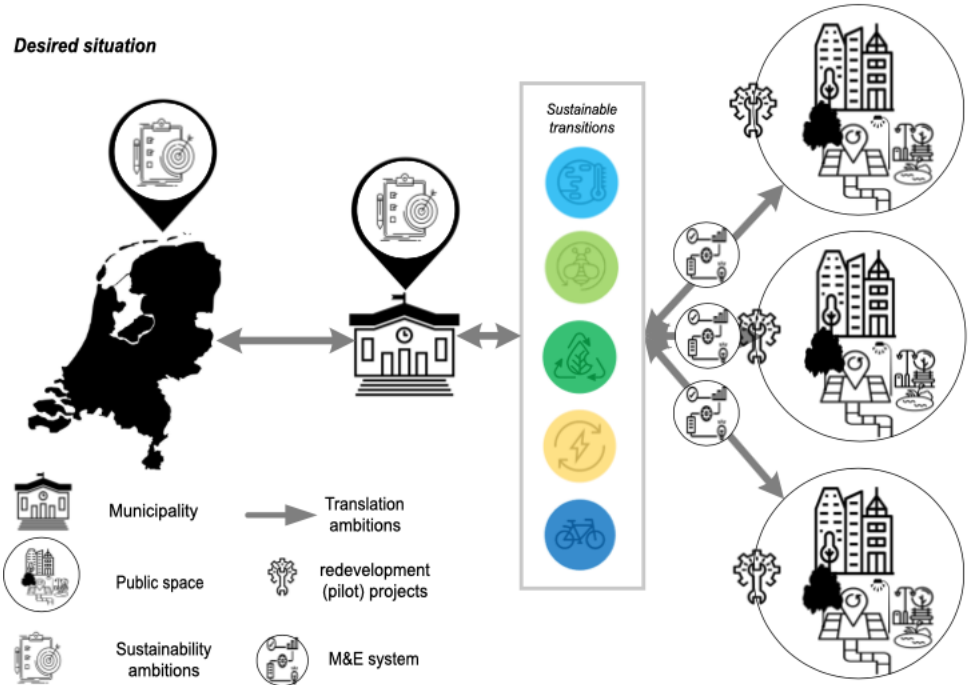


Figure 42 - - Improving potential feedback loops by the M&E blueprint (author creation)

The developed M&E blueprint will identify all relevant steps and related requirements that are part of monitoring and evaluation. Over a period, the project managers collect the monitoring results of redevelopment projects and evaluate them. The insight into the achieved progress provides the possibility to ascertain the impact of the redevelopment project on the stated sustainability goals. In this way, the M&E blueprint encourages communication between departments and within a municipality's layers. Arguments for the outline are provided below. The literature review results and interviews in sub-activity *3.3* are consulted to provide substantiation.

1. Each municipality is different due to size, political perspective, physical circumstances, and specific challenges and has different priorities. Therefore, a specific M&E system would not apply to each municipality, let alone the different redevelopment projects within a single municipality. Personal communication I1 & I2 indicated that a filled-in or fixed system would be difficult to achieve due to the variety between municipalities. The focus should be on a sequenced approach a municipality can proceed with by themselves (Personal communication I1 & I2).
2. Different perspectives on the concept of sustainability and the related transitions exist (Verma & Raghubanshi, 2018; Tapia et al., 2021; Bauwens et al., 2022). It is advocated that the definition is mutual determined at least before the designing phase of redevelopment projects (Personal communication, I8, 2022). Therefore, the blueprint with preconditions and a procedure will create consensus and provide continuity among various stakeholders and departments to formulate the definitions and related indicators (Personal communication, I5, 2022). Expected is that a predetermined definition, for instance, indicators, is not desired since municipalities have different interpretations of sustainability and transitions.

3. Despite the required flexibility and adaptability, the standardisation of monitoring and assessment tools is lacking (Martek et al., 2019; Huovila et al., 2019; Poponi et al., 2022; Karjalainen & Juhola, 2021). A blueprint with preconditions and procedures will provide standardisation that allows flexibility and adaptability within which municipalities can operate.
4. Accordingly, in recent years many studies have been performed on the elements of monitoring and evaluation systems. Causing that there are many separated solutions, for instance, indicator framework and monitoring system, although the overview is missing (Miola & Schiltz, 2019; Papageorgiou et al., 2021). The availability of solutions makes it difficult for willing municipal managers or other municipal officials with limited time and knowledge of M&E to oversee the necessary process and set actions (Personal communication, I3, 2022).

Hence this explorative study focuses on developing an M&E blueprint, which will guide municipalities in developing their M&E system. This M&E system can support municipal managers in tracking the performance of sustainable solutions (niche innovations) in pilot redevelopment projects; the potential in comparison to conventional solutions could be indicated. To track the performance of sustainable solutions, various steps are part of the concept of M&E that must be considered. The following section determines the minimum requirements for the structure & design and the functionalities of the desired system.

4.2 Elicit requirements

The requirements are the essential building blocks for the proposed M&E blueprint. According to Johannesson & Perjons (2014), the relevancy of requirements depends on the characteristics of the problem, the outlined solution, technological opportunities, previously proposed solutions, and stakeholder interests and opinions. It is essential to determine two types of requirements: *Structural & Design requirements* and *Functional requirements***.**

Structure & Design: Requirements that indicate how the M&E system should be structured and designed

Functional: Requirements that indicate the functionalities an M&E system should provide. Functional requirements are used to determine the necessary steps.

Structure of section 4.2

The section consists of three steps; **inventory**, **classify requirements** and visualise **results** to determine the required 'building blocks of the artefact'. The inventory step consists of multiple inventory approaches. Therefore, an overview of *4.2* is stated below.

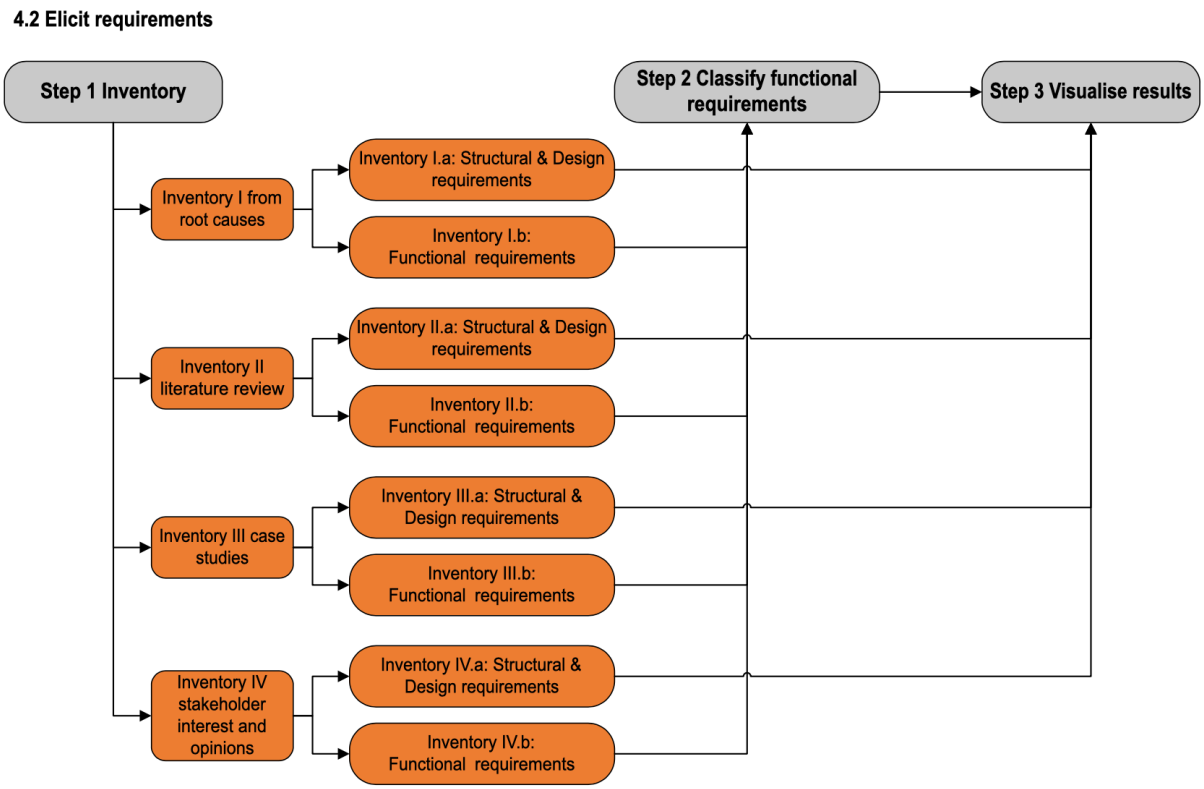


Figure 43 – Overview of inventory steps (author creation)

Johannesson & Perjons (2014) provide guidelines for defining relevant requirements.

1. Specify the type of artefact and the characteristics
2. Formulate each requirement in precise, concise, and understandable
3. Justify why each requirement is needed
4. A realistic and original artefact that fulfils the requirements
5. Specify which sources are consulted
6. Describe the used sources

Following the guidelines, guideline 1 is addressed in section 4.1. The rest of the guidelines are included in the steps.

4.2.1 Step 1: Inventory of requirements

Multiple research methods are practised to inventory relevant Structure & Design, and Functional requirements for formulating an M&E blueprint. The first inventory is based on the stated Root causes in *3.3.* Each identified root cause is summarised based on the related challenges stated in *Figure 41*. Based on the identified root causes, requirements are formulated. The requirements are divided between Structure & Design, and Functional requirements. Duplicate requirements are indicated in grey.

Inventory I.a: Derive Structural & Design requirements from root causes in the current situation

R(oot cause) 3. Lacking consensus and perspective: Among scholars, it is often neglected that a sustainability challenge has not one “single, correct, or optimal” solution, besides the presence of a

plurality of indicators, frameworks, and possible interpretations cause that there is no long-standing consensus on a “right” or “objective” method to measure transitions performances.

1. Requirement: The M&E system should elaborate on the necessary steps to Monitor and Evaluate per project

R4. Governmental/institutional: Despite the efforts of individuals due to fractured municipal departments with varying languages regarding sustainability, involvement of many people, lacking priority and obligation to report progress, new transition programmes and different political perspectives, it is experienced as challenging to M&E.

2. Requirement: The M&E system should be flexible to the political perspective per municipality and adaptive over time.

R5. Failing assessment tools: The current assessment tools/approaches lack (general) standardisation of monitoring results that apply to each municipality, considering the interaction between multiple scale levels and, at last, the monitoring in a local context.

3. Requirement: The M&E system should apply to every municipality
4. Requirement: The M&E system should, despite its required standardisation, be specifically applicable in a local context.

R9. Practicalities: M&E is time-consuming because there is a lack of consensus among individuals' implementation and interpretation. Besides, each redevelopment project is different and therefore requires additional attention.

5. Requirement: The M&E system should cost additional time for municipal managers during a project - therefore, it should be automated as much as possible.

R10. Financial: various monitoring equipment and systems are too expensive for municipalities to implement within the entire municipal area.

6. Requirement: The M&E system should be financially feasible for municipalities to implement.

Inventory I.b: Derive Functional requirements from challenges in the current situation

R(oot cause) 1 - Basics of monitoring: The possibilities regarding monitoring are not widely known besides lacking monitoring performance in the past due to ignoring or not knowing basic principles of monitoring, which caused aversion by municipal managers to implement M&E.

1. Requirement: The M&E system should include a zero-measurement of the current situation, also known as a baseline within each project.
2. Requirement: The M&E system should describe a minimal period of subsequent and continuous monitoring with intervals of a month to provide sufficient insight. Requirement:
3. The M&E system should consist of quantitative data; however, qualitative data will be considered when there is no sufficient quantitative data. Additionally, a procedure for the use of qualitative data is required.
4. Requirement: The M&E system should guide how to homogeneous monitor to cover all the relevant concepts of sustainability in a real-life setting

R2. Lacking parameters & frameworks: The number of available goals, indicators and frameworks are overwhelming, although these are often vague, ambiguous, single-use, or defined wildly varied, causing that is not applicable on a local scale or in different areas.

5. Requirement: The M&E system should provide consensus in an integrated way on what sustainability is.
6. Requirement: The M&E system should elaborate on defining the transitions.
7. Requirement: The M&E system should state the relevant operational goals, indicators and KPIs for a specific redevelopment project.
8. Requirement: The M&E system should obligate elaboration between stakeholders (partners and departments) of Monitor and Evaluate per project.

R3. Lacking consensus and perspective: Among scholars, it is often neglected that a sustainability challenge has not one "single, correct, or optimal" solution, besides the presence of a plurality of indicators, frameworks, and possible interpretations cause that there is no long-standing consensus on a "right" or "objective" method to measure transitions performances.

X. Requirement: The M&E system should provide consensus in an integrated way on what sustainability is (*Requirement 5*)
X. Requirement: The M&E system should elaborate on defining the transitions (*Requirement 6*).
X. Requirement: The M&E system should state the relevant operational goals, indicators and KPIs for a specific redevelopment project (*Requirement 7*).

R4. Governmental/institutional: Despite the efforts of individuals due to fractured municipal departments with varying languages regarding sustainability, involvement of many people, lacking priority and obligation to report progress, new transition programmes and different political perspectives, it is experienced as challenging to M&E.

X. Requirement: The M&E system should provide consensus in an integrated way on what sustainability is (*Requirement 5*).
X. Requirement: The M&E system should elaborate on defining the transitions (*Requirement 6*).
X. Requirement: The M&E system should state the relevant operational goals, indicators and KPIs for a specific redevelopment project (*Requirement 7*).
7. Requirement: The M&E system should provide a clear indication or/and overview of which persons within a project/municipality should be involved and their function.

R5. Failing assessment tools: The current assessment tools/approaches lack (general) standardisation of monitoring results that apply to each municipality, considering the interaction between multiple scale levels and, at last, the monitoring in a local context.

11. Requirement: The M&E system should enable interaction between multiple scale levels (city-region-project).

R6. Inclusion of stakeholders: The communication and inclusion with local stakeholders are lacking, causing different perspectives on a desired public space, missing important bottom-up initiatives and lacking comprehensive coverage of the sustainability concept in a local setting.

12. Requirement: The M&E system should describe how to include local stakeholders in formulating goals and indicators
13. Requirement: The M&E system should describe how the evaluation of monitored results is communicated to local stakeholders in a redevelopment project of the public space.

R7. Research gap: Since the implementation of sustainability is relatively new in urban development, additional research is required to select interdisciplinary indicators.

X. Requirement: The M&E system should provide consensus in an integrated way on what sustainability is (*Requirement 5*).
X. Requirement: The M&E system should elaborate on defining the transitions (*Requirement 6*).
X. Requirement: The M&E system should state the relevant operational goals, indicators and KPIs for a specific redevelopment project (*Requirement 7*).

R8. The complexity of transitions: The introduction of multiple transitions within the public space causes challenges due to a variety of conciseness of transition-related solutions, the implementation rate of transitions, and the influence and perspective municipalities have concerning the transitions.

X. Requirement: The M&E system should provide consensus in an integrated way on what sustainability is (*Requirement 5*).
X. Requirement: The M&E system should elaborate on defining the transitions (*Requirement 6*).
X. Requirement: The M&E system should state the relevant operational goals, indicators and KPIs for a specific redevelopment project (*Requirement 7*).
14. Requirement: The M&E system should indicate the degree of possible municipal influence.
15. Requirement: The M&E system should estimate the design and implementation processing time.

R9. Practicalities: M&E is time-consuming because there is a lack of consensus among individuals' implementation and interpretation. Besides, each redevelopment project is different and therefore requires additional attention.

16. Requirement: The M&E system should facilitate an approach to reach a consensus regarding Requirements 5 to 8.

R10. Financial: various monitoring equipment and systems are too expensive for municipalities to implement within the entire municipal area.

-

A first conclusion drawn from the distracted requirements of root causes is the urgency for consensus on multiple matters. Specifically, the matters are elaborated in steps 2 to 6 (agreeing on outcomes, selecting Key indicators, baseline data, monitoring) in the 10-step model created by Kusek & Rist (2004) (figure 26). The functional requirements determine what the artefact should give substance to.

Inventory II: a literature review of requirements on the blueprint

The literature review aims to provide insight from a theoretical perspective on the requirements for an M&E blueprint. The literature review for the definition of Root causes led to minimal requirements in Inventory I to treat the challenges. An additional literature review is performed to inventory additional minimal requirements to create an M&E blueprint and the purpose it must fulfil. The (sub) sub-activity can be seen as an extra step to identify potential requirements that have not been included yet. Again, the literature review will consist of four steps: Identification, Screening, Eligibility, and Inclusion. As indicated below in Figure 44.

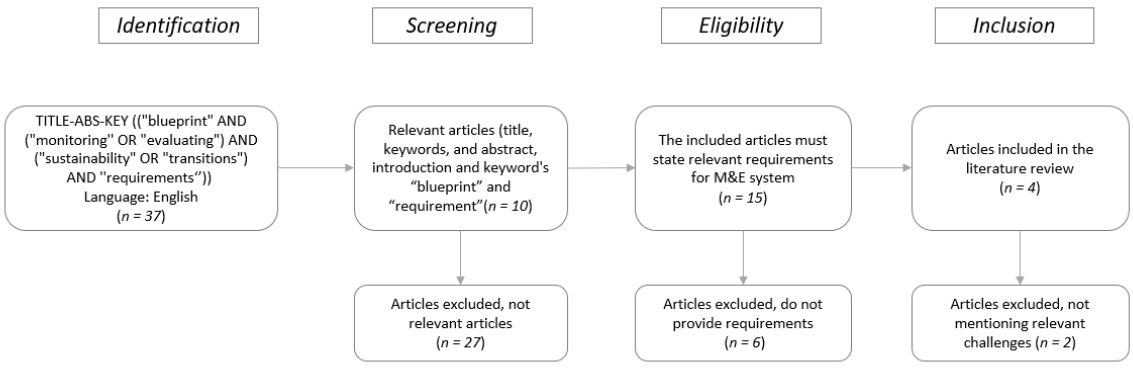


Figure 44 literature review on minimal requirements

Identification

The relevant articles were collected from Science Direct using the keywords "blueprint", "monitoring", "evaluating", "sustainability", "transitions" and "requirements". The term "blueprint" is a specific synonym such as procedure or approach that results in 1000+ articles. Two filters were used to narrow down the number of irrelevant articles. The first filter was to select articles written in English. The second filter was a Boolean operator: TITLE-ABS-KEY, including "AND" and "OR". The Boolean operator has been used to combine search terms and generate accurate outcomes. The combination of filters resulted in the following search semantics:

TITLE-ABS-KEY (("blueprint" AND ("monitoring'' OR "evaluating") AND ("sustainability" OR "transitions") AND ''requirements''))

Language: English

-> n = 37 articles

*Results on 20-04-2022

Screening

In contradiction to the literature review of 3.3, step 2 (Screening) and step 3 (Eligibility) are separated because the initial information concerns the inventory of requirements for a monitor and evaluation blueprint of sustainability. Therefore, the 37 articles of step 1 (identification) were screened on relevancy. The screening included reading the title, keywords, and abstract, scanning the introduction and searching specifically for the keyword's "blueprint" and "requirement" of each article.

Following the screening guidelines, 27 articles are irrelevant for this study. Thus, in total, n = 10 articles.

Eligibility

The resulting ten relevant articles were scrutinised, inventorying whether relevant requirements were stated and determining the eligibility of the requirements. Therefore, in addition to screening, the articles must relate to sustainability in urban areas, cities or public spaces. The additional requirement resulted in 4 relevant articles. Unstructured backward snowballing did not provide satisfactory results.

Inclusion

All four remaining articles provided insight into potentially relevant requirements for an M&E blueprint regarding sustainability in the public space.

Inventory II.a – Inclusion literature review on Structural & Design requirements

Table 5 – Structural & Design requirements Inventory II.a

Requirement	Description	Source
7	The M&E system results should be applicable to use at higher scale levels.	(Ikram et al., 2021)
8	The M&E system should be useable, valuable, and functional. (Usability indicates whether the process was easy to implement. Functionality describes whether the process does what it was designed to do. Valuable was evaluated by looking at the organizational impact	(González Chávez et al., 2021)

Inventory II.b - Inclusion literature review on functional requirements

Table 6 – Functional requirements Inventory II.b

Requirement	Description	Source
5	The M&E system should provide consensus on what sustainability is	(Ikram et al., 2021)
13	The M&E system should describe how to include local stakeholders in formulating goals and indicators.	(Löhr et al., 2022)
14	The M&E system should describe how the evaluation of monitored results is communicated to local stakeholders in a redevelopment project of the public space.	(Löhr et al., 2022)
12	The M&E system should, despite its required standardization, be specifically applicable in a local context.	(Rolf et al., 2020)

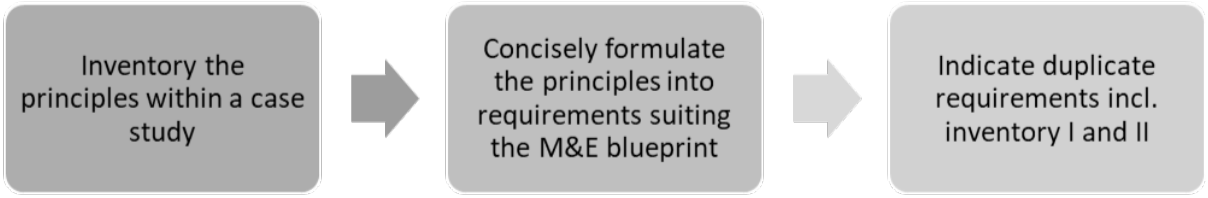
The Literature review provides two additional Structural & Design requirements. The number of requirements gained from the literature review is less than Inventory I due to limited available relevant research papers. The limited number of feasible papers could result from using the less suitable combination of semantics to define requirements. Furthermore, it could indicate a limited amount of research on M&E requirements.

Inventory III: Case study requirements (technological opportunities + previously proposed solutions)

In recent years multiple technological developments and innovative research programmes on Monitoring and Evaluation occurred. These developments and research programmes provide insight into existing solutions and technological opportunities. Furthermore, the cases contain relevant requirements to the desired M&E blueprint. Therefore, Inventory III exploits three existing systems and solutions as a case study. The cases are analysed, and the mentioned requirements are stated below. Based on the analysis, it becomes evident to elucidate requirements.

1. World bank – Ten Steps to a Results-Based Monitoring and Evaluation System
2. +CityxChange - Approach and Methodology for Monitoring and Evaluation
3. Horizon Internet Technologies – I Was There as a Service (IWTAAS) & Sightview

The presented results below describe the cases and additional elucidated requirements. The minimal principles or guidelines mentioned in each case study are translated into a list of requirements and placed into the inventory format (removed duplicates).



Analysis Case study 1

World bank - Ten Steps to a Results-Based Monitoring and Evaluation System By Kusek & Rist (2004)

Description

Around the globe, governments are grappling with internal and external demand and pressure for improvements and reforms in public management. The increasing numbers of international initiatives are prodding governments into adopting results, including the Millenium Development Goals and, years later, the PCA goals. These agendas urge to measure aid financing to determine if initiatives have an impact and thus are a success or failure. Accordingly, monitoring and evaluation (M&E) is a powerful public management tool used to help policymakers and decision-makers track progress and demonstrate the impact of a given project, program, or policy (Kusek & Rist, 2004). Therefore, in 2004 the Ten Steps result-based M&E system was developed to track progress and provide a feedback component concerning outcomes and consequences of governmental actions.

Functioning

The 10-step model consists of ten steps to adequately Monitor and Evaluate—each step with a specific function.

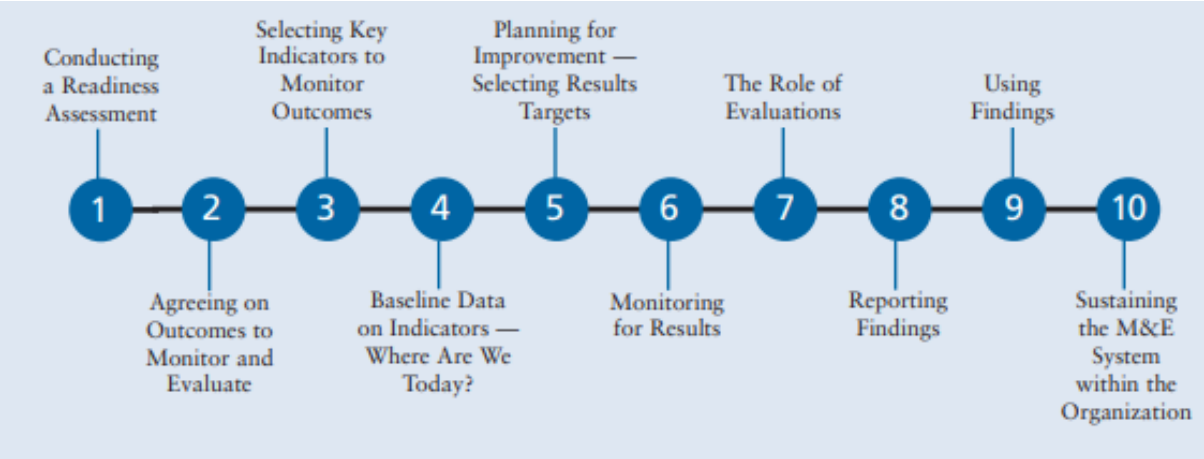


Figure 45 - *ten-step model from Kusek & Rist (2004)*

1. Conducting a readiness assessment

According to the case study, several different models are possible for building an M&E system. However, the complexity and nuances of the local context might be lacking in the proposed M&E systems. Causing the necessity of the local situation to be vaguely understood, and too little emphasis is placed on existing political, organisational, and cultural factors and contexts. Therefore, a first step that should be taken is the readiness assessment. This diagnostic aid will help determine where an organisation stands regarding monitoring and evaluation. This step is relevant before designing and building a results-based M&E system and consists of the following requirements:

a. Identify and determine if incentives or the driving need exists— institutional, personal or political — before beginning to
b. Specify the roles and responsibilities and available existing structures to monitor and evaluate goals (who are relevant, a political agenda etc.)
c. Inventory the current capacity of project managers to monitor and evaluate adequately (technical and managerial skills, available technology, financial resources and experience)

2. Agreeing on Outcomes to Monitor and Evaluate

According to Kusek & Rist (2004), all governments have goals, and governments need to know the aim of a goal before starting to work on it. Step two purposely chooses and agrees on the outcomes derived from the goals to monitor and evaluate. Goals are long-term (SDGs), and outcomes have a relatively intermediate time frame (five to ten years). Following from outcomes, targets of approximately three years can be

specified. It is crucial to emphasise outcomes instead of setting indicators; outcomes must be determined first before they can be indicated. The desired outcomes demonstrate which road to take and whether success has been achieved. It is essential to set outcomes in an M&E system, and building the system is a deductive process in which the inputs, activities, and outputs are all derived and flow from the set of outcomes.

a. Building a participatory and consultative process involving the stakeholders when choosing outcomes is crucial. The participatory process should develop goals, set outcomes, and build an indicator system.
b. Identify specific stakeholder representatives of each relevant stakeholder group.
c. Identify important stakeholder concerns groups.
d. Translate problems into statements of possible outcome improvements
e. Outcomes should be disaggregated sufficiently to capture only one improvement area in each outcome statement.
f. Development of a plan to assess how a government or organisation will achieve these outcomes
g. Translating problems into a positive single outcome statement is critical to the process.

3. Selecting key performance indicators to monitor outcomes

After appropriate outcomes have been stated, key indicators can be defined. Both quantitative and qualitative indicators provide a reliable way to measure achievement and reflect on achievements connected to interventions. Indicators should monitor all levels of the M&E system, thus concerning inputs, activities, outputs, outcomes, and goals. All system levels should be monitored to determine the success and where improvements can be made. Monitoring outcomes enables managers to assess the degree to which intended outcomes are achieved. Significant methodological and political considerations are involved in creating excellent and effective indicators.

a. Setting indicators to measure progress in inputs, activities, outputs, outcomes, and goals
b. Measuring performance indicators on a regular, predetermined basis. (This allows adjustments)
c. Translate desired outcomes in measurable performance indicators (iterative process)
d. The indicator selection process should consider, include, and reconcile stakeholder interests among multiple stakeholder groups.
e. With the minimal number of included indicators, directly measuring the desired outcome should be possible.
f. Use CREAM – Clear (precise and unambiguous), Relevant (appropriate to the subject at hand), Economic (available at a reasonable cost), Adequate (provide a sufficient basis to assess performance) and Monitorable (Amenable to independent validation)
g. The quantitative indicators should be reported as a specific number (median or mean) or percentage.
h. Qualitative indicators imply rather qualitative assessments which have compliance with quality or level. It provides insight into, among other things, changes in institutional processes or behaviours of individuals.
i. Performance indicators should be relevant to the desired outcome and not affected by other tangential issues.
j. Indicators should be monitorable, meaning they can be independently validated or verified, which is another argument in favour of starting with quantitative indicators instead of qualitative ones.
k. Proxy indicators should be where data for direct indicators is not available or when data collection will be too costly. ("Better to be approximately correct than precisely wrong")
l. All perspectives – substantive, technical and policy – need to be considered when determining indicators when formulating indicators.

m. Indicators need to be a direct reflection of the outcome itself.
n. At least three measurements are required to establish a baseline.

4. Setting Baselines and Gathering Data on indicators.

After formulating key performance indicators, the baseline data about the current situation should be established. The baseline indicates the first measurement and sets the current condition or circumstances against future change. The baseline provides evidence to learn about the current level and performance patterns by which decision-makers can measure subsequent policy, program, or project performance. There are eight baseline questions to be asked, visualised in figure 45.

Table 4.1
Building Baseline Information

Indicator	Data source	Data collection method	Who will collect data?	Frequency to collect	Cost and difficulty to collect	Who will analyze data?	Who will report data?	Who will use data?
1								
2								
3								

Figure 46 - building baseline information from Kusek & Rist (2004)

a. What sources can supply the relevant data for indicators
b. Collect only the data that is intended to use
c. Design and compare data collection methods with stakeholders (ideally, a combination of data collection methods is used) – figure 46
d. Data collection strategies necessarily involve trade-offs concerning cost, precision, credibility, and timeliness.
e. Use existing and available data as much as possible if it is trustworthy.
f. Subsequent and continuous measurements are vital since they will provide trend data directed from the baseline.

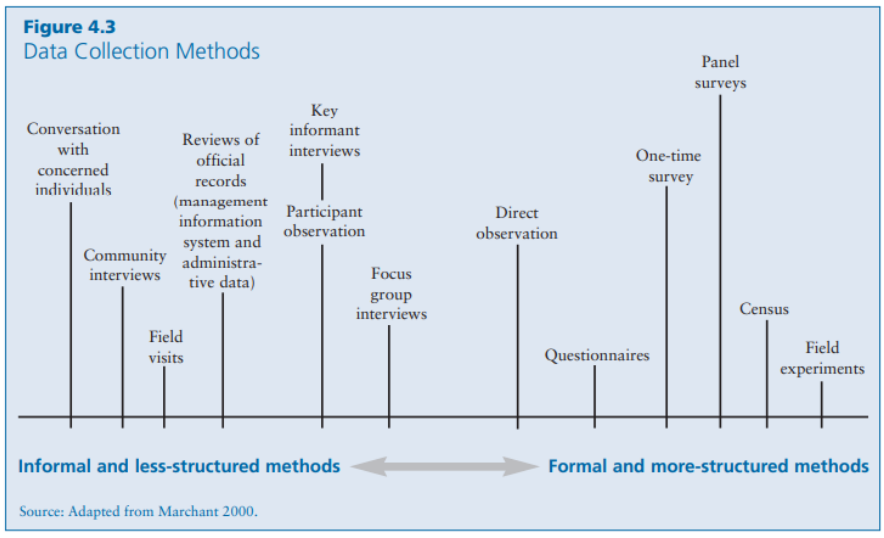


Figure 47 - data collection methods from Kusek & Rist (2004)

5. Planning for Improvement – Selecting results targets

After collecting the baseline data on indicators, the following step determines targets. Thus, identify the expected and desired level of the project, program, or policy results. This requires the selection of specific performance targets. A *target* is a specific objective that describes the number, timing and location of what is desired to realise. Therefore, targets can be seen as quantifiable levels of the indicators that an organisation wants to achieve by a given time. *Figure 47* shows the relationship between outcome, indicators, baselines and targets.

a. There must be a clear understanding of the baseline starting point – previous performance should be considered in projecting new performance targets.
b. Setting targets regarding expected funding and resource levels throughout the target period (capacity, budgets, personnel, funding, resources and facilities)
c. Targets must be feasible given all the resources available.
d. The targets should be short-term objectives (3-4) for achieving an outcome.
e. Longer stated targets should work with interim targets.
f. Flexibility is required while setting targets because resources may be cut out during the period.
g. With new indicators, a range should be used.
h. Targets should not be inflicted with political winds.
i. Use an Overall Performance-Based Framework—the completed matrix of outcomes, indicators, baselines, and targets. Performance targeting is critical to the process of reaching outcomes.

Figure 5.3
Developing Targets for One Policy Area

Example: Education

Outcomes	Indicators	Baselines	Targets
1. Nation's children have better access to preschool programs	1. Percent of eligible urban children enrolled in preschool education 2. Percent of eligible rural children enrolled in preschool education	1. In 1999, 75 percent of children ages 3–5 2. In 2000, 40 percent of children ages 3–5	1. By 2006, 85 percent of children ages 3–5 2. By 2006, 60 percent of children ages 3–5
2. Primary school learning outcomes for children are improved	1. Percent of Grade 6 students scoring 70% or better on standardized math and science tests	1. In 2002, 75 percent scored 70 percent or better in math, and 61 percent scored 70 percent or better in science	1. By 2006, 80 percent scoring 70 percent or better in math and 67 percent scoring 70 percent or better in science

Figure 48 - developing targets from Kusek & Rist (2004)

6. Monitoring for Results

After selecting the targets, the information can be used to monitor results. Therefore, a system to compile the required data improves the decision-making process. The data collection provides evidence of the performance and indicates potential or needed adjustments for any given project, program, or policy. Managers use various organisational tooling to manage inputs, including budgets, staffing plans, and diverse activities. Therefore, an M&E system should align with annual plans and other work plans to become a results-orientated system. Implement two types of monitoring – implementation monitoring and results monitoring. Implementation monitoring (how well outputs are achieved using available inputs and activities) tracks the means and strategies used to achieve a given outcome. The figure below depicts how

outcomes and targets are linked to annual work plans. The plans represent the means and strategies of an organisation to achieve outputs and, in the end, outcomes and impacts (figure 49).

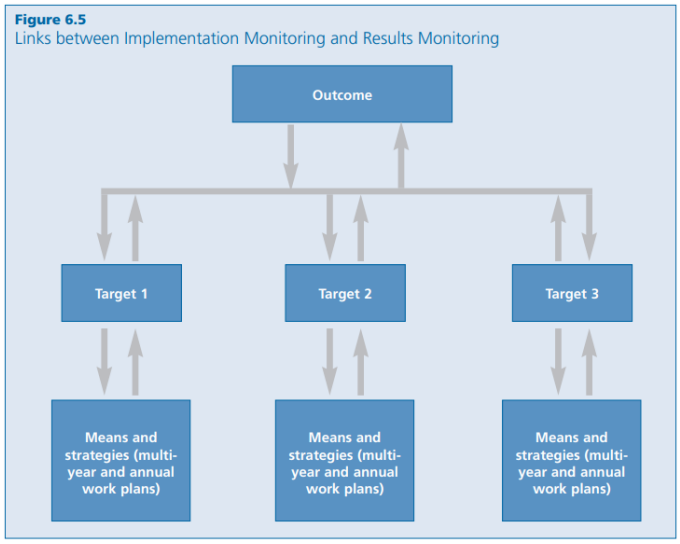


Figure 49 - links between outcome, targets and means and strategies from Kusek & Rist (2004)

a. The result information should be used at the project, program, and policy levels.
b. The information of results should move both horizontal and vertical through an organisation.
c. The demand for results information should be identified at each level.
d. The responsibility of each level must be clear (what is relevant data, when and how collected, who collects and reports it and for whom is data collected.
e. A monitoring system should be applied to partnership efforts. Partnerships can be created within the own department, organisation or beyond (figure 50)

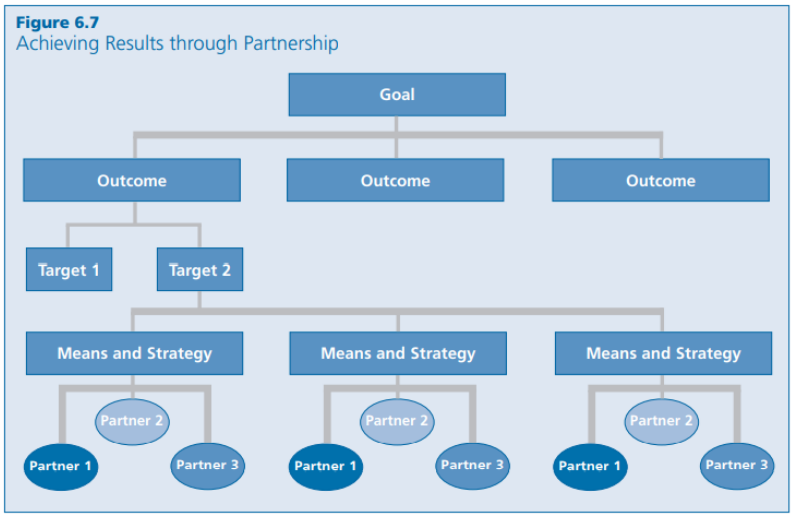


Figure 50 - partnership efforts from Kusek & Rist (2004)

f. The demand for performance information at each level needs to be identified.
g. A fundamental element of a monitoring system is owned and must come from those who use it at every level.
h. A champion should ensure sufficient data is generated correctly, shared and reported.
i. Management is an essential element of a monitoring system, and determining who, how, and where the system will be managed is critical for its survival.

j. An essential element of a monitoring system is maintained to prevent decaying and collapsing.
k. Monitoring systems require constant improvements. Therefore, it is vital to consider the new advances in management and technology.
l. An essential element of a monitoring system is credibility and should rely on valid and reliable data.
m. To maintain credibility, the data collection for all indicators (results and implementation) should include reliability (stable and consistent), validity (directly and succinctly), and timeliness (frequency, currency and accessibility)
n. Performance data should be analysed over time to compare present data to look for trends and other changes.
o. The monitoring strategy should include a distinct data collection and analysis plan (consisting of units of analysis, sampling procedures, data collection instruments, frequency of data collection, data analysis method and interpretation, responsibilities, partners, for who is the information, dissemination procedures and follow-up findings).
p. Data collection instruments and procedures should be pretested.

7. The role of evaluations

A monitoring system tracks performance as it is essential for managers to know whether policies, programs, and projects are moving in the desired direction. However, monitoring does not provide evidence on how changes occur, nor it cannot address strengths and weaknesses in projects, programmes, or policies. To address these and other relevant questions to generate relevant results, the evaluation of the information is essential—evaluation intents to incorporate the lessons learned into the decision-making process. Evaluation and monitoring complement one another – generating questions and providing answers. M&E uses the same data but generates but poses different questions and is often used in tandem to support ideas. The emphasis of evaluation is not just to assess causes but on developing an evaluation capacity in governments, which supports managers in developing a results-based management approach.

a. M&E should emphasise building sources of ongoing evaluation information instead sporadic individual evaluation
b. Evaluation should be pragmatic and useable for managers to help make resource allocation decisions.
c. Evaluation should be pragmatically useable for managers to rethink the causes of a problem.
d. Evaluation should be pragmatic and useable for managers to identify emerging problems.
e. Evaluation should be pragmatically valuable for managers to support decision-making on competing or best alternatives.
f. Evaluation should be pragmatically useable for managers to support public sector reform and innovation.
g. Evaluation should be pragmatically useable for managers to build consensus on the cause of a problem and how to respond.
h. Evaluation should be pragmatically useable for managers to answer management questions.
i. Therefore, there are different kinds of questions and different types of evaluations; there is no size fits all template (performance logic chain assessment, pre-implementation assessment, process implementation evaluation, rapid appraisal, case study, impact evaluation, and meta-evaluation.
j. To consider if monitored information is usable, it must contain six characteristics – impartiality (free of political bias), usefulness (relevant, timely, understandable and address the asked question), technical adequacy (meet relevant technical standards), stakeholder involvement (stakeholders are consulted and involved), feedback and dissemination (sharing information), and value for money (spend essentially but no more)

8. Report findings

Performance information from monitoring and evaluation provides necessary feedback on a specific project, program, or policy. Analysing and following the findings' reporting is critical because it addresses what, when and to whom performances are reported. In addition, it considers the current technical capacity of a specific organisation.

a. Determine the use of M&E findings (demonstrate, convince, educate, explore and investigate, document, involve, gain support and promote understanding), and the central purpose is to deliver the message.
b. When reporting the M&E findings, it should know and target the audience; therefore, a communication strategy should be developed (who will receive what information, in what format, when, who will prepare the information and who will deliver it).
c. The M&E results should be disseminated periodically to provide feedback to decision-makers.
d. The M&E results should be short and relevant to the target audience.
e. The M&E results should highlight the implications of recommended actions.
f. The presentation of performance data should be clear and understandable (avoid acronyms and jargon.
g. A written summary should contain an introduction, overview, present data on findings selectively and understandable and conclusions connected to evidence on performance.
h. An executive summary should be maxing four pages, present significant findings, recommendations, background, and purpose of the study, and briefly address substantial questions, issues and research questions.
i. Oral presentations on the findings should be simple, straightforward, and tailored to the audience.
j. Visual presentation should highlight key and performance findings in charts, graphs, and maps.

9. Using the findings

The primary purpose of an M&E system is to improve performances within an organisation or inform decisions that can lead to budgetary increases-or decreases. The M&E system provides accountable and transparent necessary feedback concerning the progress of projects, programs, and policies throughout their respective cycles.

a. Knowledge management should be adapted when the findings continuously create knowledge.
b. Policy and program evaluation should have a vital and systematic role in organisational learning. M&E systems can be an institutionalised form of learning and knowledge when the knowledge is disseminated and available to users.
c. The political environment should be adjusted to encourage continuous reporting.
d. The results should be actively shared with potential users and partners and open to the web.

10. Sustaining the M&E system within the organisation

Ideally, the M&E system should be a long-term effort and sustaining such systems within governments or organisations, the long-term process involved in ensuring utility needs to be recognised. The following components are crucial in sustaining an M&E system.

a. The demand for M&E should be structured required to legislation and regulations.
b. The organisation and relevant people or proper functions for collecting, analysing, and reporting performance should be clearly defined.
c. The departments within an organisation should be promoted and able to keep up the communication.

d. The level of communication on data collection, analysis, and reporting should go beyond the level of government and align the various levels.
e. The M&E should report to each level within an organisation because "pass-through" levels create vulnerability.
f. The M&E findings on performances should be trustworthy and credible information.
g. The producers and M&E system need protection from political reprisals.
h. The M&E findings on performances should be transparent and subject to independent verification.
i. The government department linked to the M&E findings should not be exempted from the accountability of stakeholders.
j. The government or organisation implementing an M&E system should have technical and managerial skills.
k. Including the M&E system should provide incentives (rewarding, addressing problems, value learning and budget savings are shared) to encourage the use of performance information and keep managers and stakeholders on track.

Review

Despite the thorough description of the proposed M&E system, there are critical sidenotes. First, the study originates from 2004 and is possibly less accurate to the current situation. In addition, due to the focus on especially national governments around the globe, it might lack regional applicability. While the case study uses examples to describe requirements, it does not describe a way to monitor or evaluate practically in an urban environment; as a result, those practicalities are often neglected. At last, the case study proposes a result-orientated system; however, the question arises if a governmental institution should be result-based? Because a government should focus on serving the population and should focus on benefits rather than results.

Opportunities

The Ten Steps to a Results-based M&E System describes the necessary steps and requirements to develop and sustain an M&E system for governments and organisations. The case study aims to develop an M&E system that tracks progress and provides feedback concerning outcomes and consequences of governmental actions has similarities with the conducted research. Therefore, the ten steps, including requirements, provide an optimal first step to developing an M&E blueprint.

Inventory III.a1 – Case study I on Structural & Design requirements

Table 7 - Inventory III.a1 – Case study I on Structural & Design requirements

Requirement	Description	Recurring
9	The M&E system should include maintenance to prevent decaying and collapsing.	
10	The M&E system should be a participatory and consultative process involving stakeholders when determining required outcomes and how to achieve these - The participatory process should start with developing goals and continue with setting outcomes, building an indicator system and designing a combination of collection methods.	3

Inventory III.b1 – Case study I on Functional requirements

Table 8 – Inventory III.b1 – Case study I on Functional requirements

Requirement	Description	Recurring

17	The M&E system should gauge the relevant roles and responsibilities and available existing structures to monitor and evaluate goals (who are relevant, is there a political agenda etc.).	
18	The M&E system should inventory the current capacity of managers or public servants in a municipality to monitor and evaluate adequately (technical and managerial skills, available technology, financial resources, and experience)	
19	The M&E system should identify the specific stakeholder representatives of each relevant stakeholder group and the significant concerns of that group to include and reconcile their interests.	2
20	The M&E system should translate occurring municipal problems/challenges into statements of possible outcome improvements.	
21	The outcomes presented in the M&E system should be disaggregated sufficiently to capture only one improvement area in each outcome statement.	1
22	The M&E system should define indicators to measure progress in inputs, activities, outputs, outcomes, and goals.	1
23	The M&E system should measure performance indicators regularly, predetermined basis.	
24	The M&E system should define desired outcomes into the minimal amount of SMART (operational) goals, performance indicators and KPIs (iterative process).	8
25	The M&E system should follow a trade-off between CREAM guidelines for indicators to set feasible targets throughout the minimal period – Clear (precise and unambiguous), Relevant (appropriate to the subject at hand), Economic (available at a reasonable cost), Adequate (provide a sufficient basis to assess performance) and Monitorable (Amenable to independent validation).	
26	The quantitative indicators used in an M&E system should be reported in terms of a specific number (this includes number, median or mean) or percentage.	
27	The M&E system should imply qualitative indicators and thus qualitative assessments which have compliance with quality or level. It provides insight into, among other things in, changes in institutional processes or behaviours of individuals.	
28	The performance indicators of an M&E system should be relevant to the desired outcome and not affected by other issues tangential to the outcome.	
29	Proxy indicators in the M&E system should be used where data for direct indicators are not available or when data collection will be too costly. (“Better to be approximately correct than precisely wrong”).	
30	The M&E system should include all perspectives when formulating substantive, technical and policy indicators that need to be considered when determining indicators.	
31	The indicators of the M&E system need to be a direct reflection of the outcome itself.	
32	The M&E system should require at least three measurements to establish a baseline.	
33	The M&E system should collect only data that is necessary.	
34	The M&E system should use existing and available data as much as possible if it is trustworthy.	
35	The targets of an M&E system should be short-term objectives (3-4) on the path to achieving an outcome.	
36	The M&E system should work with interim targets when using long term targets.	
37	The M&E system should require flexibility while setting targets because resources may be cut out during the period.	
38	The M&E system should consider a range when using new indicators.	
39	The targets of an M&E system should not inflict by political winds.	
40	The M&E system should make use of an Overall Performance-Based Framework. The completed matrix of outcomes, indicators, baselines, and targets. Performance targeting is critical to the process of reaching outcomes.	
41	The M&E system should enable objective choices at the project, program, and policy levels.	1
42	The M&E system should enable transiting information of results both horizontal and vertical through an organisation. To pragmatically enable managers to make resource allocation decisions, rethink causes of a problem, identify emerging problems, support decision making, support public sector reform and innovation, build consensus within the organisation and answer management questions.	9
43	The M&E system should identify the demand for desired results information at each level.	1
44	The M&E system should indicate the responsibility (ownership) of the monitoring elements at every level (what is relevant data, when and how collected, who collects and reports it and for whom is data collected).	2
45	The M&E system should be applied to partnership efforts. Partnerships can be created within the own department, organisation or beyond.	
46	The M&E system should appoint a responsible champion to stress that sufficient data is adequately generated, shared and reported.	
47	The M&E system should include constant improvements. Therefore, it is vital to consider the new advances in management and technology.	

48	The M&E system should be based on reliable (stable and consistent), valid (directly and succinctly), and timeliness (frequent, current and accessible) performance data to maintain credibility.	3
49	The M&E system should analyse performance data over time to compare present data and identify trends and other changes.	1
50	The M&E system should include a monitoring strategy consisting of a distinct data collection and analysis plan. Consists of units of analysis, sampling procedures, data collection instruments, frequency of data collection, data analysis method and interpretation, responsibilities, partners for who is the information, dissemination procedures and follow-up findings).	1
51	The M&E system should pre-test the data collection instruments and procedures to identify unusual external factors that could influence the value of variables.	
52	M&E should emphasise building sources of ongoing evaluation information instead sporadic individual evaluation	1
53	The M&E system should determine the required type of evaluation. There is no size fits all template (performance logic chain assessment, pre-implementation assessment, process implementation evaluation, rapid appraisal, case study, impact evaluation and meta-evaluation).	
54	The M&E system should consider if monitored information is usable, it must contain six characteristics – impartiality (free of political bias), usefulness (relevant, timely, understandable and address the asked question), technical adequacy (meet relevant technical standards), stakeholder involvement (stakeholders are consulted and involved), feedback and dissemination (sharing information), and value for money (spend essentially but no more)	1
55	The M&E system should formulate a communication strategy in advance to determine the use of M&E findings (demonstrate, convince, educate, explore and investigate, document, involve, gain support and promote understanding), the target audience, central purpose to deliver the message and who will receive what information, in what format, when, who will prepare and deliver.	4
56	The M&E results should be short and relevant to the target audience.	
57	The M&E results should highlight the implications of recommended actions.	
58	The presentation of results from the M&E system should be in a clear and understandable form (avoid acronyms and jargon).	
59	A written summary of the M&E system result should contain an introduction, summary, present data on findings selectively and understandable and conclusions connected to evidence on the performance.	
60	An executive summary of an M&E system result should be four pages (maximum) and present significant findings, recommendations, background, the purpose of the study and briefly address significant questions, issues, and research questions.	
61	The oral presentation on the results from an M&E system should be simple, straightforward, and tailored to the audience.	
62	The visual presentation of the results from an M&E system should highlight attractive key and performance findings in charts, graphs and maps.	
63	The M&E system should have a vital and recurring role in evaluating policy and programs to achieve organisational learning. M&E systems can be an institutionalised form of learning and knowledge when the knowledge is disseminated and available to users.	
64	The M&E system should encourage the political environment on continuous reporting.	
65	Implementing an M&E system should be structured and therefore requires establishment within legislation and regulations.	1
66	The M&E system should clearly define the functions of relevant people within an organisation regarding collecting, analysing, and reporting the performance of data and targets.	
67	The M&E system should promote and encourage the various departments within an organisation to maintain communication.	
68	The M&E system should protect initiators, users and stakeholders from political reprisals.	
69	The M&E system findings on performances should be transparent and subject to independent verification.	
70	The government department linked to the M&E system findings should not be exempted from the accountability of stakeholders.	
71	The government or organisation implementing an M&E system should consist of technical and managerial skills.	
72	The inclusion of the M&E system should provide incentives (rewarding, addressing problems, value learning and budget savings are shared) to encourage the use of performance information and keep managers and stakeholders on track.	

This case study provides two structural & design requirements and 57 functional requirements. Within the entire Inventory process (all four steps), there were 39 requirements duplicates since the essence or

purpose of the requirement was complementary to a requirement already present in the table above. It is chosen to remove the duplicates from the list to improve the readability.

Analysis Case study 2

+CityxChange – Approach and Methodology for Monitoring and Evaluation
By William Hynes, James Sweeney, Sheryl Lynch, and Daniel Rood (2019)

Description

The purpose of the European +CityxChange project is to develop a standardised approach and methodology to Monitor and Evaluate the impact of interventions in eleven demonstration projects across Europe. M&E is a crucial element within the +CityxChange project and simultaneously provides tools for a comprehensive policy and innovation community. The M&E approach is an evidence-based process which enables tracking and validating the progress and performance of various interventions regarding the broader European goals.

The research document provides a framework (guideline) for how M&E in the eleven demonstration projects (DP) of the +CityxChange program should be handled. M&E defines if project interventions have the intended result, enabling an overall assessment and whether something could be done differently to achieve prescribed goals and objectives.

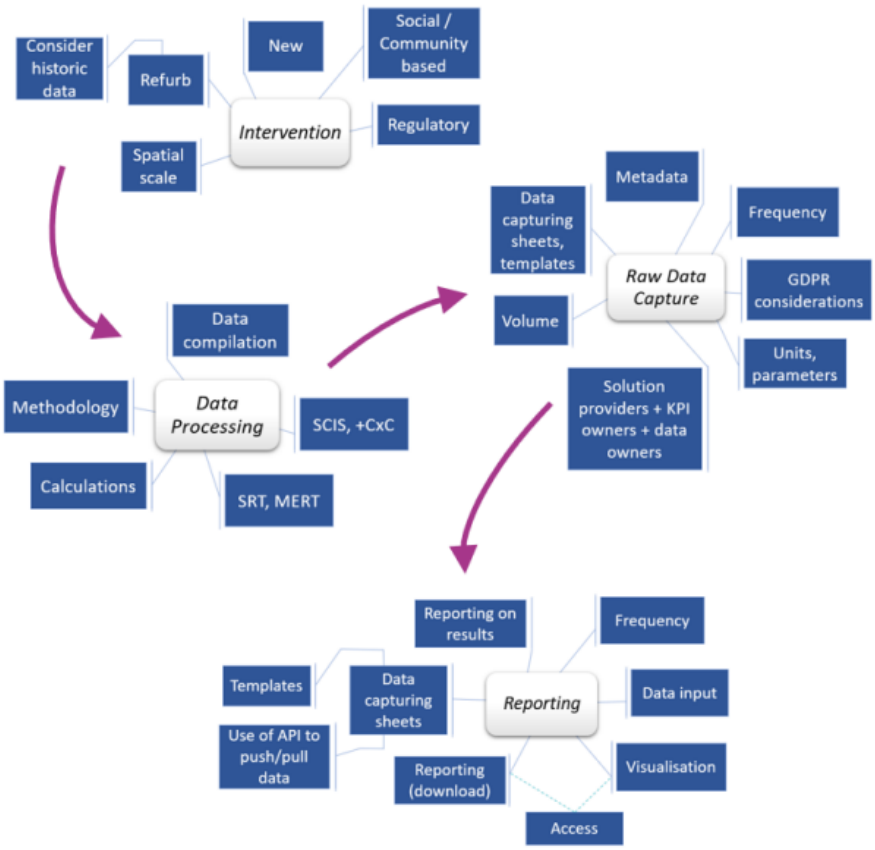


Figure 51 - +CityxChange approach by Hynes et al. (2019)

A standardised M&E approach and methodology were developed to execute similar M&E between all participating DP's. The standardised M&E approach and methodology consists of a developed KPI Framework to assess the performance and success of interventions. A standard approach for monitoring and evaluating data minimises the modification needed to perform statistical analysis and report results among the various projects.

Functioning

A standardised M&E approach and methodology were developed to execute similar M&E between all participating DP's. The standardised M&E approach and methodology consists of a developed KPI Framework to assess the performance and success of interventions. A standard approach for monitoring and evaluating data minimises the modification needed to perform statistical analysis and report results among the various projects. Therefore, the following basic requirements are made:

a. There should be an agreement between the relevant partners on all definitions and calculations.
b. The defined calculation methodology and KPI parameters should be applied throughout the project lifecycle to ensure that data is monitored consistently and accurately.
c. The need to modify the M&E to perform statistical analysis and reporting data after each project should be minimal.

1. Data requirements

Besides standardised requirements, there is authoritative guidance regarding data requirements of project interventions to ensure a successful and high-quality data process.

a. The Monitoring data should be measured directly at the source of interventions by 'hand' or automated measuring systems indicating value, operating performance, and capacity.
b. The monitoring data should be detailed to minimise faults due to a lack of data.
c. The data owners should include all monitored metadata, including data collection sheets.
d. A zero-measurement should be included to determine the effectiveness of interventions.
e. A pre-performed inventory should identify any unusual external factors that might influence the value of variables.
f. To compare datasets over time and places, is it essential to record the variances which influence the data results (such as weather conditions)

2. Monitoring Phases

Four phases of monitoring over the project lifecycle are defined – Definition, Implementation, Monitoring and Long-term monitoring.

Definition

a. Select and refine the relevant KPIs
b. Determine monitoring concepts for each project (e.g., focus on building, energy supply units, etc.)
c. Determine key metrics and parameters of KPIs
d. Define the zero measurements, also known as baseline
e. Formulate a detailed plan regarding monitoring procedures

Implementation

f. The existing systems or project performance should be monitored one year before the proposed intervention.
g. The monitoring should include an identification of each measurement unit of each intervention.

h. There should be a close collaboration between M&E solution provides and impact/data owners before monitoring starts.
i. All key points and experiences should be documented to improve the replication and implementation.

Monitoring

j. The defined KPIs should be consistently monitored to collect performance data.
k. The first year should be used to optimise the operating system to prevent operational issues.
l. The intervention's performance data should be compared to the baseline and expected target.

Long term monitoring

m. Data quality and consistency should be kept at the same standard
n. The data should be managed efficiently to predict maintenance, failures, and improvements.

3. Capturing and reporting data

The KPI framework defines which data is collected and provided by the KPI owner. Two roles can be defined, the KPI owner and the Data owner. The KPI owner takes the lead in implementing, testing, and monitoring interventions. On the other hand, the Data owner acts as a complementary partner to KPI owners, provides technical support and tools, and assists in implementing interventions.

a. The KPI owner should ensure that intervention impacts are recorded correctly and available.
b. The KPI owner should agree to the KPIs' definition, description, and calculation method.
c. The KPI owner should confirm that it can deliver each indicator's calculation requirements and parameters.
d. The KPI owner should review the accuracy and relevance of the monitoring data.
e. The Data owners are responsible for managing data monitored from project interventions.
f. The Data owners should protect personal data.
g. The Data owners should follow the principle 'as open as possible and as close as necessary to ensure the safe sharing and usage of project data.
h. Each partner should be fully aware of their involvement in a particular KPI to track progress and have the data available for reporting each KPI.
i. The metadata records should include sufficient detail about spatial information resources, allowing users to make accurate judgements on the content, quality, currencies and conditions of access and re-use.
j. While determining relevant data sources, KPIs and indicators, the International Organisation for Standardization (ISO) should apply.
k. The data collection process of KPIs should be ongoing and constant released at monthly intervals.
l. The actual reporting depends on the agreement made on reporting frequency.
m. The monitoring starts after the completion of each completion of intervention specific.
n. It is essential to define a baseline to compare future performances.

4. Defining boundaries

The project implementations have a particular impact on a predefined spatial location. The KPI framework can be adjusted to the spatial scale level. Therefore, it is relevant to determine the spatial scale of projects because it provides a macro or micro view of a particular KPI's effect on the environment in which it is implemented.

a. The spatial scale should be assigned to each KPI.
b. The level at which the KPI is reported should be determined.

5. Data Governance

The multiple partners involved in the project should agree on the working knowledge regarding each KPI and how the data owner will have to apply specific data governance.

a. Each KPI and data owner should be contacted to discuss the relevant KPI in more detail and to reach a consensus on expected outcomes (Which datasets should be used, Where the data is originating from, How the data should be monitored and modelled, and specify each KPI unit of measurement, the platform where the information will be stored and, in which format the partners will be able to view the captured data).
b. A data management plan should be developed to formulate guidelines on how data governance, handling, management, security and sharing should be achieved.
c. Regulations state that organisations must inform participant data providers about their identity and the legal reason for using and processing participants' data.
d. The data collectors must follow the obligated steps for compliance by adding necessary disclaimers and ensuring participants or data provides full consent where, why, what data is collected and how the data is used, stored, managed and kept.
e. The organisation is responsible for demonstrating how data is safely handled.
f. A Data Protection Officer (DPO) should be appointed.
g. DPO must share their contact with participants to keep an open line of communication
h. The risk profile of personal data (scale, sensitivity and protection) should be established.
i. The potential losses of participants should be considered if their data would leak.
j. Data protection by design should be implemented: it ensures that data privacy features and technologies are written into the project documentation or software at the beginning of a project.
k. Data protection by default should be considered to set the service settings automatically on protection-friendly and only data specifically necessary.
l. The DPO should perform regular audits on the security of data.
m. Unnecessary data should not be collected or stored.
n. The data should be stored safely with limited access in the case of ID and personal information.
o. Each individual working with the data should be responsible for the necessary security.
p. Back-up systems should be in place to prevent the loss of data.
q. The guidelines for data governance should be elaborated in a Data Management Plan (DMP)
r. The DMP should generate project data Findable, Accessible, Interoperable, and Re-usable (FAIR)
s. All captured monitoring data should be available to all project partners.

6. Reporting Tools

The +CityxChange project applies a specific created M&E reporting tool. It consists of three primary functions. First, it provides project partners with a template for specific data input, which will be stored and managed within a database. The completed data is analysed and highlighted through reports, summaries and visualisations. Finally, the analysed data is made available to project stakeholders.

7. Key Performance indicators

Predetermined KPIs are used in a project measurement tool. The indicators measure social, environmental and economic factors of specific technical and non-technical interventions. At the same time, having the necessary metrics to measure the performance of interventions regarding aligned goals and sustainable principles. The KPIs are assembled in a KPI framework that keeps continuous track of interventions, which are then validated against the projects or organisational goals.

Data collection and calculation of KPIs occurs via DCS (Data collection sheets) through APIs connected sources. A DCS is created for each KPI, containing various fields to capture and calculate data. The KPI owner is responsible for filling in the required information and submitting the data to the relevant reporting tool for further processing. KPI data will be captured in Self Reporting Tool (SRT) and transferred to the Monitoring and Evaluation Reporting Tool (MERT) for modelling, analysis and visualisation. The KPI framework was created to compile multiple sources as part of the Smart Cities Information Systems (SCIS) existing of various sources. A web-based reporting tool captures project-defined KPIs not linked to the SCIS.

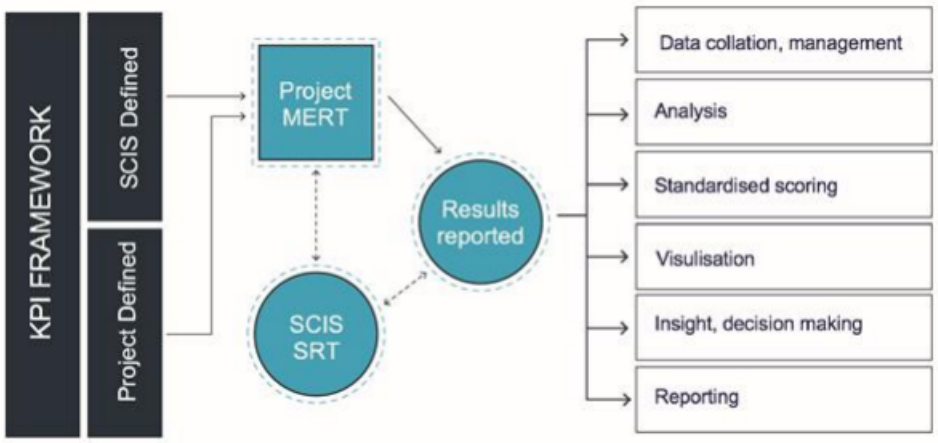


Figure 52 - Key Data flow from KPIs to reporting tools from Hynes et al. (2019)

a. Divide the KPIs into core themes – which are in line with the specific objectives of the project
b. Include all relevant organisations/stakeholders in determining the KPIs
c. Establish a straightforward process and methodology to collect the relevant data – establish clearness among stakeholders on the various roles of data owner and collector.
d. The KPI owner is responsible for filling out the necessary information and submitting collected data.
e. Maximise consistency of M&E over various projects
f. Guide KPI owners on the collection of monitoring data consisting of the following details: definition, description, KPI and data owner, spatial scale and level of reporting, calculation methodology, calculation parameters, data requirements, reliability, and availability, the expected target, unit of measurement and the frequency of reporting.
g. Project partners should provide feedback on the proposed KPIs to ensure alignment and understanding of what will be expected regarding actual data collection and capturing when interventions are implemented.
h. Determine core KPIs which apply to all projects (General technical, environmental, Economic, ICT and mobility KPIs).
i. Determine supporting KPIs supplementary to the Core KPIs - the supporting KPIs provide insight and additional metrics to consider performance measurement of interventions.

8. Monitoring and Evaluation Scoring Outputs

Results must be understandable for both non-technical and technical audiences. Standardisation of project outputs allows the comprehension of each KPI. Standardisation will increase the ease of data analysis and handling large amounts of data. Standardisation is transforming or manipulating data into a consistent and useable configuration. The standardisation allows for comparing results and ensures consistency in reporting of project data.

a. Standardisation is implemented since it ensures consistency in reporting of project data since all data is transformed into a single format comprehensible to all stakeholders.
b. Establish the average value for an area for each KPI (mean)
c. Calculate the variance that exists in the data for each KPI (standard deviation)
d. Standardise indicator outputs to facilitate comparison of KPIs (z scores)
e. Structure an index score for each KPI

It is crucial to evaluate the relevance of KPIs to inform on the intervention's potential contribution to the scaling and replication of a project.

Review

The Approach and Methodology for M&E's aim are to provide a detailed technical analysis and requirements for collecting and managing data to track and validate the progress and performance of each intervention against the stated goals. The program focuses on seven cities across Europe. The approach and methodology primarily indicate the relevant aspects of an M&E system instead of providing the (minimum) requirements. However, it is feasible to distract the rather general requirements.

Opportunities

The Approach and Methodology for M&E provide opportunities, especially on the Data Governance aspects and how to handle sensitive data adequately. In addition, it is interesting to consider the existing research and results under European Union's Horizon 2020 innovation programme and Smart Cities Information System. The executed research and profound results might support overcoming practicalities.
The table below includes requirements which are elucidated from case study II. The table uses the same explanation as in case study I.

Inventory III.a2 – Case study II on Structural & Design requirements

Table 9 - Inventory III.a2 – Case study II on Structural & Design requirements

Requirement	Description	Recurring
11	The first year of the M&E system should be used to optimise the operating system to prevent operational issues.	

Inventory III.b2 – Case study II on Functional requirements

Table 10 - Inventory III.b2 – Case study II on Functional requirements

Requirement	Description	Recurring
73	The M&E system should be based on an agreement between the relevant partners on all definitions and calculations.	
74	The defined calculation methodology and KPI parameters of an M&E system should be applied throughout the entire project lifecycle to ensure that data is monitored consistently and accurately.	
75	The M&E system should be adapted minimally to perform statistical analysis and report data after each project and compare.	
76	The necessary data of the M&E system should be measured directly at the source of interventions by 'hand' or automated measuring systems indicating the system's value, operating performance, and capacity.	
77	The monitoring data of the M&E system should be detailed to minimise monitoring faults due to a lack of data.	
78	The M&E system should persist that data owners include all monitored metadata, including data collection sheets.	
79	The M&E system should compare datasets over time, and places and record the variances which influence the data results (such as weather conditions).	

80	The M&E system should determine the monitoring focus for each project (e.g., focus on building, energy supply units, etc.).	
81	The M&E system should monitor existing systems or project performance one year prior to proposed interventions.	
82	The M&E system should include identifying each measurement unit of each intervention.	
83	The M&E system should collaborate closely between M&E project leaders and impact/data owners before monitoring starts.	
84	The M&E system should document all key points and stakeholder experiences to maximise consistency and improve replication over various projects to guide municipal managers.	2
85	The data collected with the M&E system should be managed efficiently to predict maintenance, detection of failures and improvements.	
86	The M&E system should obligate that the KPI owner ensures that intervention impacts are recorded correctly and available.	1
87	The M&E system should obligate that the KPI owner agrees to the KPIs' definition, description, and calculation method.	
88	The M&E system should obligate that the KPI owner reviews the monitoring data's accuracy and relevance.	
89	The M&E system should obligate that Data owners are responsible for managing monitored data from project interventions.	
90	The M&E system should obligate that data owners should protect personal data.	
91	The M&E system should obligate those data owners should follow the principle 'as open as possible and as close as necessary to ensure the safe sharing and usage of project data.	
92	The M&E system should inform and reach a consensus with each partner (KPI owner, data owner, departments, organisations) about their involvement in a particular KPI. To track progress and report on it following pre-defined guidance - Which datasets should be used, Where the data is originating from, How the data should be monitored and modelled, specify each KPI unit of measurement, the platform where the information will be stored and, in which format the partners will be able to view the captured data. Including the following details: definition, description, KPI and data owner, spatial scale and level of reporting, calculation methodology, calculation parameters, data requirements, reliability, and availability, the expected target, unit of measurement and the frequency of reporting.	2
93	The M&E system metadata records should include sufficient detail about spatial information resources, allowing users to make accurate judgements on the content, quality, currencies and conditions of access and re-use.	
94	The M&E system should apply the International Organisation for Standardization (ISO) standards when determining relevant data sources, goals, KPIs and indicators.	
95	The M&E system should agree on reporting frequency.	
96	The M&E system should start directly after the completion of each completion of intervention specific.	
97	The M&E system should assign the spatial scale to each KPI.	
98	The M&E system should determine the level(s) at which the KPI is reported.	
99	The M&E system should develop a data management plan to formulate guidelines on how to achieve data governance, handling, management, security, and sharing.	
100	The M&E system should include regulations that state that organisations are obligated to inform participant data providers about who they are, the legal reason for using data, and processing participant data is not unnecessarily collected and stored.	1
101	The M&E system should obligate data collectors of KPIs to follow steps for compliance by adding necessary disclaimers and ensuring participants or data provides full consent where, why, what data is collected and how the data is used, stored, managed and kept.	
102	The M&E system should appoint a Data Protection Officer (DPO).	
103	The M&E system should obligate that the DPO share their information regularly with participants to keep an open line of communication.	1
104	The M&E system should establish a risk profile (scale, sensitivity and protection required) of personal data to classify the potential losses of participants' data would leak.	1
105	The M&E system should include the Data protection by design principle to ensure that data privacy features and technologies are written into the project documentation or software at the beginning of a project. Everyone is responsible for the necessary security.	2
106	The M&E system should obligate data protection by default and set the service settings automatically on protection-friendly and only necessary data.	
107	The M&E system should obligate the DPO to perform regular audits on data security.	

108	The M&E system should store personal data safe with limited access.	
109	The M&E system should include backup systems to prevent data loss.	
110	The M&E system should consist of a Data Management Plan (DMP), representing the data governance guidelines.	
111	The DMP of the M&E system should generate project data Findable, Accessible, Interoperable, and Re-usable (FAIR)	
112	The M&E system should make captured monitoring data available to all project partners.	
113	The M&E system should divide KPIs into core themes which align with the project's specific objectives.	
114	The M&E system should establish clearness among stakeholders on the various roles of data owner and collector - Establish a straightforward process and methodology to collect the relevant data.	
115	The KPI owner within an M&E system is responsible for filling out the necessary information and submitting collected data.	
116	Project partners of the M&E system should provide feedback on the proposed KPIs to ensure alignment and understanding of what will be expected regarding actual data collection and capturing when interventions are implemented.	
117	The M&E system should determine core KPIs which apply to all projects (General technical, environmental, Economic, ICT and mobility KPIs).	
118	The M&E system should determine supporting KPIs which are supplementary to the Core KPIs - the supporting KPIs provide insight and additional metrics to consider the performance measurement of interventions.	
119	The M&E system should establish general reporting rules - the average value for an area for each KPI (mean), the variance that exists in the data for each KPI (standard deviation), facilitate comparison between KPIs (z-scores), structure and index score for each KPI and evaluating the relevance of KPIs to inform on the interventions potential contribution to eventual scale-up and/or replicate project interventions.	5

In total, this case study provides one structural & design requirement and 49 functional requirements. Within the entire Inventory process (all four steps), there were 15 requirement duplicates since the essence or purpose of the requirement was complementary to a requirement already present in the *table* above. It is chosen to remove the duplicates from the list to improve the readability.

Analysis Case study 3

It Was There as a Service (IWTAAS) & Sightview Horizon Internet Technologies

Description

Successful companies and organisations require diverse data to assist in business decisions in a data-driven world. However, collecting the relevant data from company activities can be challenging, often requiring a complex system integration with specific competencies and skills. It Was There as a Service (IWTaaS) is a platform offered by Horizon Internet Technologies. It allows a company to collect, convert, and dispatch data from any data source to any application. IWTaaS is an easy-to-use, no-code platform that serves as a universal connector between multiple data sources and applications for companies to collect the necessary data for business decisions. One of the features of IWTaaS is that the integrity of the data is secured by blockchain technology to validate the integrity of data.

Horizon Internet Technologies offers a solution composed of their It Was There as a Service (IWTaaS) platform (figure 52) and the SightView application built for the construction industry. The platform collects data from sensors, mobile apps, and open data sources and provides this data in the correct format needed for the SightView or any other application (figure 53). The application detects and transparently visualises for all stakeholders if the project requirements have been fulfilled, which can be evaluated for further

action. This service allows stakeholders to view the same information to increase trust, reduce disputes, decrease on-site audits, and minimise payment process times.

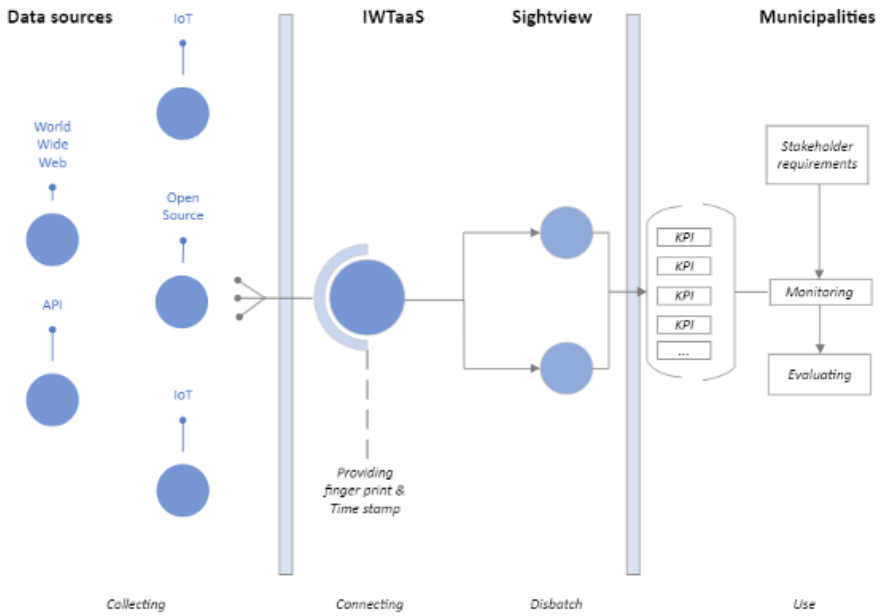


Figure 53 – Overview IWTaaS (author creation)

Functioning

The overview below, in addition to figure 54, visualises the functioning of IWTaaS and its relation to Sightview or other Power BI or ArcGIS applications. The essence of the IWTaaS approach is to pursue a fixed approach for all necessary steps, which will guide stakeholders and owners throughout the process and result in an integer process. After each cycle, the steps can be further optimised to address the needs and desires.

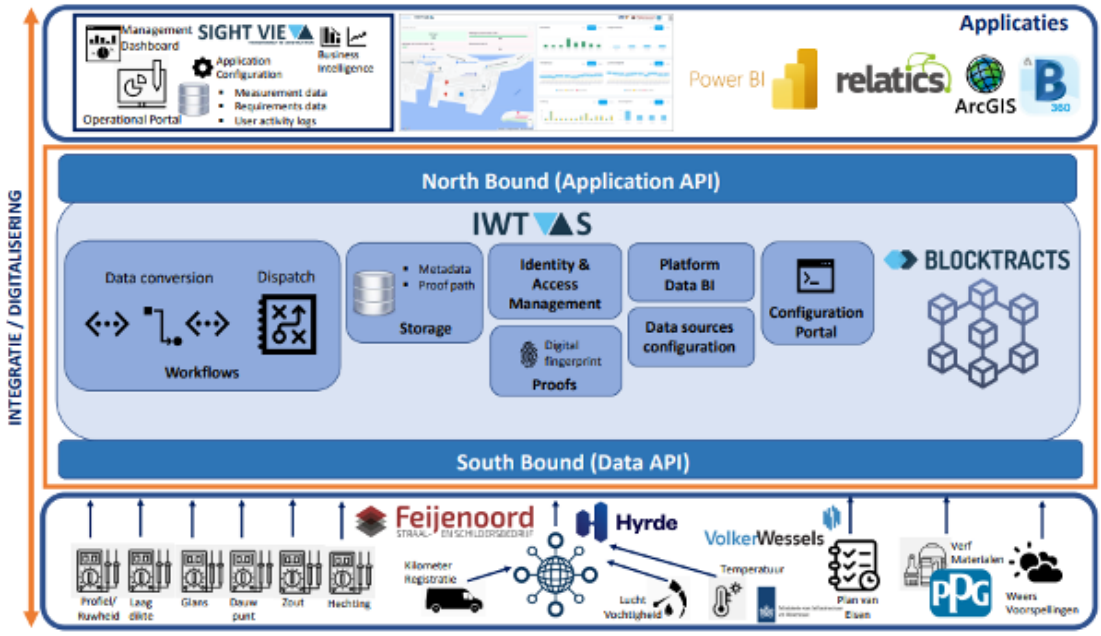


Figure 54 - functioning IWTaaS – (Source: Horizon Internet Technologies)

The steps below elaborate on the necessary actions.

1. Collecting

New and existing data sources such as APIs, World Wide Web, IoT and open sources are utilised to collect desired/necessary data. The necessary information is stated in the contract requirements. In the figure above (left below), the data regarding the profile/roughness, layer thickness, glaze, dew point, salt and bonding of assets (in this case of lock gates) is relevant for the correct execution of maintenance. In addition, the kilometres are registered, and humidity, temperature and used paint material are captured. The program requirements are also included to be examined in a subsequent phase.

- What are minimal contract requirements within the projects
- What are the existing available data sources, and do they meet the contract requirements
- Identify what information is missing
- Identify what data sources are relevant
- Create a data collection plan on how the information can be collected, how often and from which location.
- Identify all the stakeholders participating in the project and their possibility to deliver data or participate in collecting it.

2. Connecting

After determining which information is relevant and how it can be collected; APIs, World Wide Web, IoT and open sources, the data sources must be connected to the platform. To connect the relevant data sources to the platform, the file types are inventoried and connected via drag and drop to the IWTaaS platform. The platform converts the data from different data file types to a similar desired file type, such as JSON.

- Inventory what file types the data sources are delivered in
- Make agreements with data deliverers over the consistency of data delivery, period and reliability
- Determine the desired file type in which all information must be formatted

3. Dispatch

After the collected data is converted into the correct format, it will be dispatched to the desired storage – such as a database.

- Determine a central location or locations where the converted data must be dispatched to.
- Determine how often datasets must be sent to this database

4. Store

The data packages (retrieved data from a single event and source) will receive a digital fingerprint (proof) when stored in a database. The digital fingerprint proves the integrity of legitimately collected data.

- Maintain the credibility and legitimacy of the data sources by adding a digital fingerprint

5. Calculate

The stored data can be used to calculate and determine values. It is necessary to determine how stored data can be used to calculate specific values. It is possible that within a company or organisation, each department uses the data to determine output (values) relevant to the stated indicators or KPIs. This requires fixed calculation methods.

- Create a calculation strategy that indicates what outputs (indicators/KPIs) are relevant based on contract requirements or ambitions and state which data will be used to calculate output (values)— creating a fixed calculation method.

6. Visualise

Direct from the database after the calculations; the data can be used to visualise desired results over time. The visualisation can be live executed in different applications such as ArcGIS, PowerBI or Sightview. *Figure 54* below provides an example of a dashboard within Sightview. The dashboard provides information on the various necessary values achieved.

- Determine in which applications the results must be visualised and how the results must be visualised.

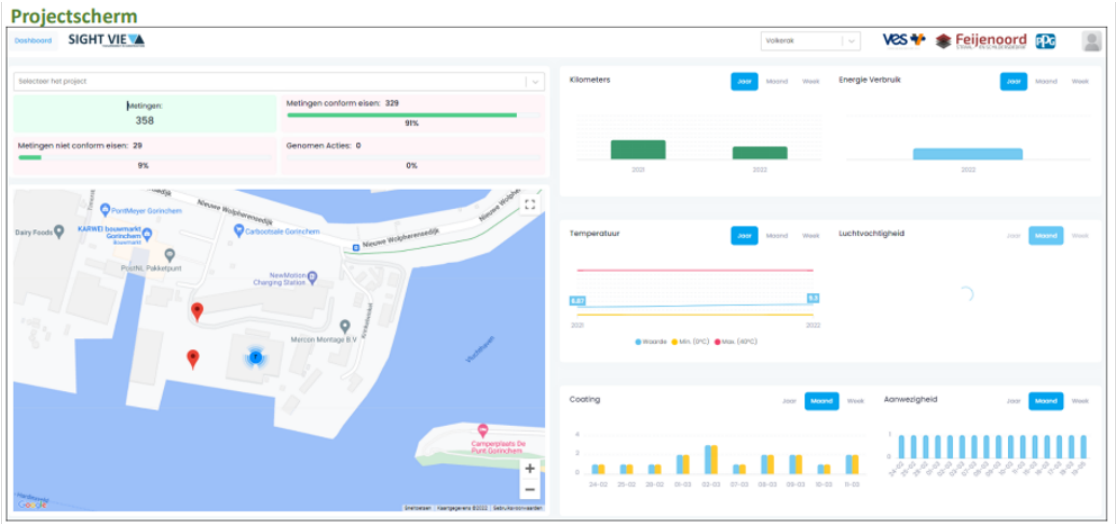


Figure 55 – dashboard indicating results – received from Horizon Internet Technologies.

7. Evaluate

The collected data instantly verifies or evaluates if project requirements are met during construction.

- Determine what output needs to be evaluated
- Determine the stakeholders who must be evaluated and the format of the evaluation per stakeholder group
- Determine potential improvements

Review

In contradiction to the two other cases, IWTaaS is a technological solution which has proven its value in renovation projects. It is relevant to include such a case since it has the potential to bypass or resolve current challenges that interfere with M&E within municipalities from occurring. In addition, IWTaas has proven its value within projects. It easily collects data sources quickly, converts the data into the correct format and visualises the results in dashboards. This case is therefore illustrated to indicate what such technological innovations offer to the desired goal. Simultaneously, it urges the need for a comprehensible description of the system functioning for all involved and how it can align with the existing steps.

Opportunities

The IWTaaS platform can collect and convert all types of data into the required format, which can then be routed to one or more applications. The IWTaas and Sightview application are usable as a technological solution to overcome difficulties or complexities during the redevelopment projects.

Inventory III.a3 – Case study III on Structural & Design requirements

Table 11 – Inventory III.a3 – Case study II on Structural & Design requirements

Requirement	Description	Recurring
12	The M&E system should use a fixed approach for all necessary steps, which will guide stakeholders and owners throughout the process and result in an integer process.	
13	The M&E system should allow optimization to address needs and desires of stakeholders	

Inventory III.b3 – Case study III on Functional requirements

Table 12 – Inventory III.b3 – Case study III on Functional requirements

Requirement	Description	Recurring
120	The M&E system should identify what the relevant minimal contract requirements are for the monitoring and evaluation process.	
121	The M&E system should identify the existing available data sources, and check if the existing that sources van be used to meet the contract requirements	
122	The M&E system should identify if there is information that cannot be collected via existing data sources	
123	The M&E system should consist of a data collection plan on how the information can be collected, how often, and from which location.	
124	The M&E system should identify all the stakeholders participating in the project and their possibility to deliver data or participate in collecting it.	
125	The M&E system should inventory what file types of the data sources are delivered in	
126	The M&E system should make agreements with data deliverers over the consistency of data delivery, period, and reliability	
127	The M&E system should determine the desired file type in which all information must be formatted	
128	The M&E system should state where the collected or converted data must be dispatched to.	
129	The M&E system should state how often datasets must be sent to a centralized or decentralized datasets	
130	The M&E system should maintain the credibility and legitimacy of the data sources by for instance adding a digital fingerprint	
131	The M&E system should initiate a calculation strategy that indicates what outputs (indicators/KPIs) are relevant based on contract requirements or ambitions and state which data will be used to calculate output (values)	
132	The M&E system should determine in which applications the results must be visualised and how the results must be visualised	
133	The M&E system should determine which output needs to be evaluated for each stakeholder	
134	The M&E system should indicate with relevant stakeholders what are the potential improvements	

This case study provides two structural & design requirements and 15 functional requirements.
The gathered results of the case studies provide an extensive insight into the minimal requirements for the M&E blueprint to develop an M&E system. Two cases were based on online documents, and it was possible to distillate the utilised requirements. However, there is a possibility that the requirements are too generalistic since it was not explicitly implemented in a local project. The third case, on the contrary, was a technological solution applied in a local project. Therefore, the requirements are realistic since it is derived from an existing project. However, this may influence the generalizability of the requirements to another situation. It is relevant to include such a case as well since it has the potential to bypass or resolve current challenges that interfere with M&E within municipalities from occurring. Nevertheless, the combination of

an implemented system (IWTaaS) and cases methodology and approach (10-step model and +CityxChange) resulted in a wide variety of requirements and similarities.

Inventory IV: Stakeholder interest and opinions

The purpose of the conducted interviews with scholars and municipal managers was twofold. The first aim was to identify the root causes for lacking M&E within municipalities. The second aim was to inventory and define the minimal requirements of the M&E blueprint from the perspective of the municipal managers and scholars. Each interviewee was asked about the minimal requirements of an M&E blueprint. The requirements below are an inventory of the reproduced answers.

Table 13 elaborates on 26 requirements provided by municipal managers and scholars. If the requirement has already been stated, reference will be made to this established requirement to prevent rehearsal. In contradiction to Inventory III, the duplicates are mentioned (in grey) because it provides insight into the interest and opinions of the interviewees.

Inventory IV.a – Structural & Design requirements derived from interviews

Table 13 – Inventory IV.a – Structural & Design requirements derived from interviews

Requirement	Description	Recurring
25	The M&E system should be a participatory and consultative process involving stakeholders when determining required outcomes and how to achieve these - The participatory process should start with developing goals and continue with setting outcomes, building an indicator system and designing a combination of collection methods.	*I2, I8*
17	The M&E system should cost limited additional time for municipal managers during a project - therefore, be automated as much as possible.	*I5*
14	The M&E system should be equipped for the strategical, tactical and operational layers who are all relevant in a redevelopment project.	*I3*

Inventory IV.b – Functional requirements derived from interviews

Table 14 – Inventory IV.b – Functional requirements derived from interviews

Requirement	Description	Source
31	The M&E system should define desired outcomes into a minimal amount of SMART (operational) goals, performance indicators and KPIs (iterative process).	*I1, I6, I8*
10	The M&E system should be flexible to the political perspective of the municipality.	*I2, I5, I6*
92	The M&E system should formulate a communication strategy in advance to determine the use of M&E findings (demonstrate, convince, educate, explore, and investigate, document, involve, gain support and promote understanding), the target audience, central purpose to deliver the message and who will receive what information, in what format, when, who will prepare and deliver.	*I2*
10	The M&E system should be flexible to the political perspective of the municipality.	*I2*
135	The M&E system should add inspirational images and results to inspire and attract relevant municipal people.	*I3*
136	The M&E system should focus on concrete measures/ sustainable solutions instead of “adding green” use “four square meters of fescues (Festuca grass).”	*I3, I6*
137	The M&E system should adjust the language to the target audience – tactical and practical municipal managers, policymakers, and councillors (strategic level).	*I3, I5*
131	The M&E system should adjust the language to the target audience – tactical and practical municipal managers, policymakers, and councillors.	*I3*

48	The evaluation result should enable municipal managers, policymakers, and council members to make objective choices.	*I3*
138	The M&E system should monitor KPIs throughout the entire city; in this way, the results of a redevelopment project can be placed into perspective.	*I4*
2	The M&E system should describe a minimal period of subsequent and continuous monitoring with intervals of a month to provide sufficient insight.	*I4*
139	The M&E system should focus on an area-orientated approach, and the inner city is different from the outskirts.	*I4*
140	The M&E system should operate independently from the administrative winds. To prevent the councilman stops the M&E when results are indicated	*I4*
141	The M&E system result should be made simplistic in a dashboard.	*I7*
8	The M&E system should obligate elaboration between stakeholders (partners and departments) of Monitor and Evaluate per project.	*I5*
1	The M&E system should include a zero-measurement of the current situation, also known as a baseline within each specific project.	*I5, I6*
5	The M&E system should provide consensus in an integrated way on what sustainability is.	*I6*
142	The M&E system should be transparent for all users and stakeholders.	*I8*
19	The M&E system should be financially feasible for municipalities to implement	*I7*
112	The M&E system should obligate data protection by default and set the service settings automatically on protection-friendly and only necessary data.	*I7*
143	The M&E system should use symbols for communication instead of quantitative and qualitative data (return of animal species due to improving nature quality.	*I9*
144	The M&E system should not focus on all possible indicators but instead on 4/5 indicators that can be monitored and evaluated accurately.	*I9*
145	The M&E system should include a gaming aspect and tell stakeholders about the redevelopment projects.	*I9*

The interviewees indicated 3 Structural and Design requirements and wo duplicates. In addition, 23 Functional requirements were mentioned, of which 12 were duplicates. Based on the four inventories, 14 structural requirements have been identified to develop an M&E system. And in total, 145 Functional requirements that should be part of an M&E system have been identified. These 145 Functional requirements should be stated within the M&E blueprint. However, it is impossible to determine which requirements are relevant and essential at this stage. This would require additional sessions with, for instance, municipalities to determine. Even then, it is hard to determine which requirements are relevant or not. Testing the M&E system in a redevelopment project would indicate the performance and gaps. However, this is beyond the scope of this thesis project. Although, Step 2 is used to align and create structure within the inventoried requirements.

4.2.2 Step 2: Classify requirements

In Step 1, 14 structural and Design requirements and 145 Functional requirements are defined. The inventoried requirements are possible situation-specific requirements, especially if it concerns functionalities. Therefore, the 14 Structural and Design requirements are essential in determining the blueprint. However, most of the requirements are generic and applicable to any artefact. A first classification is made to create focus within the list of requirements. The classification themes are based on the recurring topic of the requirements.

The requirements evolve around the following twelve topics:

- Applicability (n = 2)
- Basics of monitoring (n = 26)
- Consensus on outcomes to M&E (n = 2)

- Data protection & Privacy (n = 16)
- Evaluation (n = 10)
- Governmental/ institutional consensus (n = 19)
- KPI & Objectives (n = 27)
- Practicalities (n = 12)
- Reporting (n = 11)
- Stakeholders (n = 6)
- Sufficient data sources (n = 9)
- Sustaining (n = 5)

Within M&E, multiple topics are relevant according to the root causes, literature review, interviewees, and case studies. However, not all topics part of M&E receives the same amount of (necessary) attention. Causing that the requirements are not evenly distributed per topic. Although, each topic is self-contained and relevant to consider when developing an M&E Blueprint. *Visit Appendix 3 for a complete overview of the classification of requirements.*

The list (in Excel) is made in four steps: 1) inventory all requirements, 2) remove duplicates & concise formulation, 3) adjustment requirement number & classification and 4) remove duplicates and divide between Structural & design and Functional requirements. Step 3 visualises the source of requirements described in a Sankey diagram.

4.2.3 Step 3: Visualizing results

The number of requirements causes it hard to trace the origin of requirements or division of sources per topic. Therefore, the four sources are linked to the twelve topics in the image below. The visualisation concerns a Sankey (flow) Diagram which summarises the transfers from the origin to the end station. The width of the arrows indicates the proportion of requirements.

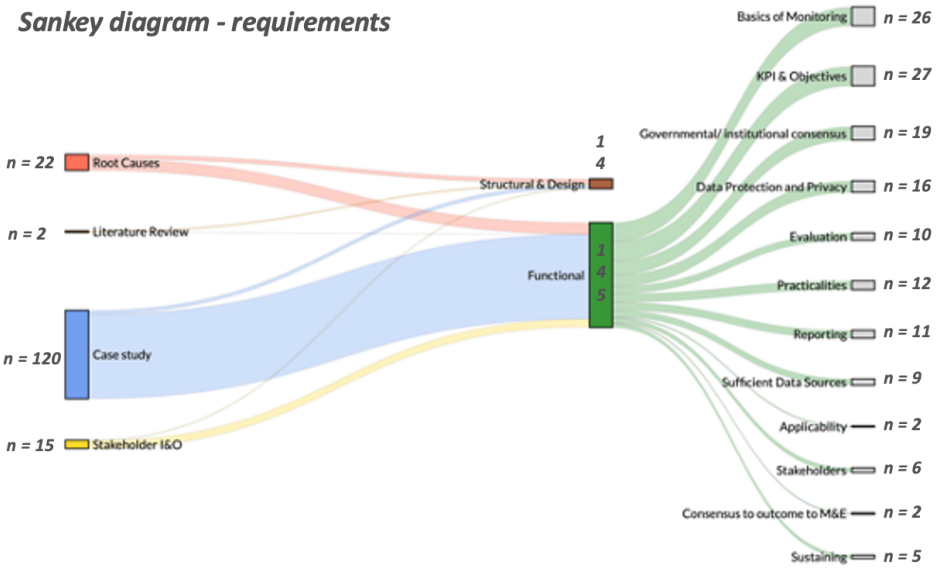


Figure 56 - Sankey Diagram with Origin of Requirements and division per topic (author creation)

However, there is a critical note regarding the used approach and visualisation. The duplicates are not considered causing the Sankey diagrams to provide a distorted picture of reality. The duplicates are removed subsequential after each inventory step causing the latest inventory step to have a lesser

contribution. Therefore, causing Stakeholder I&O to contribute twelve requirements while the interviewees indicated 26 requirements. As mentioned before, duplicates were removed to improve the readability of the research document.

Summarisation and conclusion of sub-question 2

Chapter four used a combination of literature, interviews and case studies to provide substance to the second sub-question:

What are the essential requirements to compose the Monitor and Evaluation blueprint?

Outline M&E blueprint

The first section elaborates the desired artefact to address the stated knowledge gap by developing a robust, systematic, and integral system for robust and effective monitoring and evaluation to enable learning. A system for monitoring and evaluation that applies to all Dutch municipalities is not feasible within the given time; a Monitoring and Evaluation (M&E) blueprint will be developed. In addition, arguments provided by interviewees and literature indicated that

- Each municipality is different due to size, political perspective, physical circumstances, and specific challenges and has different priorities (Personal communication I1 & I2).
- Different perspectives on, for instance, sustainability transitions exist (Verma & Raghubanshi, 2018; Tapia et al., 2021; Bauwens et al., 2022). Therefore 'hard' definitions cannot be provided.
- Despite the required flexibility and adaptability, the standardisation approach of monitoring and assessment tools is lacking (Martek et al., 2019; Huovila et al., 2019; Poponi et al., 2022; Karjalainen & Juhola, 2021).
- Technological solutions make it difficult for willing municipal managers or other municipal officials with limited time and knowledge of M&E to oversee the necessary process and set actions (Personal communication, I3, 2022).

Therefore, an M&E blueprint will be developed. A sequenced approach includes all appropriate steps, guidance and minimal requirements that a municipality can subsequently follow. In turn, municipalities provide substance to the system with an approach for each step relevant to their policies with stated ambitions and existing strategies.

Elicit requirements

It is essential to determine two types of requirements: *Structural & Design requirements* and *Functional requirements*.

- *Structure & Design:* Requirements that indicate how the M&E system should be structured and designed
- *Functional:* Requirements that indicate the functionalities an M&E system should provide. Functional requirements are used to determine the necessary steps.

Three steps were taken to determine the requirements for the M&E blueprint. First, inventory the requirements via addressing the Root causes in chapter 3, a structured literature review, three case studies and the opinion of the interviewees. The inventorying resulted in 14 essential Structural and Design requirements to develop and design the M&E blueprint. Besides, 145 Functional requirements are relevant for implementing the M&E blueprint.

The requirements were handled in four steps: 1) inventory all requirements, 2) remove duplicates & concise formulation, 3) adjust requirement number & classification, and 4) remove duplicates, add source and determine Structural & Design and Functional classification.

However, multiple shortcomings must be considered when using the requirements. The inventoried requirements are not verified with, for instance, the stakeholder in this study. Most requirements are derived from case studies. Nonetheless, it is unknown if case studies I & II deliver and function the way they describe. Another challenge could be that requirements from the inventorying steps are derived from a specific context, causing the requirement to only be relevant in that specific context.

The Structural & Design, and Functional requirements will form the basis of Chapter 5 – Design and Develop Artefact.

5.

Chapter 5: Design and Develop M&E blueprint

In chapter 5, the M&E blueprint is designed and developed using the defined outline and requirements from the preceding chapter to address the problem definition. In section 5.1, imagination and brainstorming, a sketch of the M&E blueprint is created with requirements and existing ideas derived from the case studies. Sections 5.2 and 5.3 are combined as described in chapter 2.4. The created sketch from section 5.1 is structurally optimised via three focus group discussions to the final M&E blueprint prototype. The final developed M&E blueprint prototype is elaborated in section 5.2. Section 5.3 justifies and reflects upon the optimisations made after each focus group discussion. Providing substantiation of the final prototype. The final prototype was built into the first version of the M&E blueprint. Section 5.4 elaborate on how the M&E blueprint can be operated and the shortcomings that require further attention, elaboration, or research. The final product of chapter 5 is the M&E blueprint.

5.1 Imagine and Brainstorm sketch

This section delivers a Sketch of both the Structure & Design and a Functional interpretation of the desired M&E blueprint. The sketch is developed by enhancing and combining existing ideas; a sketch will be structured. It is assumed that enhancing existing and proven ideas will create a sufficient basis that appeals to often more conservative management departments, as indicated by Personal communication, I3 (2022).

The first step determined the desired situation, which gave direction to the brainstorming sessions. The relevant information to formulate the desired situation was derived from previous chapters. The brainstorming was divided into two topics executed in multiple steps to collect the necessary information on the structure and relevant topics for the M&E blueprint. These elaborated steps resulted in the M&E blueprint sketch. The input, necessary steps for brainstorming and result of section 5.1 is visualised in *figure 57.*

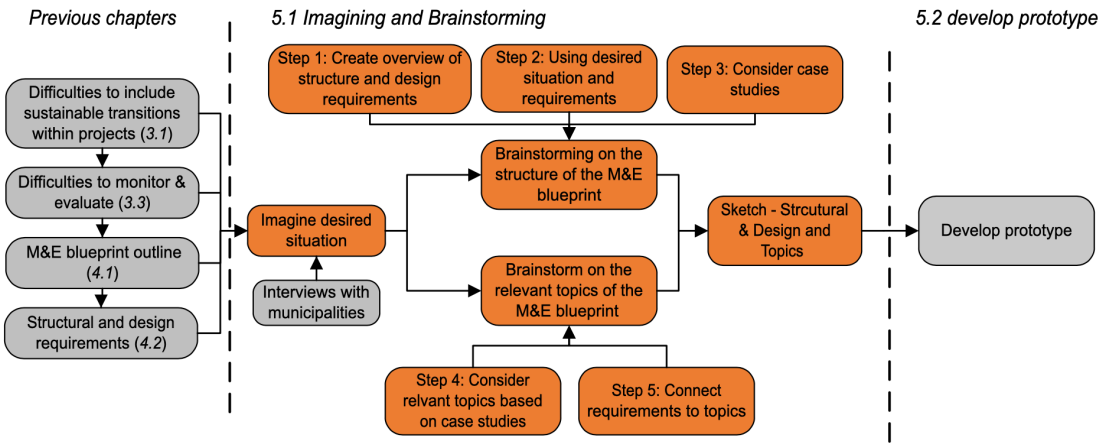


Figure 57 - approach section 5.1 (author creation)

In contrast to the assumption that groups generate more ideas than individuals, research does not support this assumption (Johannesson & Perjons, 2014). It is argued that individuals should be able to generate ideas independently, which will improve divergent thinking in groups in a subsequent phase. To include the desires of stakeholders and learn from existing solutions, the brainstorming occurs structured with the use of collected requirements and case studies. In addition, interviews indicated that it was difficult for interviewees to determine what an M&E system should look like or its functions. Therefore, it was expected that the interviewees would provide more insight if they could respond to an existing sketch (discussed in *5.2 & 5.3*).

Imagine the desired situation

Redevelopment projects in the public space provide a Window of Opportunity to include sustainable transitions and related solutions. However, as *Chapter 3.1* indicates, applying sustainable transitions within the public space encounters many difficulties and progresses slowly due to:

- Conflicting (sustainable) objectives within the public space
- The complexity of sustainability within the municipal organisation
- Applicability of sustainable transitions and related solutions
- Complex municipal organisation
- The opportunity and pitfalls of pilot projects

Pilot projects are indicated as decisive projects since these projects are used to test sustainable solutions (niche innovations). However, as stated by Personal communication I1, I6, I8 & I9 (2022), no lessons are learned from these pilot projects. The stated conclusion is that municipalities are unaware of the achieved impact of implemented sustainable solutions in pilot redevelopment projects due to lacking monitoring and evaluation, causing the scaling up of sustainable solutions remains behind and cannot alter regime levels. To encounter the above-stated challenges. Monitoring and Evaluation are defined as a solution to learning from these pilot projects (Arkesteijn et al., 2007; Vogelezang & Wijnands, 2008; Gemeente Amsterdam, 2021; Personal communication I7 & I8, 2022; Gemeente Amsterdam (2022).

However, as *Chapter 3.3* concluded, municipalities have not yet succeeded in monitoring and evaluating sustainability in redevelopment (pilot) public space projects due to various (root) causes. By considering the artefact outline (*4.1*), Structural & Design requirements (*4.2*) and interviews with municipal managers and advisors, the M&E blueprint must enable the following:

Creating a robust, systematic, and integral M&E blueprint for Dutch municipal organisations. Enabling municipal (project) managers to develop a tailored system for their municipality to monitor and evaluate sustainability solutions in redevelopment (pilot) public space projects.

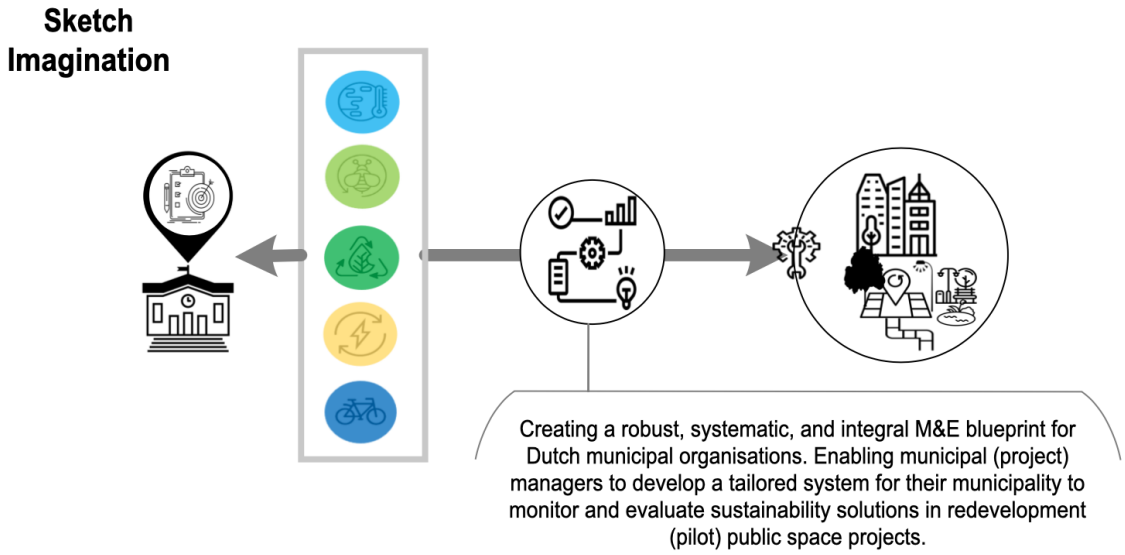


Figure 58 –Sketch Imagination I – Desired situation (author creation)

Personal communication, I1 (2022) states that there is no solution ("no size fits all") that will fit all desires and requirements. Therefore, a robust, systematic, and integral process should support and guide municipalities through the necessary steps for M&E. An M&E system should be flexible and adaptive to local circumstances that may vary between municipalities. At the same time, the system must be uniform, structured, and guiding, enabling municipalities to adopt, follow, provide substance, adjust through the necessary steps, and create comparable outcomes. It is essential to keep it simple so every municipality can work with it. According to Personal communication, I1 & I2 (2022) and considering Structural and Design Requirements 1 to 14 (*Appendix 3).*

Brainstorm – create the structure of the M&E blueprint

The Individual brainstorming session aims to sketch the M&E blueprint to meet the desired situation iteratively. To structure the brainstorming process, a MIRO Board is created.

Step 1: State the 14 Structure & Design Requirements (*3.5*) on a MIRO board.

Figure 59 - Overview Structural & Design requirements (author creation)

Step 2: The combined *Desired situation* and the 14 requirements part of *Structure & Design* are used to formulate ideas that will contribute to creating the structure of the blueprint. The potential ideas are made up based on both taking the requirements into account and contributing to the desired situation. This resulted in the following main takeaways.

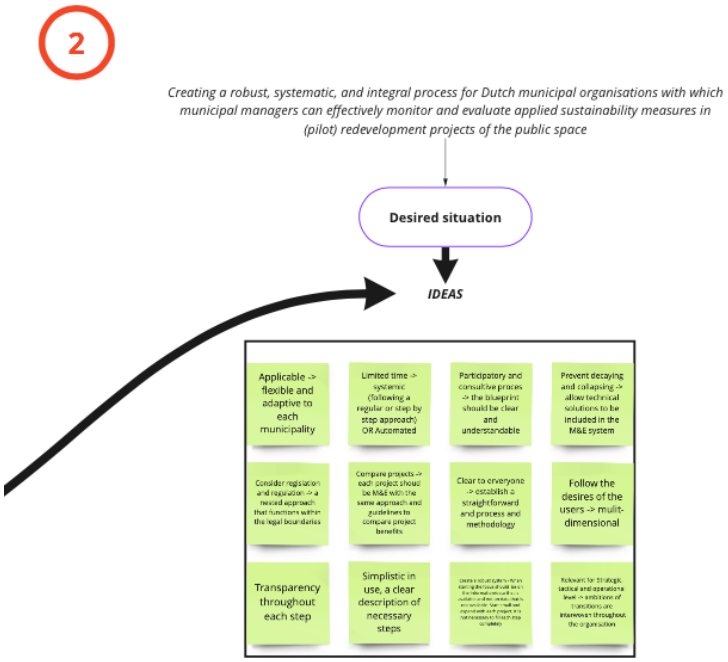


Figure 60 - Brainstorming main takeaways structure (author creation)

MAIN Takeaways for the structure of the blueprint:

- Introducing a system consisting of multiple chronological steps would have multiple benefits:
  - It will make it easier to understand the system
  - The users would become able to master the system after using it a couple of times, and this would reduce the processing time.
  - Similar steps for each project would require understanding within each project. This will create a general understanding of the sustainability of all redevelopment projects.
  - The outcome of each project can potentially be compared
- Allow technical implementations/innovations to be part of the system. Municipalities may choose if they would like to implement them.
- Keep it simple; otherwise, the M&E system will not be integrated into the workflow.
- Providing only the boundaries for each necessary step and related approach to include and determine relevant aspects will allow some freedom for own interpretation and desires. Allowing multi-dimensional use of the M&E system.
- Clear guidance is provided by combining the multiple steps with an approach to collect the necessary information or determine the approximation for each step. Supporting municipalities in creating suiting M&E for their project.
- Create a robust system that is easy to get along with and comprehendible for everyone.
- The M&E blueprint should be used throughout the organisation and can therefore be seen as a communication tool.

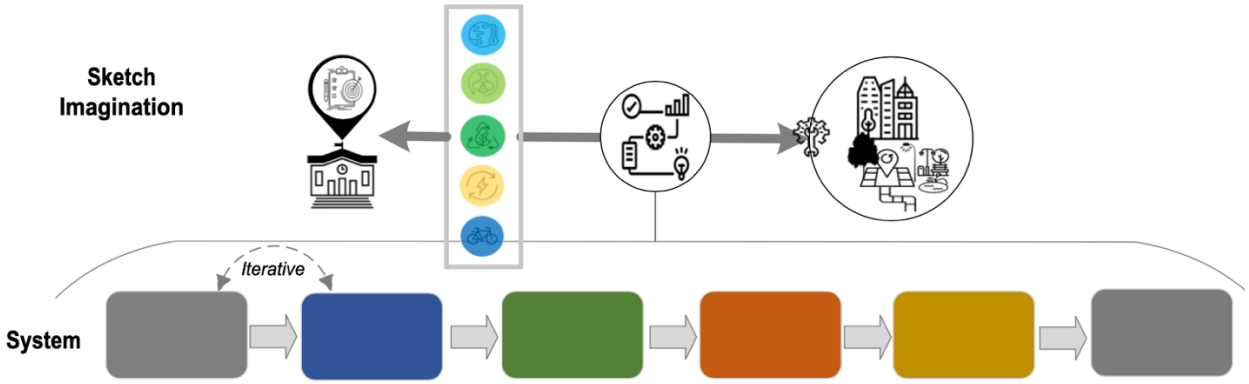


Figure 61 - Sketch Imagination (author creation)

Step 3: In addition to the ideas of step 2, the structure of case studies is considered to provide ideas. Each case study is provided with multiple tops and tips. Based on the formulated tips and tops, the main takeaways are formulated.

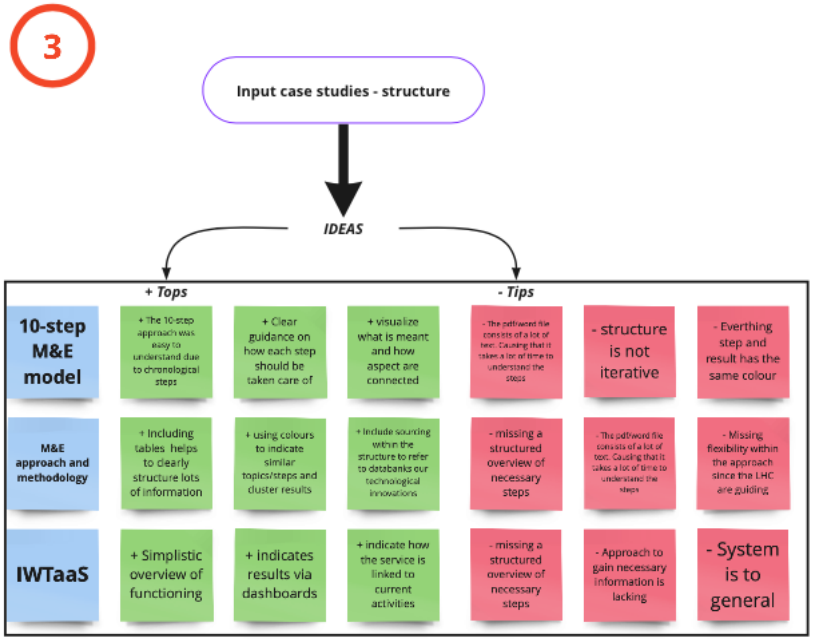


Figure 62 - Input case studies on the structure (author creation)

MAIN Takeaways for structure:

- The chronological order of steps with clear guidance made it easy to understand the purpose
- Visualising steps, approaches, examples, results, and relations helped to make it understandable
- Indicate how all aspects are linked to each
- Using colours to indicate similar topics or cluster results is beneficial for the readability
- Be cautious with the amount of text
- Create an iterative structure to review previous steps based on new knowledge
- Provide flexibility to users to provide substance
- Approaches for each step should be included to provide a complete overview

Result brainstorm structure

The generation of ideas is based on a combination of *Structure & Design requirements*, the *desired situation* and results in Main Takeaways to formulate a structure. The main takeaways from the blueprint structure's first draft are visualised below. The structure consists of three major components: System, Approach and Technical Solutions.

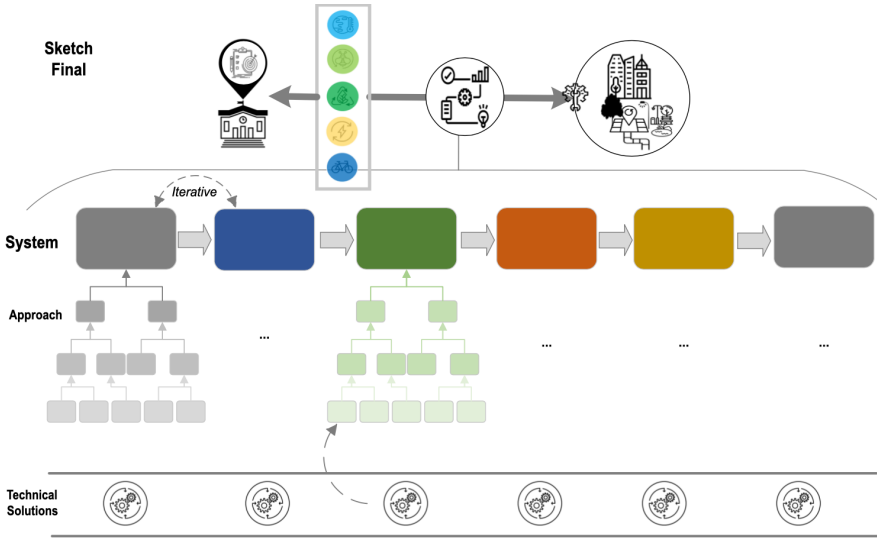


Figure 63 – Sketch Blueprint's structure (author creation)

System: The system consists of multiple chronological separate but related steps. Each step contains a specific topic and purpose requiring attention and completion when M&E must be introduced.

Approach: As each step requires completion, the approach is introduced to collect all relevant information, set agreements among colleagues about specific topics, appoint tasks to persons and guide involved colleagues through each step.

Technological Solutions: Technological solutions are included to improve the system's functioning and bypass or resolve current challenges that withhold municipalities from M&E sustainability in redevelopment projects. However, municipalities may choose if, where and how they want to include technological solutions within the process. The technological solutions must include a comprehensible description of the solution functioning and how it affects and align the step(s).

These are the three main components of the M&E blueprint. However, the structure is a draft and can be adjusted by the forthcoming steps.

Brainstorm – Iteratively determine relevant topics.

In addition to creating the structure, it becomes relevant to determine the necessary topics and steps. Furthermore, what information, agreements, persons, and appointing are relevant for each step and how to approach it. Multiple steps are taken in addition to the previous steps in MIRO to connect and summarise the collected information. In **step 4**, case studies are consulted to identify the relevant topics that need to be addressed. In general, the three case studies consist of similar topics. However, the used terminology and the size of addressed topics to adequately M&E are contrasting among the cases. Therefore, the topics of the three cases are clustered. The case presenting the 10-step model was utilised as a starting point since this case consists of a remarkably concise description of the required topics.

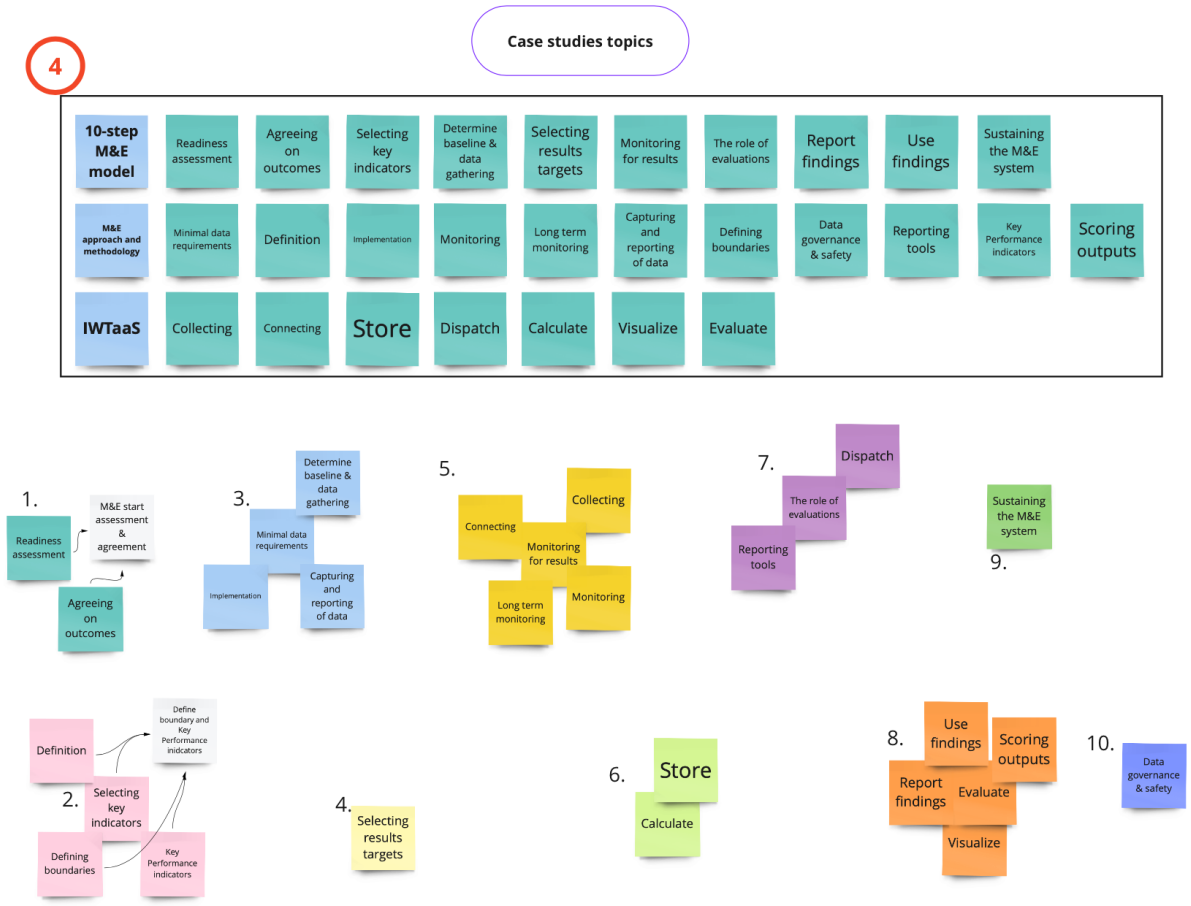


Figure 64 – Derive topics from case studies (author creation)

After the topics were clustered, a familiar name representing all aspects was chosen, and the clustering resulted in ten general topics to which the requirements can be linked (**Step 5**)**.** Below each topic, the related requirements are stated:

1. M&E start assessment & agreements: The M&E readiness assessment and agreement are a diagnostic aid that will help determine where a municipality stands, including institutional, personal and political incentives, roles and responsibilities and determination of capacity.
   -> n = 16
2. Define Boundary and Key Performance Indicators: Collaboratively determine spatial and political boundaries and emphasise desired outcomes where indicators on each level can be based on for a specific (redevelopment) project.
   -> n = 23
3. Minimal data requirements: Provide strict guidelines and roles for establishing baseline data of the current situation and the minimal date requirements for the entire process
   -> n = 27
4. Selecting targets: Collaboratively identify and determine performance targets
   -> n = 9
5. Monitoring: Use various sources (WWW, IoT or APIs) to consistently collect data on formulated KPIs to provide evidence of the performance and indicate the potential or needed adjustments for any given project, program, or policy.
   -> n = 10
6. Store & Calculate: Store the collected data safely in a database or blockchain and use predetermined calculation methods to determine the contribution of interventions in redevelopment projects.

-> n = 5

7. Dispatch: Connect the stored and calculated data from the database directly to the desired application or format that suits each department's needs, role and function.

   -> n = 6

8. Report and Evaluate: Standardise project output into a consistent and useable configuration that allows the comparison of results and ensures the consistency of reporting. The performance information provides transparent feedback on a specific project, program, or policy throughout the lifecycle.

   -> n = 23

Compared to topics 1 to 8, topics 9 and 10 generally focus on the sustaining and safety of the M&E system.

9. Sustaining the system: Ideally, the M&E system should be a long-term effort and sustaining such systems within governments or organisations. The long-term process involved in ensuring utility needs to be recognised. In addition, the M&E system requires updates through evaluations, specific adjustments to the municipality or per project and allowing technological innovations.

   -> n = 8

10. Data governance & Safety: The involved multiple partners and stakeholders at various levels in the project should agree on the directives and formulate agreements regarding data governance and sensitivity throughout the process.

    -> n = 18

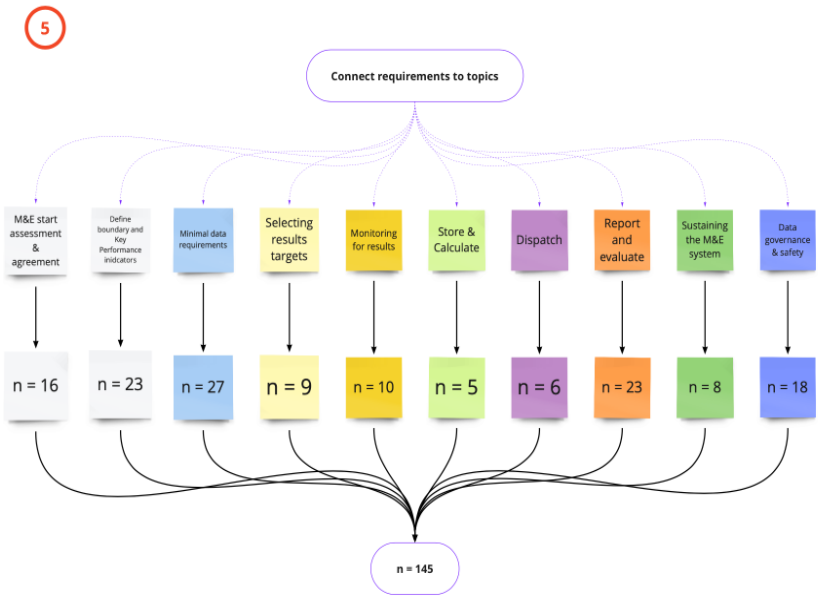


Figure 65 Connecting functional requirements to topics (author creation)

The division of requirements per topic is visible in *Appendix 3*. The topics and related requirements will form the basis of the M&E blueprint. The afterwards sub-activity will subsequently use the topics and related requirements used in the sketch to formulate the desired prototype.

4.2 Elaborate prototype from Sketch

The generated idea that led to a sketch in the previous section will be further developed into an M&E blueprint prototype. The purpose of the prototype is to provide an overview of both the core functions and the architecture of the desired M&E blueprint. Subsequently, creating the desired prototype from a sketch requires clarification on both functional and structural functions.

According to Johannesson & Perjons (2014), the functional description of the sketch requires insight into the following aspects: who are the users, displaying the interaction between the users and the M&E blueprint, what the artefact offers and why that is relevant for the users and how the M&E blueprint will be used. In addition, the architecture elaboration will provide the description and visualisation of the structural components and functions of the M&E blueprint. A municipality, consultants, and developers evaluate the combination of the architecture and functional description in three separate focus group discussions. Each focus group iteratively provides optimisation of the prototype and composes input for the artefact that will be built in this thesis project. The sub-activity *4.2* will elaborate on the prototype from the sketch, while *4.3* will substantiate and clarify the made functional and architectural decisions.

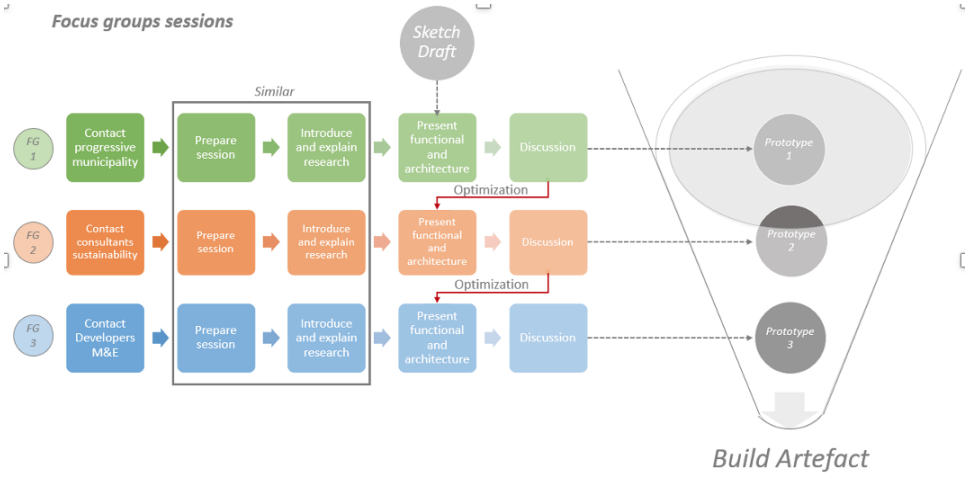


Figure 66 – Focus group optimisation of the prototype (author creation)

Three sessions were conducted, starting with a group of municipal advisors (asset managers) on a tactical level who were developing a Monitoring and Evaluation approach. Municipal feedback on the sketch artefact was vital since the artefact was developed for municipalities. In this way, municipalities will have prior control over the development of the artefact. Secondly, consultants from an advisory/engineering firm advise municipalities regarding sustainability in the public space. Based on interviews, the consultants expected to have an advanced overview of the municipal needs and provide additional information to the prototype. Lastly, a focus group was held with developers from a case study to include possibilities for technical solutions within the artefact. After three Focus group sessions, the resulting Functional and Architectural (Structure & Design) description is amplified below. The implemented optimisations after each focus group discussion are discussed in section *5.3*.

Functional Description

M&E Blueprint Users

Municipalities are unaware of the achieved impact of implemented sustainable solutions in pilot redevelopment projects due to lacking monitoring and evaluation, causing the broader implementation of sustainable solutions remains behind and not alter regime levels. Therefore, the M&E blueprint aims to create a robust, systematic, and integral process for Dutch municipal organisations with which municipal managers can effectively monitor and evaluate applied sustainability solutions in (pilot) redevelopment projects of the public space.

The M&E blueprint will support municipalities in creating a suitable M&E system that a municipality can use per redevelopment project. The users are, in this case, within the municipalities. However, determining who should be appointed as the user is complex because it transcends multiple departments and levels.

There are three types of users based on the municipality's structure: strategic, tactical, and operational. The three levels of users and interactions are visualised below.

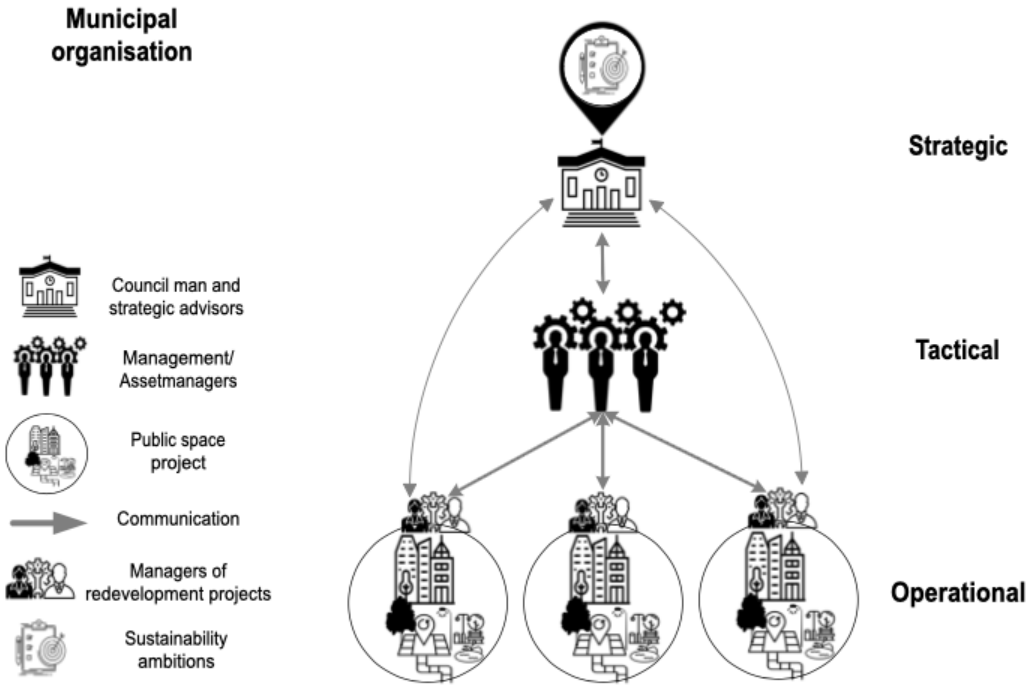


Figure 67 - Users levels within municipalities (author creation)

Simplified, the municipal organisation has the following task division regarding sustainability transitions (Focus group discussion I, 2022). Long-term sustainable ambitions are formulated at the strategic level of a municipality and consist of a councilman, strategic advisors, and possible heads of departments. The tactical level consists of, for instance, sustainable advisors and asset managers to formulate programmes and strategies to pursue the stated ambitions. On an operational level, the municipal managers execute, for example, the redevelopment projects in the public space and must and should ideally comply with the stated strategies and programs. It is essential to state that this structure and indicated connections are more complex in reality.

The M&E blueprint enables municipal (project) managers to develop a tailored system for their municipality, enabling them to monitor and evaluate sustainability solutions in redevelopment (pilot) public space projects. To enable and encourage learning and implement sustainable solutions beyond the pilot projects to accelerate the transitions. The municipal managers who determine and decide the public space design have an essential role in including sustainable solutions (Personal communication, I9, 2022). While simultaneously, the managers on the operational level are dependent on the agreements and plans made on the tactical and strategic levels. There is an underrated incremental dependency towards each level. Therefore, within the M&E blueprint, multiple steps exist, such as the M&E start assessment & agreements, defining boundaries and KPIs that cannot be determined without close collaboration between multiple levels. The managers on the operational level do not have the overview and expertise to deal with all the complex matters that revolve around the transitions (Personal communication, I2, 2022).

Therefore, as indicated by FG 1 (2022) and confirmed by FG 2 (2022), the tactical level should be appointed as the executive user and support the project managers at the operational level. The tactical level overviews the various redevelopment projects and can quickly provide feedback to both the strategic and operational levels. In addition, advisors on a tactical level have experience in asset management thinking within the

public space, which requires finding a balance between cost, benefits, and risks. With the M&E blueprint, the tactical level can translate the “high-over” ambitions to what is relevant on the operation level, creating alignment within the organisation and keeping track of the progress.

Again, it is essential to state that reality is more complex. Therefore, the built M&E blueprint should be tested and optimised to meet the organisation's needs within a pilot project.

The user's interaction with the M&E blueprint

The tactical level is appointed as desired executive level, and the first step is to use the M&E blueprint to develop a tailored system for a specific municipality. The next step is determining when the M&E system should be included in a redevelopment project. Therefore, FG2 indicated to start defining the project phases. A literature search indicated that there is no straightforward approach for redevelopment projects in the public space of municipalities. However, using various sources, the following phases can be determined (Gemeente Oosterhout, 2008; Mol, 2019; Gemeente Amsterdam, 2022b) and are verified by both FG 1 and FG 2 (*the focus groups verified the phases, not the elaboration):

1. Initiation phase: The initiation phase is started when there is sufficient reason to start a project, such as necessary redevelopment. In this phase, the motivation for redevelopment is further investigated and substantiated.
2. Plan study: In the plan study, information regarding the project area is collected, and conditions, functional demands, operational requirements, and design limitations are stated.
3. Plan developing/design phase: The urban development plan, programme, costs, and revenues are elaborated and considered.
4. Realisation phase: Starting with preparing the realisation of the design and the actual implementation of the design is established. Including agreements with construction companies and developers are drawn up, land use plans are adjusted if necessary, and management plans for the public space.
5. Using/maintenance phase: In the actual using phase, the user/maintenance phase is mainly characterised by periodic maintenance.

As indicated by Personal communication I6 (2022), retrospective monitoring and evaluation is not doable. In addition, Personal communication I8 (2022) argues that the relevant, sustainable goals and principles must be included before the plan development/design phase. Resulting in steps 1 (M&E start assessment & agreements), 2 (Define Boundary and Key Performance Indicators), 3 (Minimal data requirements) & 4 (Selecting targets) should be conducted before the Plan developing/design phase starts. According to FG2, it is essential that relevant persons to the project become aware at an early stage of what is needed for M&E after the construction of the redevelopment project and included sustainable solutions.

On the contrary, steps 5 (Monitoring), 6 (Store and Calculate), 7 (Dispatch) and 8 (Report and evaluate) should be conducted in the Using/maintenance phase after the construction of sustainable solutions is finished according to FG2. However, as discussed in FG2, in some cases, a baseline measurement is desired to determine the progress/performance of sustainable solutions compared to a conventional measure. An example is an implementation of a bicycle street (introduction, figure x) that replaces a “conventional street” to increase the number of cyclists on a specific road by 25%. This would require a zero-measurement to determine the number of cyclists on the “conventional street” before the construction starts to compare it sufficiently. In this specific case, it would require that steps 5 and 6 start before the Realisation phase (According to Requirement 81) at least a year before.

Steps 9 (Sustaining the system) and 10 (Data governance & Safety) should be considered throughout the entire process of Monitoring and Evaluation.

The figure below visualises the relation between the project phases and steps of the M&E blueprint.

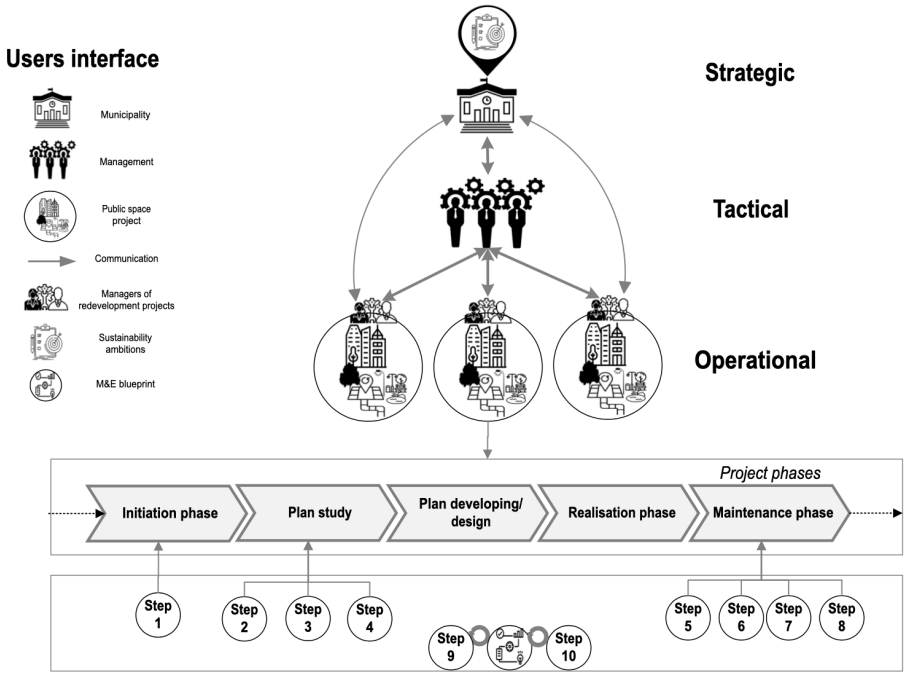


Figure 68 - - users' interaction of M&E blueprint (author creation)

The consultants in FG2 advised starting in the first couple of projects with a limited number of Key performance indicators to learn and understand the process, also stated by Personal Communication I9 (2022). After going through several cycles, it is possible to personalise the M&E system according to the organisation's preferences and scale-up. Otherwise, as Personal communication I7 (2022) experienced, municipal managers within the municipality had a poor experience with the Monitoring and Evaluation and were therefore not eager to try it again.

Contribution and relevancy of M&E blueprint

Municipalities are unaware of the achieved impact of implemented sustainable solutions in pilot redevelopment projects due to lacking monitoring and evaluation, causing the upscaling of sustainable solutions remains behind and not alter regime levels. Therefore, the M&E blueprint aims to create a robust, systematic, and integral M&E system for Dutch municipal organisations with which municipal managers can effectively monitor and evaluate applied sustainability solutions in (pilot) redevelopment projects of the public space. The M&E blueprint is manual for developing a tailored M&E system.

As per the two topics above, the M&E blueprint delivers a structured stepwise approach to include monitoring and evaluation within the project phases of redevelopment projects. It enables an opportunity to fill the urge to effectively monitor and evaluate applied sustainability solutions in (pilot) redevelopment projects of the public space. And alter regime levels; A municipality can, for example, assess market parties more specifically whether the proposed design or implementation meets the set sustainability requirements in a tender. A municipality could subsidise markt parties for each 10m3 water storage that will store rainwater during periods of excessive rainfall. The same situation could evolve for electricity if sustainable solutions can be used for peak shaving.

Furthermore, the M&E blueprint is a 'horizontal' and 'vertical' communication tool for municipalities. The M&E blueprint recommends communication between various departments (Horizontal), which is relevant because the concept of sustainability includes multiple aspects divided over various departments (matrix structure). Furthermore, the steps within the M&E blueprint recommend assessment and agreement on various matters such as division of roles, where a municipality stands regarding ambitions on sustainability, the definition of targets etc. The definition of such aspects requires communication and clarification between strategic, tactical, and operational levels (vertical) and creates a line of sight.

Furthermore, the output of the M&E system on sustainability solutions potentially provides insight into whether policies and financial spending contribute to the stated ambitions, which sustainable solutions are efficient and effective, and whether municipalities are on track to meet the stated sustainability goals for 2030 and 2050.

Architectural

The architecture of the artefact provides an overview of the structural components and the relation between these components.

Structure

The following architecture is chosen based on brainstorming potential structures in *5.1* (based on requirements for Structure and Design and arguments from interviewees) and subsequently optimised via the focus group discussion. However, updates on the architecture during the focus group discussion were limited only to curiosity about the blueprint itself.

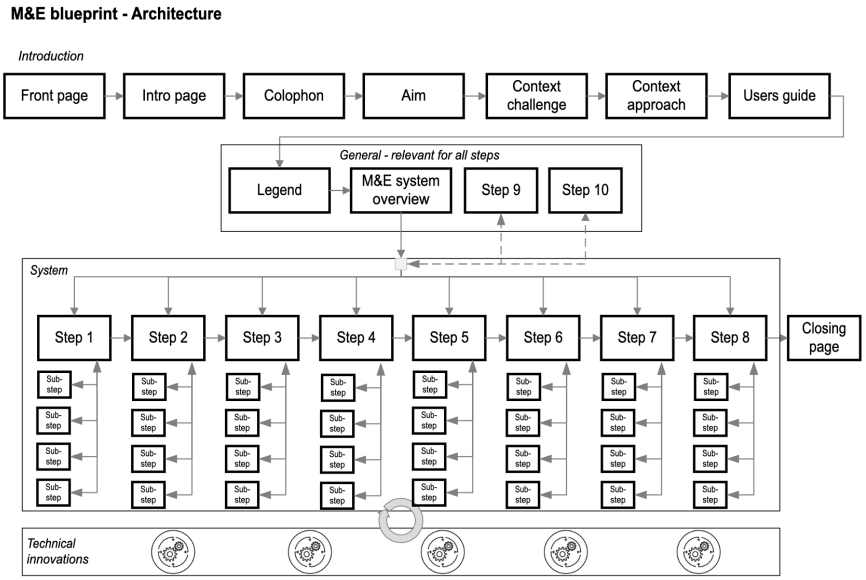


Figure 69 – Architecture of the M&E blueprint (author creation)

The architecture of the M&E blueprint consists of multiple interacting components (Introduction – General – System – Technical innovations). The first component of the M&E blueprint is the introduction that will provide the user with sufficient knowledge to comprehend its reasoning behind- and aim, how it should be operated and how the blueprint can be improved to a system. The following component is the General frame, the centre of the blueprint. The centre consists of elements essential for all steps; a legend to navigate through the various steps, the system overview, requirements for sustaining the system (step 9)

and data governance and safety (step 10). From the centre of the M&E blueprint, it is possible to directly navigate to a specific step within the following component, the System.

Moreover, the steps could be followed subsequently, and from each step, it is possible to navigate back to the M&E overview. Within each step, it is possible to visit essential sub-steps that provide additional information. The last component is the technical innovations introduced to ease and simplify steps. At this stage, one technical innovation is added: IWTaaS.

There is a division between technological solutions within the M&E blueprint. According to focus group discussion 3, there should be a difference between optional/useful technological solutions and recommended/obligated technological solutions. Doing this yourself in the first few steps related to making agreements and determining KPIs is possible. At some point, if you go to step 5 (monitoring). It takes an IT environment to make this possible. In this, it should be mandatory, for example, to have an IT environment. Besides, the participant in a focus group, discussion 3, indicated that it is essential to determine which technology solutions will be included when an M&E blueprint is developed for an M&E system specific to a municipality. If different technological solutions are chosen within steps across multiple redevelopment projects, it will be hard to compare these projects.

Design

When discussing the architecture in the focus groups, municipality participants stressed the following vital presumptions while determining the architecture:

- A written report or approach is often not read by municipal managers
- A simplistic and easy-to-use system is accessible to substantial municipal managers
- A structured system will improve the possibility of adopting it by a municipality
- The attractive visual system will increase the adoption possibility

Based on these presumptions was chosen to further develop the prototype in PowerPoint. There are multiple possibilities to realise the architecture and functions. For instance, creating an application, coded platform or more simplistic such as the chosen PowerPoint document. However, as indicated in focus group 3, PowerPoint offers many benefits over other possibilities. Compared to other possibilities, PowerPoint is an easy-to-use program; every municipality works with it, and everyone knows how to operate it within a municipality. In addition, it is a visual program, and it costs limited time to create a concept version of the M&E blueprint in PowerPoint.

5.3 Justify and reflect

The result of the previous sub-activity is the M&E blueprint prototype, which required multiple focus group discussions. These sessions subsequently optimised the sketch to the desired prototype. The optimisations were based on arguments provided during the Focus group discussions. This sub-activity will elaborate on the provided arguments within the focus group to justify the optimisations that led to the final prototype. The formulated arguments or feedback of the participants on both functional and architectural aspects are elaborated on below. The arguments of participants were used to adjust the functional or architectural aspects. On the other hand, arguments for adjustments could be debunked with requirements, literature or arguments provided during the interviews.

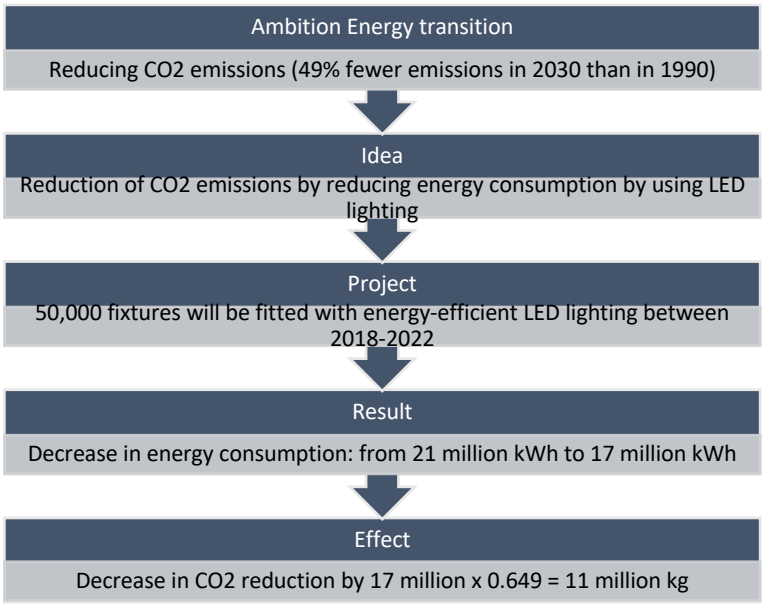
Each focus group session consisted of five steps: an acquaintance of participants, a short introduction of each participant's background, presenting research and results, a discussion of *Functional aspects* of the

M&E blueprint, *Architectural aspects* of the M&E blueprint and presenting the *Prototype*. The arguments on both Functional- and Architectural aspects, the prototype, and the made improvements after the focus group discussions are elaborated and justified below.

Justification

Discussion Focus group 1

The first focus group was held with municipal advisors (tactical level). The interview with Personal communication, I4 (2022) indicated that these advisors were working on a "Value model" (Waarden model). The reason to start with the value model was that strategic assignments (such as sustainability transition) require an integrated view within projects. There is a need for (an update of) concrete instruments to be able to make the right decisions. The municipality is working on a methodology to work subsequently from Result to effect (Philipsen, 2022). The provided example:



However, the municipality indicated that it is challenging to monitor and evaluate other ambitions which are not as tangible as energy (Personal communication I9, 2022). Furthermore, a system to monitor and evaluate is missing. During the session, the thesis project was explained, and the results of previous sub-activities were presented to provide insight into the thesis project. After the result was indicated, the discussion started.

Functional

Multiple questions were stated to start the discussion on the functionality of the M&E blueprint.

Who are the relevant users?

The following questions were asked.

- For whom is it important to monitor and evaluate?
- Does the structure correspond to the structure within the municipality?
- Is there anything missing?
- Feel free to deliver your input.

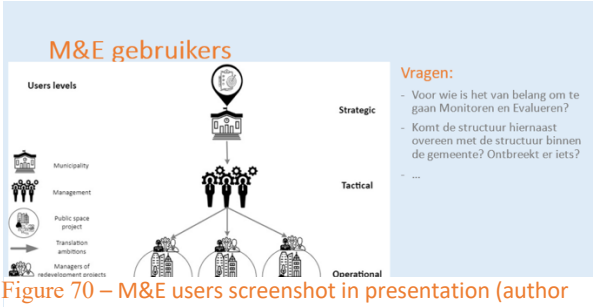


Figure 70 – M&E users screenshot in presentation (author creation)

Generally, the municipal organisation approves the process displayed in the user-level image; however, it requires some adjustments elaborated in *Table 15 below.*

Table 15 – Arguments from municipality participants on users of M&E blueprint

Arguments	Justification	Improvements
The participants indicated that the overview of Users level should emphasize on which level Monitor and Evaluation become relevant.	Despite monitoring sustainable solutions occurring on the operational level, it misses the essence that M&E is relevant on all levels, thus strategic, tactical, and operational. The need for a multi-level approach is also addressed by Structural and Design requirements 7 and Function requirements 10, 2, 41, 43, 44, 92, 98 & 137.	Include in the users' level overview, specifically who is the executive and the users.
The participants indicated that within larger municipalities, sustainability programs are separated from existing departments and 'daily work' (matrix organisation). This means that the city council becomes the client of a specific sustainable transition/program. Potentially causing the M&E will a system that is used for the transition programmes and lack inclusion within various departments. It is relevant that each department will be included as well. Each new ambition creates a new separate program, making it more complex.	Personal communication I7 and I9 also mention the matrix organisation as a potential difficulty to govern the transitions.	Specifically, address within the elaboration of the M&E blueprint that it is relevant to communicate with various departments since these departments contain relevant information on for instance local challenges.
The participants indicated that the overview displays the connection top-down and should include bottom-up approach as well. It is relevant to determine the impact of the operational level on a strategic level and communicate between the layers	As indicated by requirements 10 and 41 it is relevant that the M&E system operates throughout the levels of the organisation.	The figure must be adjusted, and additional lines of communication and collaboration must be added between each level.
The participants indicated to identify who and on which level oversees the development and execution of the M&E?	As indicated by Personal communication, I2 (2022), municipal managers on an operational level are in general not able to oversee or have and consider various departments to deal with the related matters and necessary steps. In addition, the municipal adivisor stated the "tactical gap" as an issue that needs to be addressed. Indicating that the lack of concise goals derived from the strategic gap is causing a mismatch on the tactical level and operational level regarding what should receive focus. Therefore, it becomes relevant to appoint the operational level as an executive of the M&E system development and execution	Identify with the other two focus groups if the tactical layer should be appointed as the executive of the M&E system development and execution.

M&E users' interaction with the M&E blueprint

The following questions were asked:

- do the phases correspond to your project phases for redevelopment projects?
- In which phases does it make sense to monitor and evaluate?
- Is there anything missing?
- Feel free to deliver your input.

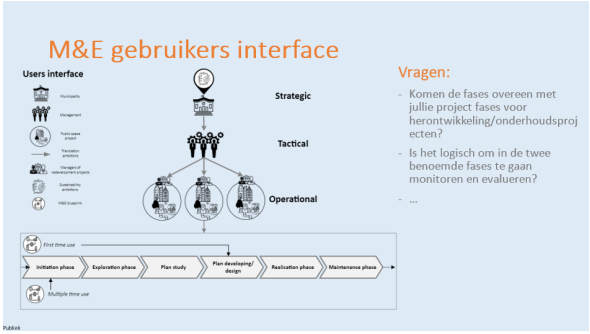


Figure 71 M&E interaction screenshot in presentation (author creation)

The following remark was provided.
Considering the municipal standard for project-based working, the stated phases fit very well. We have a planning phase, design phase, realisation phase (consisting of design, contracting and realisation) and management phase. The initial phase and the exploration phase have been combined in ambitious projects.

Table 16 - *Arguments from municipality participants on interaction with M&E blueprint*

Arguments	Justification	Improvements
The participants indicated combining the initiation phase and exploration phase. In reality, these phases share the same procedures.	A literature search indicated that there is no straightforward approach for redevelopment projects in the public space of municipalities. However, using various sources, the statement to combine the initiation and exploration phase can be determined (Gemeente Oosterhout, 2008; Mol, 2019; Gemeente Amsterdam, 2022b)	The M&E Users interaction will combine the Initiation phase and exploration phase.
The participants state to include "go/no-go moments" after specific steps. In these go/no-go moments, minimal agreements dependent on the requirements within the M&E blueprint must be established before going on to the next project phase.	The participants state that the implementation of transitions is relatively new. Causing that M&E needs to be included within the existing project phases. The provided example: KPIs and indicators must be determined to monitor and evaluate sustainability transitions. However, these KPIs and indicators are often formulated too late within the redevelopment project phases. As a result, the process is not designed to monitor and evaluate these KPIs. Requirements 73 and 126 indicate the urge for certain agreements to be established.	The M&E blueprint will indicate what agreements must be established before proceeding to the next step. Simultaneously, each step will indicate to which project phases it is linked
The participants indicate to be clear on what to monitor - the feasibility of ambitions and transitions, the process, and the effect or result of sustainable solutions?	At this thesis project stage, it was unclear what municipalities should monitor and evaluate.	Create focus and substantiate where monitoring and evaluation should be focused on. This knowledge gap is addressed after the focus group discussion.
The participants indicate to revert a loop from the maintenance phase to the exploration phase to complete the circle.	Each asset in the public space has a life cycle. At the end of a lifecycle, redevelopment is necessary as stressed in this thesis project (*1.3*).	Conduct a loop from (usage)/ maintenance to exploration phase
The participants indicate that an executive, who is responsible to monitor and evaluate, should be appointed. This person should direct municipal managers to include M&E within their projects.	As stated by the participants, someone from tactical or strategic level needs to address municipal managers to include M&E within redevelopment projects and make resources available. Otherwise, it will remain premature and it municipal managers will not include it.	Address the necessary roles per step in the M&E blueprint

The participants indicate that the overview of Users level should emphasize when steps should be included and for whom Monitor, and Evaluation becomes relevant.	Adding the M&E steps to project phases and for whom the step is/are relevant is missing. Although, necessary for the acceptance of the M&E blueprint within a municipality according to the focusgroup.	The users' interaction will indicate, specific steps of the M&E blueprint will be linked toward project phases and relevancy within user levels

What are the necessary steps to Monitor and Evaluate?

The steps of the M&E blueprint were presented and elaborated. The following questions were asked:

- Is there anything unclear?
- Is there a step missing?

So at first glance, it seems that nothing is missing. But that should, of course, become apparent in a pilot project.

Figure 72 M&E steps screenshot in presentation (author creation)

Table 17 – Arguments from municipality participants on necessary steps of the M&E blueprint

Arguments	Justification	Improvements
The participants indicate if the steps of the Monitoring and evaluation process steps could be linked to a municipality's asset management process of a municipality.	Asset management, also known as risk-based management, ensures the optimal deployment of public resources and seeks the best balance between risks, performance and costs (Gemeente Rotterdam, 2018). In the last decade, asset management is introduced within the public space of various municipalities to manage substantiated obsolete assets. However, this would require additional research on asset management and is not achievable within the scope of this thesis project.	Despite the limited scope of the thesis project, it will be included as recommendation.

What is the relevancy and capability of the system?

The elaboration on the relevancy and capability of the M&E system provided two arguments regarding the use of the M&E system and addressed questions. In general, the following was stated: the M&E system should ideally aid in considering per project the achievable percentage based on balancing the necessary cost and effect to the related ambitions.

Figure 73 M&E using & relevance screenshot in presentation (author creation)

Table 18 – Arguments from municipality participants on relevance and capability of the M&E blueprint

Arguments	Justification	Improvements
The participants indicate that the M&E system should also focus on the sum of all redevelopment projects and solutions. To what extent all those projects can contribute to the stated objectives.	This will provide relevant information to the strategic level to determine if policies create impact and if ambitions will be met.	Despite the limited scope of the thesis project, it will be included as a recommendation.

The participants indicate a shift of the sequence of the arguments for relevancy.	It should start with the most relevant purpose of the M&E blueprint.	The arguments will be shifted. Starting with the purpose of the M&E blueprint which is, in short, the monitoring and evaluation of sustainability within redevelopment projects (will be amplified in the focus group discussion 2)

Architectural

Structure

In addition to the functional aspects, the architectural sketch was presented. This provided the feedback:

- The presented subsequent structure is convenient to use. Step by step, like a manual, helps to insert new initiatives.

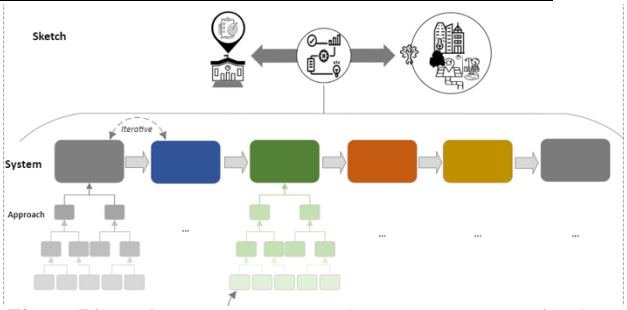


Figure 74 – M&E structure screenshot in presentation (author creation)

Design

- It is good to have an interactive presentation incorporating an approach and all relevant information. A report will not work since people will just not read it. The PowerPoint is an interactive way of telling and guiding the users through a necessary process.
- Make it attractive to work with and look at it.

Discussion Focus group 2

In addition, to focus group 1 with municipal advisors, a second focus group session was held with consultants who advise municipalities on how to include the sustainability transitions within projects. Compared to the first session, the consultants have a comprehensive overview of the challenges and needs of different municipalities. However, they have less insight on specific challenges per specific municipality.

Functional

Multiple questions were stated to start the discussion on the functionality of the M&E blueprint.

Who are the relevant users?

The following questions were asked.

- For whom is it important to monitor and evaluate?
- Does the structure correspond to the structure within the municipality?
- Is there anything missing?
- Feel free to deliver your input.

The sustainability advisors from a consultancy firm indicated some adjustments in addition to the municipal arguments. However, it requires some adjustments elaborated in *Table 19.*

Table 19 - Arguments from consultant participants on users of M&E blueprint

Arguments	Justification	Improvements
The participants indicate that the M&E system must be used throughout the organisation. The users are on three levels. However, the best level to organise the M&E system is to position the executives on a tactical level	From this tactical level, they can provide feedback to a strategic level, and they can adjust the project managers at an operational level and keep track of progress. This also has to do with accountability. From within the project, it must be accountable to the project manager and from the	Make a clear division between the users of the M&E level (within municipalities) and the executive users. Ideally, the advisors on the

	project manager it must be able to account for the tactical level and from the tactical point of view, you must be able to account for it towards the strategic level. So, in that sense, the results must be accessible throughout the organization, and it must be clear what is meant by them and what you can make of them. At the same time, the M&E system addresses the major issue, the tactical gap as described in Focus group discussion 1, via the necessary steps within the blueprint.	tactical level are assigned as executives and municipal managers are users as well as strategic level.
The participants indicate that it must be stressed that the purpose of M&E should not be primarily focused on providing feedback or results to the user level above. The M&E system should provide insight into essentials per user level to efficiently monitor and evaluate.	The stressed argument indicates the relevance of communication between different layers or departments and not just focusing on the results but also on their needs (Requirement 67). A communication strategy could support this need for communication among users (Requirement 55).	Within the M&E blueprint attention must be drawn to communication to indicate requirements per user levels.
The participants indicate the information that is relevant per user level differentiates. Therefore, it would be ideal if the M&E system generates a desired output per-user level. At a strategic level, for example, a municipality wants to prevent flooding and thus be climate-adaptive; at a strategic level, a municipality wants to know how many cubic meters of water can be stored and drained in the soil of a neighbourhood, while at an operational level the municipality wants to know whether a measure such as permeable paving performs well.	As Requirement 53 states, there is no "size fits all template", meaning that per-user level, a different evaluation output must be generated. The collected data should be evaluated based on the desired output per-user level. Therefore, Requirement 133 states that the M&E system should determine which output must be generated per stakeholder or within the scope of this thesis project per-user level.	Indicate within the M&E Blueprint that output of evaluation should be based on the desires of the user level.

M&E users' interaction, when could it be applied?

The following questions were asked:

- do the phases correspond to your project phases for redevelopment projects?
- In which phases does it make sense to monitor and evaluate?
- Is there anything missing?
- Feel free to deliver your input.

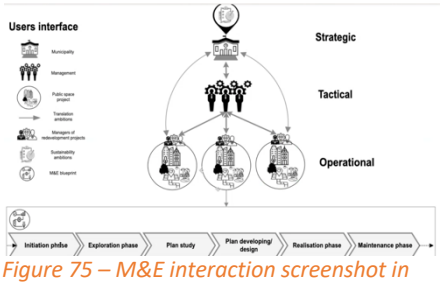


Figure 75 – M&E interaction screenshot in presentation (author creation)

The consultants distinguished between the executives and the user (levels). In Table 20 below, the questions and arguments concluded that the tactical level seems ideal for appointing executives.

Table 20 – Arguments from consultant participants on the interaction of M&E blueprint

Arguments	Justification	Improvements
The participants indicate that the project phases must be concisely defined to determine where which step of the M&E blueprint is applicable	Each municipality or organisation has a slightly different perception of the project phases (Gemeente Oosterhout, 2008; Mol, 2019; Gemeente Amsterdam, 2022b)	In total five phases will be further defined and elaborated upon.

The participants indicate that is essential that relevant persons to the project become aware at an early stage of what is needed for M&E after the construction of the redevelopment project and included sustainable solutions. Therefore, most steps are part of the plan study because during this phase the area is analysed, the scope for the project is determined and relevant KPIs are formulated. Therefore, steps 1 to 4 should occur in this phase. It is essential to know in advance what solutions are going to be monitored and evaluated. This needs to be thought through before the project is realised. The monitoring itself is conducted after the realisation during the use/maintenance phase, same with other steps.	Since information on monitoring and evaluation or a concise overview of necessary steps per project phase is missing it is not possible to justify the arguments made by the participants regarding the assignment of steps within the M&E blueprint. Therefore, this should be tested when applying an M&E system within a redevelopment project.	Include within the M&E users' interaction and M&E blueprint in which project phases the steps must be handled.
The participants indicate that in some cases a baseline measurement is desired to determine the progress/ performance of sustainable solutions compared to conventional solutions.	If it is stated would require that steps 5 and 6 start before the Realisation phase. (According to Requirement 81) at least a year before.	Include within the M&E blueprint that the start of phases 5 & 6 may vary from the original sequence of steps related to the needed zero-measurement.
The participants indicated that they would start with an accessible application of the M&E system to learn and understand the process. For instance, start with a limited number of KPIs.	After going through several cycles, it is possible to personalize the M&E system according to the organization's preferences and to scale up. Otherwise, as Personal communication I7 (2022) experienced, municipal managers within the municipality had a poor experience with the Monitoring and Evaluation and were therefore not eager to try it again. As Personal communication I9 (2022), it better to be concise on a 4/5 indicators instead of lacking clarity on 15 indicators.	Indicate within the M&E blueprint that it is necessary to start on a low scale with few indicators and try to create a process that suits the municipal organization. After several cycles the process can be scaled up.

What is the relevancy and capability of the system?

The elaboration on the relevancy and capability of the M&E system provided two arguments regarding the use of the M&E system and addressed questions.

The elaboration on the relevancy and capability of the M&E system provided two arguments regarding the use of the M&E system and addressed questions.

- The relevancy described that the M&E blueprint could be used as a 'line of sight' through all levels and departments. The participants indicated that line of sight contains only the vertical line, thus through the different levels (strategic, tactical and practical).
- In addition, the communication between various departments on an operational level could be framed as alignment.

Architectural

Structure

In addition to the functional aspects, the architectural sketch was presented. This provided the feedback:

- A clear and concise overview of the structure
- Curious about how it functions in a project

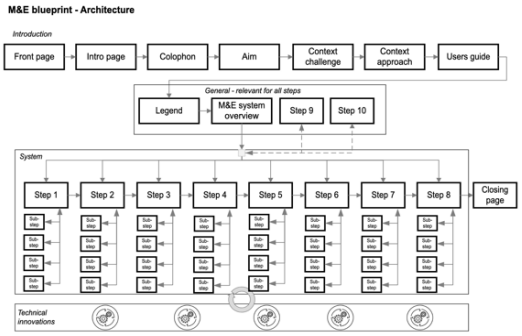


Figure 76 – M&E architecture screenshot in presentation (author creation)

Design

The M&E blueprint draft was also shown to indicate the functioning and navigating through the PowerPoint presentation. The participants were interested in the functioning of the PowerPoint. However, indicate that it must prove its value in projects.

Discussion Focus group 3

In addition, to focus groups 1 & 2 with municipal advisors and consultants, a third focus group session was held with developers of the IWTaaS and Sightview application (one of the case studies addressed in this thesis document). The focus group aimed to discuss the potential of technical solutions within the M&E blueprint. Technological solutions to ease, for instance, steps within the M&E blueprint. Technological solutions are included to improve the system's functioning and bypass or resolve current challenges that withhold municipalities from M&E sustainability in redevelopment projects.

Again, the previous chapters' introduction, methodology and results were presented. In addition, the M&E Blueprint Prototype was shown and discussed. In contrast to the previous two focus group discussions, this session focused specifically on the Design & Structure, the Functionalities of the M&E blueprint, and the Integration of technological solutions. Because the developers are not specifically aware of the municipal organisation or the challenges the project managers must encounter. Nevertheless, the developers have experience developing tools and platforms used by municipalities.

Functionalities

The participant indicated that the concept of Monitoring & Evaluation is complex to understand. Therefore, to understand the M&E blueprint, the users must understand the background and be properly instructed. Guidance will therefore be essential to be able to implement this successfully. The prototype M&E blueprint has the potential to enable a translation from strategic ambition to tactical and operational level and to ensure that lessons are learned and implemented elsewhere. Some multiple concerns or difficulties should be addressed in the blueprint as discussed below; multiple concerns or difficulties should be addressed in the blueprint.

Functions

Table 21 - Arguments from developer participants on the functions of the M&E blueprint

Arguments	Justification	Improvements
The participant indicates that a checklist should be included per step. Specific: - What is necessary to conduct a specific step? (input) - What should be the result of each step? (output)	By adding the minimal input and output, every step becomes clear and binding. A user will exactly know what must be determined at the beginning (input) and what must be achieved (output).	Per step in the M&E blueprint is indicated what is essential to start the step with (Principles) and what should be determined before proceeding to the next step (Agreements).

Including technological solutions

A general statement is that IT-related technologic solutions are complex for municipalities to introduce. Therefore, it is advised to balance between easy-to-use and what is needed. The technological solution page of each step could even become a hub of technological solutions.

Table 22 – Arguments from developer participants on including technological solutions of the M&E blueprint

Arguments	Justification	Improvements
The participant indicates that every step will have potential tooling's that should made available to ease the process.	However, as indicated, the M&E blueprint should be careful with recommending tools or services.	Within the technologic solution page, possible solutions will be suggested based on the author's knowledge. However, with the suggested technological solutions it must state that it is a recommendation, and the application of the tool is a responsibility of the user.
The participant indicates that there is a difference between the steps to determine if a technological solution is necessary. Therefore, the M&E blueprint should indicate per step if a technological solution is obligated or essential	The example provided: In the first four steps of the M&E blueprint, the essence is about making agreements, data requirements, KPIs and targets. These steps can describe in a Word file. However, in step 5, where the monitoring starts, it is not possible to use a Word file of something similar. In this phase, confirming and determining that an IT environment is used to start the monitoring is essential.	Within each step of the M&E blueprint should be stated if the suggested technological solution is optional or (strongly) recommend.
The participant indicated that it is desired to determine per municipality which technological solutions are used at each step across all redevelopment projects.	The same use of technological solutions per step across all redevelopment projects is desired since this will make it possible to compare the results each step with similar the results of other projects within the municipality.	Within step 1 of the M&E blueprint must be stated that all implemented technological solutions within redevelopment projects of the same municipality must be similar. Although the testing of new technological solutions within a certain step should be allowed.

Architectural (Structure & Design)

The participant indicated the following general statement about the prototype's architecture; the blueprint structure with subsequent steps is straightforward. Multiple arguments were provided regarding the Structure and Design of the M&E blueprint.

Table 23 – Arguments from developer participants on the architecture of the M&E blueprint

Arguments	Justification	Improvements
The participant indicates that the steps within the M&E blueprint are representative of a workflow process. There are many existing available programs that have a particular workflow function. However, these workflow programs are often too generic and usable for a dozen other topics, making them less applicable. Therefore, the steps should be specific to the users and	The participant provided justification as well: The advantage of the M&E blueprint is that it consists of a specific focus on redevelopment projects in the public space. According to Structural & Design requirement 3 the M&E blueprint must be applicable to every municipality while requirement 4 states that despites the standardization the M&E blueprint should be specifically applicable in a local	Within the introduction and steps of the M&E blueprint, a specific focus on redevelopment (pilot) projects in the public space must be indicated. However, as indicated by Structure & Design Requirement 11; the first year of the M&E blueprint and resulting system

redevelopment projects in the public space.	context. A consensus between these two extreme requirements must be found.	should be used to optimise and prevent operational issues.
The participant indicates that there are many possible programmes to develop an M&E blueprint. The prototype was developed in PowerPoint and that is in the context of the municipalities desired. In addition, the developed M&E blueprint is the first concept and should not be too complicated.	PowerPoint is desired in this specific context because it is an easy-to-use program, and every municipal employee has the program and can operate it. It is widely accepted in the IT department of a municipality. Everyone in the municipality has PowerPoint on their laptop. So, in that sense, you don't need to have approval for your tool.	The prototype was made in PowerPoint, based on the provided feedback, the first version of the M&E blueprint will be finalised in PowerPoint
The participant indicates that it is desired to use the same structure within each step of the M&E blueprint	When each step consists of the same structure it is assumed that the M&E blueprint will become more comprehensible and usable for users. Also desired by the Structure & Design Requirement 12.	Each step in the layout of the M&E blueprint will be structured in the same way.

Reflection on Focus Group Discussions

A reflection from the author on the held focus group discussions will indicate improvements for possible future sessions and stimulate individual learning (Johannesson & Perjons, 2014). Therefore, a brief reflection on both the optimisation approach and the content of the sessions is provided.

Optimisation approach

Three sessions were conducted to optimise the designed sketch, the deliverable from 4.1. This approach worked accordingly; I improved the sketch consequent with feedback to prototype v1 and v2 and finally prototyped v3. However, this structured optimisation approach had a flaw as well. The first and second focus group discussions (municipality & consultants) were not further involved after they provided feedback. A feedback loop to participants in previous feedback groups was missing. Therefore, the participants could not observe if their arguments had been considered, nor could they respond to arguments provided in other focus group discussions. This has impacted the reliability of the M&E blueprint because I could be selective by choosing the statements/arguments of participants conforming to my perspective on how the M&E blueprint should be developed and eventually function. Therefore, I would include these feedback loops within the optimisation approach in a similar or follow-up study.

In addition, I included only one municipality within the focus group discussion because this municipality was specifically developing an approach to narrow the strategic sustainability ambitions. The inclusion of only the municipality is not representative at all. I would include different municipalities within a follow-up study. If municipalities do not have experience in monitoring and evaluation, I will introduce them when the M&E blueprint is almost finished, and it is thus easier to provide feedback. Municipalities must be involved.

Content of the sessions

It was beneficial that I conducted a brainstorming session that resulted in an M&E blueprint sketch upfront. Based on this sketch, which included a Functional description (Users, Interaction, Relevant steps, Relevance and Capability of the system) and Architecture (Structure & Design), I was able to ask direct questions that provided feedback on the M&E blueprint. However, in a similar follow-up study, I intend to be less structured with questions and include some brainstorming within the session. All sessions were structured and framed, not including much creativity. I would require more own input from participants and start again with a structured brainstorming session in addition to the solo brainstorming session. It would be

interesting if similar results would arise. So instead of steering the session, I would just guide it and let it become what participants think is relevant. The content and layout of the session are also dependent on the participants. The following section proceeds with the prototype of the M&E blueprint.

5.4 Build Artefact

The designing and development of the M&E blueprint began with imagining and brainstorming the desired situation, which resulted in a sketch. The sketch was subsequently optimised to a prototype and justified. The final step is to build the M&E blueprint. As discussed in *5.2* and *5.3,* the M&E blueprint is realised in PowerPoint, and the prototype was already designed in PowerPoint. Therefore, this sub-activity does not include any methodologies or results. However, this sub-activity elaborates how the M&E blueprint can be operated and the gaps that require further attention, elaboration, or research.

Operate M&E blueprint

The M&E blueprint can be operated without this thesis document. However, a distinct explanation of how the M&E blueprint should be operated is stated. The M&E blueprint has been processed into a PowerPoint presentation. When the presentation is opened, the presentation mode must be turned on to use the functionalities within the PowerPoint.

Introduction - Slide 1 to 8

Slides 1 to 8 are an introduction to the M&E blueprint, providing background information: Title page, Colophon, Aim (visualised right), Problem definition, Approach, Users guide, Legend, and Sources. These pages must be operated just like a standard PowerPoint presentation by clicking on the page for new information, or the next slide will appear.

Figure 77 - aim, screenshot in M&E blueprint (author creation)

Specific attention is required to the legend on Slide 7.
The legend page provides information regarding the functional options encountered within the M&E blueprint. In addition, the ten steps are briefly introduced.

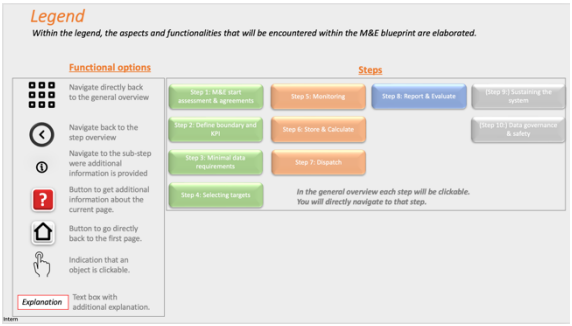


Figure 78 – legend, screenshot in M&E blueprint (author creation)

General overview - Slides 9 & 10

Slide 9 (visualised right) provides the general overview from where can be directly navigated to all ten steps part of the M&E blueprint. The ten steps are divided into four themes that represent the overall purpose. Theme Green (steps 1 to 4) addresses the structuring of the organisation, Orange (steps 5 to 7) the Data collection and processing, Blue (step 8) the results and Grey (steps 9 & 10) represents the general system option.

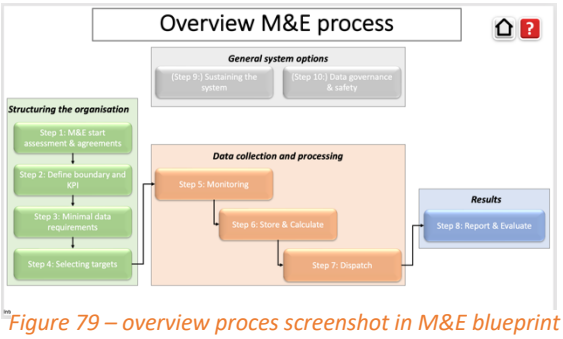


Figure 79 – overview proces screenshot in M&E blueprint (author creation)

Two functionalities are included in the upper right corner, the 'home' button to directly navigate the first slide. The 'question mark' button to get an explanation of the functionalities in the slide.

The Ten Steps – Slides 11 to 80

Each step has the same structure and layout (visualised in the image below). Therefore, Step 1 is used as an example representing all ten steps.

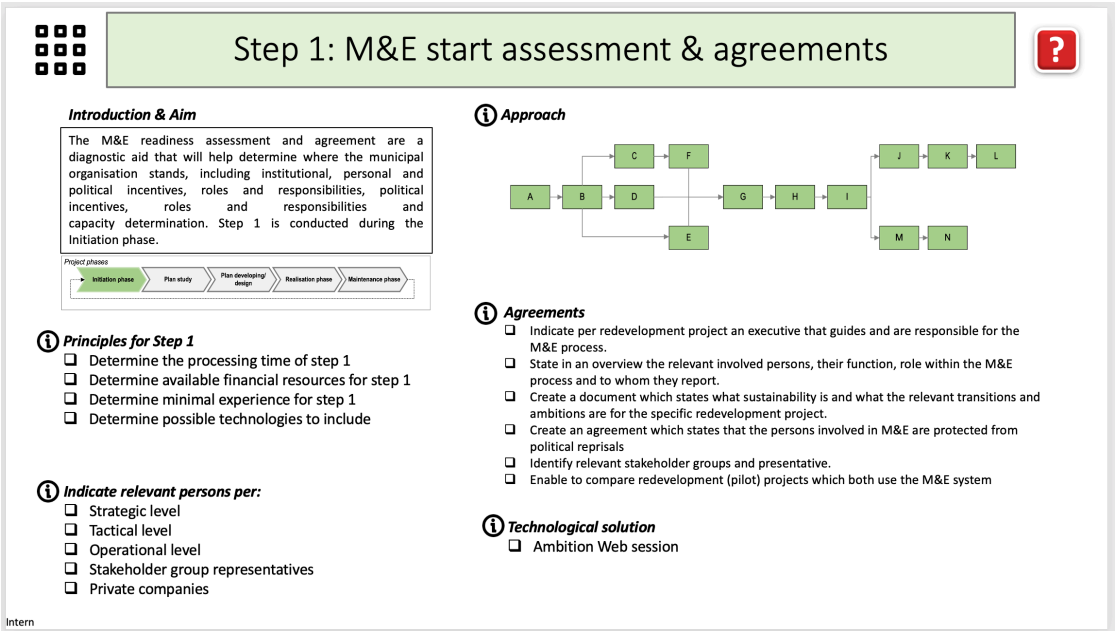


Figure 80 – overview of step 1 in the M&E blueprint (author creation)

The layout consists of the following elements:

1. Introduction & aim: explanation of the aim.
2. Relevant project phase: indication in which project phase the step should be executed.
3. Principles: The municipality must indicate principles determined at the beginning of each step, making enough resources and knowledge available to fulfil this step.
4. Relevant persons: The municipality must define the relevant persons, their function within the organisation, their role in the M&E process, SMART role description, reports to whom and special remarks.
5. Approach: Within the highlighted overview, the requirements are translated into sub-steps that must be fulfilled (at least considered). The sub-step sequence is also indicated; information from one sub-step provides input for the next sub-step. Therefore, it is valuable to consider the indicated sequence.

6. Agreements: At the end of the step, the municipality must fulfil specific agreements and decisions before going to the next step.
7. Technological Solutions: With technological solutions, it will become easier to meet the requirements of a step. Therefore, possible technological solutions, such as approaches, tools or applications, are introduced on this page.

In addition, the main overview of each step has multiple functionalities. The user will be navigated to the general overview via the upper left corner 'application' button. In the right upper corner, the 'question mark' button to get an explanation of the functionalities in the slide. Lastly, the 'information' buttons are left to each element. The user will directly navigate to a slide with more information about this specific element by clicking on this button. The image below indicates the *Approach* of step 1. Via this step, it is possible to navigate back to the general overview (upper left corner) or the overview of step 1 (upper right corner).

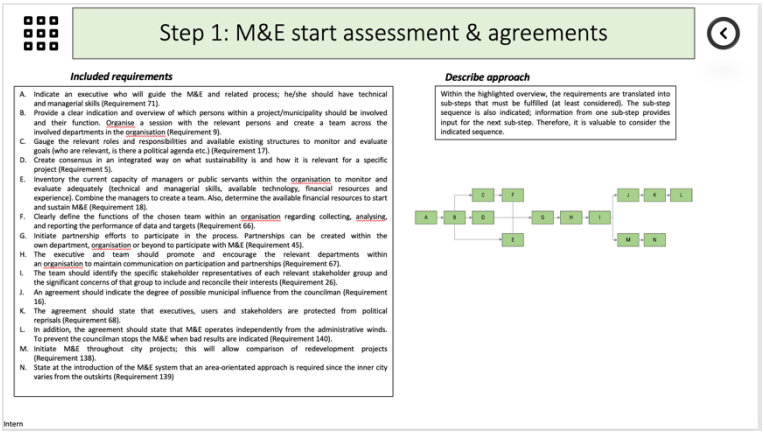


Figure 81 – overview of the sub-step approach in step 1 in the M&E blueprint (author creation)

Closing of the M&E blueprint – Slides 81 and 82

The final two slides are closing slides. Nothing relevant to mention about.

Shortcomings of the M&E blueprint

Multiple shortcomings were identified during the building of the M&E blueprint. It is plausible to state that additional shortcomings will be identified during the implementation of the M&E blueprint. These predetermined shortcomings are addressed below.

Functional requirements implementation

The functional requirements are adopted from the inventory in *3.5*. Coherence between the requirements was lacking. The requirements were ordered in a logical sequence per step to counter this shortcoming. However, this was based on assumptions from the Author based on the sequence of requirements in the analysed case studies. The sequence of requirements, stated as Approach, is not verified with users or other stakeholders. During the focus group discussion, verifying these assumptions was impossible. The participants could not verify since the concept of M&E within municipalities is underexposed and requires additional attention. The lack of verification reduces the validity and reliability of the indicated approach and requires addressing in follow-up studies.

Lacking examples

Within the M&E blueprint, specific examples, for instance, the *principles, persons, agreements, and technological solutions,* are missing. At this stage of an explorative study, it was not possible to identify such concrete examples. What will cause users might miss the purpose of a step or related sub-steps. If possible, examples from case studies have been included. The lack of examples makes the M&E blueprint distant, intangible and lacks incentives. This would require attention in follow-studies.

Technological solutions

Technological solutions are included within the M&E blueprint to ease or perform a step. The included technological solutions within the current version of the M&E blueprint are minimal. As indicated in focus group discussion 3, IT solutions are challenging to implement within municipalities. There are many non and IT solutions available and applicable to meet the desires of a specific Step. Relevant (IT) solutions could be recommended per step. However, it is not possible within the current stage of the M&E blueprint to identify relevantly (IT) solutions per step. The M&E blueprint should be demonstrated first to identify the gaps or inconveniences per step that needs to be addressed. Again, this would require attention in a follow-up study.

Summarisation and conclusion of sub-question 3

Chapter three used a combination of brainstorming and focus group discussion to provide substance to the third sub-question:

How should a Monitor and Evaluation blueprint, architectural and functional, be developed?

Approach

The third activity aimed to design and develop an M&E blueprint that addresses the explicated problems in *3.1, 3.2 & 3.3* (sub-question 1) and uses the defined outline and requirements of *4.1 & 4.2* (sub-question 2). Via Imagination and Brainstorming, an M&E blueprint Architectural (structure & design) and Functional sketch were created. The sketch was subsequently optimised to a prototype with arguments stated in three Focus group discussions with a municipality, consultants, and developers of the IWTaaS case study. Simultaneously, the stated arguments were justified by using requirements of statements from interviewees or literature. The final prototype led to the construction of the M&E blueprint. Chapter 5 provides a structured answer to how a Monitor & Evaluation blueprint is composed to meet the users' desires.

Functional description

The users are within the municipal organisation. However, determining who should be appointed as the user was complex because it transcends multiple departments and levels. There are three types of users based on the municipality's structure: strategic, tactical, and operational. The tactical level should be appointed as the executive user and support the project managers at the operational level. The tactical level overviews the various redevelopment projects and can quickly provide feedback to both the strategic and operational levels. The project managers on the operational level should use the M&E blueprint. The M&E blueprint enables municipal (project) managers to develop a tailored system for their municipality, enabling them to monitor and evaluate sustainability solutions in redevelopment (pilot) public space projects. Collaboration between the layers is essential. Implementing the M&E blueprint is related to the project phases of a redevelopment project. The following phases are defined, and related steps are stated:

1. Initiation phase: Step 1 (M&E start assessment & agreements)

2. Plan study: 2 (Define Boundary and Key Performance Indicators), 3 (Minimal data requirements) & 4 (Selecting targets)
3. Plan developing/design phase
4. Realisation phase
5. Using/maintenance phase: steps 5 (Monitoring), 6 (Store and Calculate), 7 (Dispatch) and 8 (Report and evaluate)

Steps 9 (Sustaining the system) and 10 (Data governance & Safety) should be considered throughout the project phases.

The M&E blueprint delivers a structured stepwise approach to include monitoring and evaluation within the project phases of redevelopment projects. It enables an opportunity to fill the urge to effectively monitor and evaluate applied sustainability solutions in (pilot) redevelopment projects of the public space and alter regime levels.

Architecture

The following architecture is chosen based on brainstorming potential structures in *5.1* (based on requirements for Structure and Design and arguments from interviewees) and subsequently optimised via the focus group discussion.

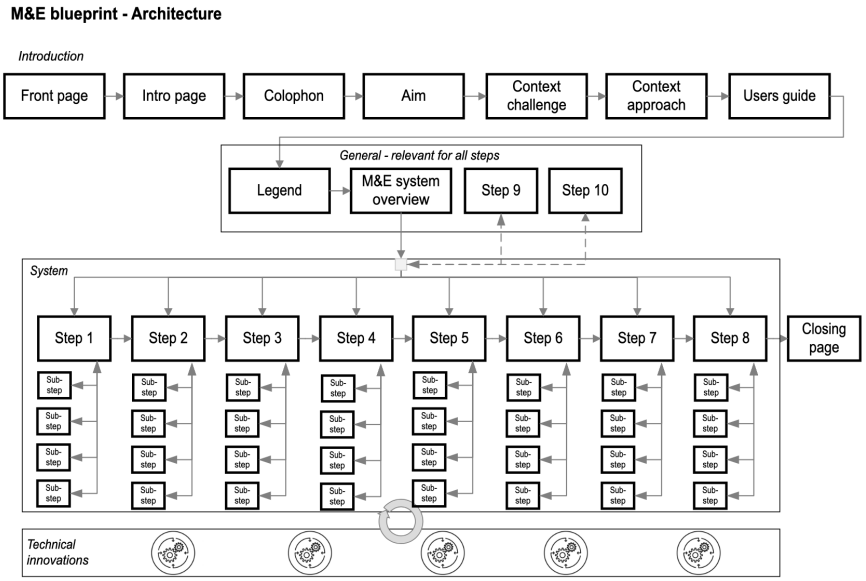


Figure 82 - Architecture of the M&E blueprint (author creation)

Developed M&E blueprint

The M&E blueprint answers the sub-question; it should be developed following various stakeholders. The M&E blueprint in PowerPoint provides a robust, systematic, and integral process that project managers (operational level) can use in collaboration with the tactical level to create their M&E system that effectively monitors and evaluates applied sustainability measures within (pilot) redevelopment projects. The M&E is robust because it can be applied to every municipality and give it its twist. Systematic because it contains a structured process with steps. And integral because it includes various sustainability transitions that are taking place within the public space.

It must be stated that the developed M&E is based on an explorative study and therefore requires follow-up studies. Besides, as indicated in this chapter, various shortcomings must be addressed, such as the *Implementation of functional requirements, Lacking examples and Technological solutions* to improve the

validity and credibility of the M&E blueprint. However, in contrast to the beginning of this thesis project, the M&E blueprint provides a robust, systematic, and integral approach that can be used.
The next chapter will demonstrate and evaluate the developed M&E blueprint.

6. Chapter 6: Demonstrate and evaluate the M&E blueprint

In chapter 6, the M&E blueprint is demonstrated and evaluated. Due to the explorative nature of the thesis project and the limited time frame, the M&E blueprint is not demonstrated nor evaluated within an existing project. Nevertheless, in section 6.1, the built M&E blueprint is demonstrated to the interviewees and participants of the focus groups. The study provides interviewees and participants with an opportunity to provide feedback on the M&E blueprint regarding potential improvements and, most relevant if the blueprint meets their desires. The feedback on the developed artefact, parts of the thesis project, and improvements are elaborated in section 6.2.

6.1 Demonstrate the M&E blueprint

The M&E blueprint was demonstrated via a recorded presentation. In this video, the M&E blueprint was explained following the approach mentioned in *Chapter 5.4* to operate the M&E blueprint. To demonstrate the M&E blueprint, sufficient information to the receivers (interviewees and participants of the focus group discussion) is provided and, including a survey that could be used for evaluation, multiple activities were executed. The necessary activities are visualised below.

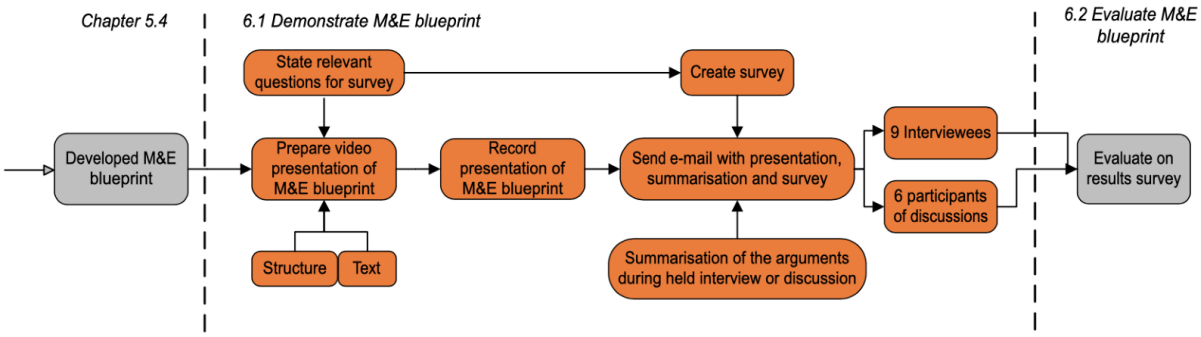


Figure 83 – approach section 6.1 (author creation)

The performed activities are elaborated in this subchapter, including the approach and results.

Input chapter 4.4

The built M&E blueprint in chapter *4.4* is input for the demonstration in *5.1*.

Preparation of video presentation of M&E blueprint

The first step in the preparation of the recorded video was determining the relevant topics to receive at least feedback on via a survey:

- If the purpose formulation, problem definition, used research approach, and Users' guide within the M&E blueprint is clear.

- If the stated problem in the M&E blueprint and thus this thesis document is recognised.
- If the interviewees and participants have the feeling that their provided arguments are included within the M&E blueprint.
- If the structure (steps, design, and functioning) of the M&E blueprint in PowerPoint is desired.
- If there are already any improvements, they would like to see them in the M&E blueprint.
- If they are willing to introduce the M&E system within their municipality on a specific redevelopment project.

The topics refer to the stated problem definition in 3.1 & 3.3, requirements in 3.5 and the determined Architecture and Functionalities in Chapter 4. Based on the above-stated topics, the focus on the video presentation was prepared. First, by determining the structure, it was chosen to follow the storyline of the M&E blueprint. The next step was determining the relevant information that should be shared within the video. The presentation provides both background information (aim, problem definition, approach, users guide, legend, and sources) and an elaboration on the steps and related functionalities of the M&E blueprint. The maximum duration of the recorded presentation was set to 15 minutes max. It was assumed that if the presentation were any shorter, relevant information would be left out. If it had been any longer, the number of persons willing to participate would decrease. The translation of the Dutch text can be found in *Appendix 4.*

Recording of the video presentation

Figure 84 – screenshots from recorded video (author creation)

After the video presentation was prepared, the presentation was recorded in Dutch. The recording was performed via MS teams. Below three screenshots are made from the recorded presentation. It is possible to receive the (Dutch) recording.

The following topics are addressed:

- The blueprint aims to provide a robust, systematic, and integral process that supervises municipal managers and advisors to create a system that effectively monitors and evaluates applied sustainability solutions within (pilot) redevelopment projects.
- The problem definition describes what prompted the development of the Monitoring and Evaluation blueprint that Dutch municipalities can use as a guideline to record the performance of applied sustainability measures in redevelopment projects of public spaces.
- It amplifies the used research approach and methodologies to explore, design and develop the first version of the desired M&E blueprint to track the performance of sustainable solutions within (pilot) redevelopment projects of the public space.
- The User's Guide describes how the M&E blueprint can be viewed and used and the coherence of the various components in the Generic Overview. This is supplemented with insight into the various steps that make up the overview and the various functionalities that can be used.
- Within the legend, the aspects and functionalities that will be encountered within the M&E blueprint are elaborated.
- Within the M&E blueprint, sources are used to substantiate specific statements. These statements are based on findings in papers conducted during the literature review or via an argument provided during one of the nine interviews. References are made with footnotes. Each footnote represents

one specific source which can be used multiple times. The extended version of the sources can be found in the thesis document.
- The general overview of all the steps from where can be directly navigated to all ten steps part of the M&E blueprint.
- The layout of each step is elaborated in *4.4.*

Creation of the survey

As described in the methodology, the first step is determining the survey type. According to Kelley-Quon (2018) and Day et al. (2022), the survey is descriptive since it serves the data collection among the interviewees and participants to create a general understanding and possibly identify a trend in the provided results. A descriptive survey does not assume a hypothesis. In addition, the relevant themes and related questions must be established. The questions revolve around the following topics which are:

- does the M&E blueprint address the problem(s) experienced by municipalities?
- Are both the architectural and functional aspects desired?
- If the provided arguments during the interviews and discussions on requirements are included? – Are the provided inputs used within the M&E blueprint.

The stated topics are mentioned in the *Preparation of the video presentation*. Based on these topics, questions are formulated.

According to Kelley-Quon (2018) and Day et al. (2022), multiple requirements must be included when formulating the survey questions. In general, questions must be unbiased (objectively), understandable, and answerable. Furthermore, the sequence of the questions is relevant as well. The initial question should be broad and easy to answer. Therefore, the first question will focus on the job function of each participant in the survey. The following questions are chronologically arranged and clustered around the same topics. Complicated terms are avoided as much as possible. When stating complicated terms or questions, an explanation is provided. Unfortunately, an essential element of pretesting the survey was not feasible for a limited period.

The survey is in Dutch since all interviewees and participants are Dutch. In addition, the questions are predetermined multiple-choice questions to encourage the interviewees and participants to fill in the survey quickly. However, this requires that the provided options represent all outcomes. The participant in the survey should have the option to formulate his answer to a question.

These requirements, in combination with the predetermined topics, led to the formulation of the following questions and possible answers:

Table 24 - Questions of the survey

Questions	***Caption***	***Possible answers***
1. What is your function?	*Fill in one answer*	a. Project manager at a municipality b. Advisor at a municipality (tactical level) c. Head of the department at a municipality d. Academic e. Consultant f. Developer g. Or other… (able to fill in)
2. Was the explanation in the presentation about the purpose, problem definition and research approach used for the Monitoring & Evaluation blueprint clear?	*You can indicate multiple answers. If you indicate 'No' or 'Partly', please indicate what was not clear.*	a. Yes b. No c. Partly d. Because…

3. Do you recognise the described problem?	*The problems described in the presentation are: 1. the difficulties in applying various sustainable measures during (major) renovations in public space (due to conflicting goals in public space, the complexity of sustainability, applicability of sustainable transitions and related solutions & complex municipal organisation). 2. The learning capacity from pilot projects is limited. So, a pilot project is applied, but the knowledge is not used further here.*	a. I don't recognise both answers. b. I only recognise the difficulties in applying various sustainable measures during (major) renovations in public spaces. c. I only recognise that the learning capacity from pilot projects is limited d. I recognise both answers e. I do not work at, for or with a municipality f. I see another reason, namely
4. Are your provided arguments and requirements been incorporated into the concept of the M&E blueprint during the interview or focus group discussion?	*If you have doubts about the arguments and requirements you have given, you can look at the Word document you sent (see attachment email).*	a. Yes, it looks like it. b. Not, not all provided arguments c. Not even one argument d. I will need more information on the Monitoring & Evaluation blueprint to determine if all arguments are included. e. Which arguments are not included…?
5. What do you think of the structure (construction, design & functioning) in the PowerPoint?	*Select one or more answers*	a. Seems excellent and easy to use b. Difficult to say with the received information c. No opinion d. I have some recommendations…
6. What do you think is still missing from the Monitoring and Evaluation blueprint?	*Select one or more answers*	a. It doesn't seem like anything is missing b. That's hard to say for this; I need more information c. Yes, the following is missing…
7. Would you like to introduce a Monitoring & Evaluation blueprint within your municipality or project with which you can set up your Monitoring & Evaluation System?	*Select one or more answers*	a. Yes, I would be interested in that. b. Yes, but only if I/we are also involved in further developing the blueprint. c. Perhaps if the Monitoring and Evaluation blueprint has been proven in another municipality. d. No, no need of e. Or…

The survey was constructed in *www.Survio.nl*, a free survey builder and was distributed to eleven interviewees and six focus group discussion participants.

Summarise main arguments

As indicated in the Data collection methods (*2.4*), interviews and focus group discussions are transcribed. The arguments provided in these interviews and focus group discussions were summarised. It was relevant to include these arguments since it is expected that the interviewees and participants were not aware of or remember the arguments they provided during these sessions. The interviewees occurred at the end of March and the beginning of April. It was therefore presumed that the interviewees did not have specifically in mind what was discussed at that time. Therefore, within each e-mail address to a specific interviewee and participant of the discussion, a summarisation (1 – 2 A4) of the provided arguments was included. They enabled interviewees and participants to become aware of the arguments and provided a possibility to react to these statements.

The used arguments from the nine interviews are summarised in Appendix 1 The summarization of the arguments provided during the Focus group discussions can be in Chapter 4.3. Each interviewee and participant received only the arguments they provided.

Distribution of the Rerecorded presentation, Main arguments & Survey

An email was sent to each interviewee (9) and participant (6). The e-mail described the purpose of the Recorded video presentation, the Summarized arguments document & Survey and why the feedback of the interviewees and participants is vital. The translation of the sent email can be found in *Appendix 4.* The following chapter elaborates on the results gained via the survey—enabling the evaluation of the M&E blueprint.

6.2 Evaluate the M&E blueprint

In the previous sub-activity, the M&E blueprint was demonstrated to the 9 interviewees and 6 participants of the focus group discussions. The demonstration occurred via an email consisting of a recorded video presentation, summarization of the arguments and survey. Based on the feedback provided in the survey, the M&E blueprint was evaluated. In addition, the sub-activity formulated an answer to the stated fourth sub-question.

Summarise & evaluate feedback

The mail including the recorded video presentation, summarization of arguments and survey was sent to 9 interviewees and 6 participants of the focus group discussions. Of the total 15 possible respondents, 6 persons completed the survey. In addition, 1 person was absent, and 3 persons indicated that they did not have any time available during the 1,5 weeks the survey was published. This means that unfortunately 5 persons did not fill in the survey or leave a response.

Question 1: What is your function?

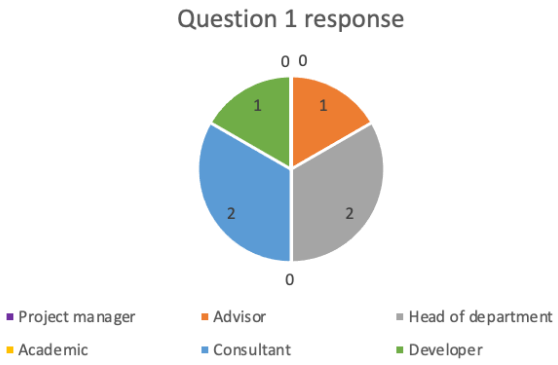


Figure 85 – survey question 1 (author creation)

Observation:
The results indicate that both advisors and the head of the department of a municipality filled in the survey. Two consultants and one developer filled in the survey. Remarkable enough the municipal managers did not fill in the survey. It is not identified why the municipal managers have not responded

Question 2: Was the explanation in the presentation about the purpose, problem definition and is the research approach used for the Monitoring & Evaluation blueprint clear?

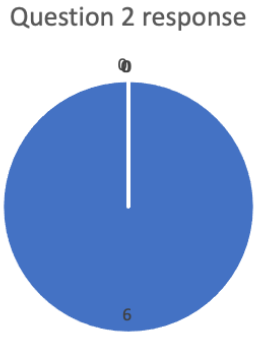


Figure 86 – survey question 2 (author creation)

Observation:
All respondents indicated that the explanation in the video presentation about the purpose, problem definition and research approach was understood.

Question 3: Do you recognise the described problem?

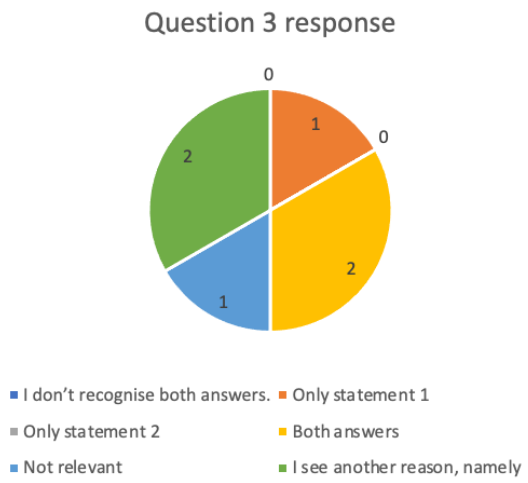


Figure 87 - – survey question 3 (author creation)

Observation:
The respondents provided mixed answers to the stated question. Two respondents indicated that both statements about the described problem are relevant. One respondent recognises only statement 1. Another respondent indicated that the question is not relevant to him/her (developer).

Two respondents provided other answers:
- I think they sound logical and can imagine that they are real challenges. However, I am not sure.
- Another additional reason: A municipality is not in the position to enforce sustainable applications, e.g.: no owner of the energy network

It can be deduced from the respondent's feedback that the problems are recognized. However, which problems are recognized varies among the respondents. This may indicate that this differs per municipality. In short, defining problems within the implementation of sustainable solutions within redevelopment projects of the public space requires additional attention. Although, the number of provided answers is too low to draw any fundamental conclusions.

Question 4: Are your provided arguments and requirements been incorporated into the concept of the M&E blueprint during the interview or focus group discussion?

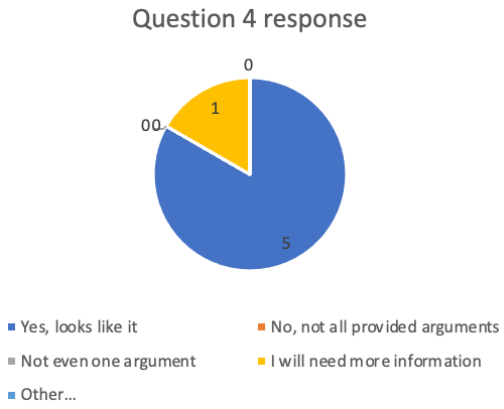
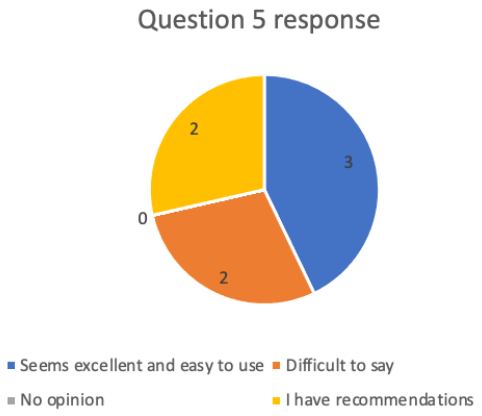


Figure 88 – survey question 4 (author creation)

Observation:
Five respondents indicated that their provided arguments and feedback is included within the recorded video presentation of the M&E blueprint. One respondent will need more information

Question 5: What do you think of the structure (construction, design & functioning) in the PowerPoint?



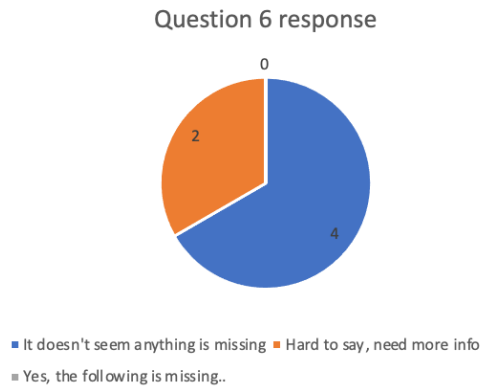
Observation:

The respondents provided mixed answers to the stated question. Three respondents indicate that the M&E blueprint seems excellent and easy to use. Two respondents indicated that is difficult to say based on the recorded video presentation. Two other respondents had recommendation:

- I am missing a concretely worked out and appealing example to convince the users. That is also difficult with a master's thesis.
- Regarding the steps of the M&E blueprint; We are bad at the preliminary phase of projects within the municipality; so, steps 1 to 4 will help. But we don't have KPIs for any transition now, making it difficult to implement steps 5 - 10.

Figure 89 – survey question 5 (author creation)

Question 6: What do you think is still missing from the Monitoring and Evaluation blueprint?



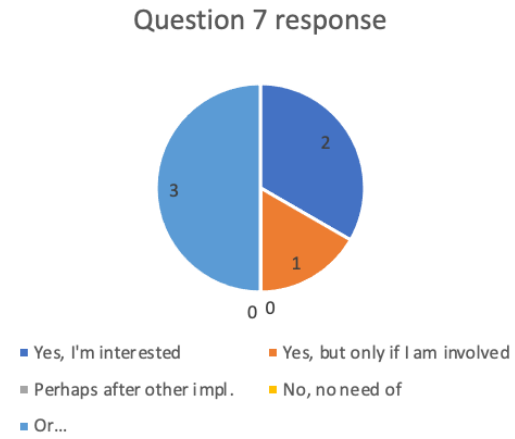
Observation:

Four respondents indicate that nothing particular is missing on the M&E blueprint. Two respondents indicate that it is not possible to state if anything is missing. More information would therefore be required.

Figure 90 – survey question 6 (author creation)

Question 7: Would you like to introduce a Monitoring & Evaluation blueprint within your municipality or project with which you can set up your Monitoring & Evaluation System?

Observation:



The closing question provided mixed answers. Two respondents indicated that would like to implement the M&E blueprint within their municipality. One respondent indicates that they want to use the M&E blueprint only if he/she is involved in the further development of the blueprint itself. Three respondents provided other answers:

- As a project team, I think it would be interesting to apply once
- Unfortunately, I am no longer able to implement this. The proposed concept remains interesting!
- I want to talk about what we can possibly do with it

Figure 91 – survey question7 (author creation)

The last question indicates that all respondents conditionally would like to use the M&E blueprint within their organization. The evaluation of the results is stated within the conclusion of sub-question 4.

Summarisation and conclusion of sub-question 4

Chapter four used a survey to provide substance to the fourth sub-question:

What are the users' (municipalities) opinions regarding the developed M&E blueprint?

Demonstration

The M&E blueprint was demonstrated via a recorded presentation. In this video, the M&E blueprint was explained following the approach mentioned in Chapter 5.4 to operate the M&E blueprint. The following topics were part of the video recorded presentation:

- If the purpose formulation, problem definition, used research approach, and Users' guide within the M&E blueprint is clear.
- If the stated problem in the M&E blueprint and thus this thesis document is recognised.
- If the interviewees and participants feel that their provided arguments are included within the M&E blueprint.
- If the structure (steps, design, and functioning) of the M&E blueprint in PowerPoint is desired.
- If there are already any improvements, they would like to see them in the M&E blueprint.
- If they are willing to introduce the M&E system within their municipality on a specific redevelopment project

The video recording was sent in an e-mail. The e-mail included a summary of the arguments the interviewees and participants stated and a survey including the above-stated topics.

Evaluation

It is impossible to draw any fundamental conclusions on the M&E blueprint based on the six respondents of the survey. This would require additional respondents and especially project managers. However, the survey provides some points of interest. First of all, the recorded video presentation was clear and straightforward. Besides, there is overlap between the identified problems (3.1); at the same time, additional problems are suggested. The suggested problem is mentioned in section 3.1. Besides, it is indicated that the problem that is experienced might differ.

None of the respondents feels that their arguments or requirements (section 4.2 and section 5.2) are missing. Alternatively, the M&E blueprint lacks any (major) features or information. However, based on the 15-minute video, it is hard to identify missing minor features. Lastly, it is interesting to conclude that all respondents are interested, and most are able and willing to discuss the M&E blueprint further. That might also be the reason that these respondents filled in the survey. The persons who did not respond to the e-mail and reminder e-mail might not be interested in using the M&E blueprint. According to the above-stated elaboration, it is viable to state that the opinions regarding the M&E blueprint are positive to explore and use the M&E blueprint.

The provided answers of additional respondents must provide sufficient insight if the M&E blueprint addresses the stated problem and meets the stated expectations and desires. However, that was not feasible within the limited time frame.

7.

Chapter 7: Conclusion

Chapter 7 presents the findings of the conducted explorative study. Starting in Section 7.1 with an introduction and conclusion of results of each separate sub-question stated in this explorative study. The findings provided for each sub-question are a substantiation for answering the research question of the leading research questions in section 7.2. In addition, the product of this explorative research, the M&E blueprint, is concluded within section 7.2. The provided conclusions to each sub-question led to the development of the M&E blueprint. Section 7.3 will complete the conclusion section with a general conclusion on the explorative study and follow-up studies.

7.1 Introduction of conclusion and answering of sub-questions

This section will briefly introduce the explorative study to summarise the sub-questions and conclude each sub-question.

Introduction of conclusion

The built environment is among the most significant contributors to climate change and, simultaneously, the most vulnerable (Filho et al., 2019; C40 Cities, 2021; Lin et al., 2021; Hadfield & Coenen, 2022). In recent decades human-induced climate change instigated mitigative and adaptative sustainability ambitions, which stimulated various sustainability transitions to come into existence (Geels, 2005; Smith et al., 2010; De Haan & Rotmans, 2011; and Ernst et al., 2016). Municipalities have been appointed the director role to achieve the stated ambitions by implementing the related sustainability transitions; energy transition, climate adaptation, circular economy, mobility transition and enhancing biodiversity within the built environment (Klimaatplan, 2021; Ministerie van Binnenlandse Zaken en Koninkrijkrelaties, 2022; Programma Aardgasvrije Wijken, z.d..

The public space provides a window of opportunity to assemble the sustainability transitions and simultaneously include these during redevelopment projects such as sewage replacement and renewal (Maring & Blauw, 2018; Esmail et al., 2020; Duivenvoorden et al., 2021; Personal communication I1, I3, I9). While handling these necessary major and expensive redevelopments, an opportunity for embracing sustainable solutions as part of sustainable transitions arises Architecture Workroom Brussels et al., 2020). In recent years, across the Netherlands, pilot redevelopment projects in the public space were used as a breeding ground to introduce innovative solutions in the conservative municipal organization (Van Winden & Van den Buuse 2017; Personal communication I1, I7, I8 & I9, 2022). However, despite the window of opportunity, applying sustainable transitions within the public space encounters many difficulties and progresses slowly (Leeuw, 2019; Bestuursacademie Nederland, 2020; Ministerie van Binnenlandse Zaken en Koninkrijkrelaties, 2022). The “successful” sustainable solutions in redevelopment projects are not scaled beyond pilot projects (Van Winden & Van den Buuse 2017; Personal communication I1 & I7, 2022).

Learning from the applied sustainable solutions, scaling up to other redevelopment projects, and competing with unsustainable solutions is limited. Causes Dutch municipalities are falling behind in achieving the stated sustainability ambitions for 2030 & 2050

Successful sustainable solutions in redevelopment projects are not scaled up beyond pilot projects; it is stated that learning from the niche innovations, scaling up to other redevelopment projects, competing with non-sustainable solutions and eventually altering regime levels is limited.

Successful sustainable solutions are limited to other redevelopment projects within municipalities. To enable "learning" tracking of implemented sustainable solutions performances in redevelopment projects provides insight into the functioning of the implemented sustainable solutions. To track sustainable solutions performances, adopting a robust, systematic, and integral perspective for effective monitoring and evaluation of progress during the implementation of sustainability transitions in urban redevelopment is advocated (Klopp & Petretta, 2017; Tapia et al., 2021; Papageorgiou et al., 2021). Therefore, the concept of Monitoring and evaluation concept is explored in this study to indicate the performance of niche-level innovations and align with the prevailing regime's expectations.

Therefore, this explorative study aimed to:

Clarify why the implementation of sustainability transitions among project managers of municipalities is lacking and develop a robust, systematic, and integral system for robust and effective monitoring and evaluation to enable learning.

The aim of the study has been translated into the formulation of four sub-questions.

Answering Sub-question 1

What is causing that sustainability transitions are not implemented in redevelopment projects, and why is it important?

What is causing that sustainability transitions are not implemented in redevelopment projects?

Interviewees indicate five identified potential reasons causing that sustainability reasons are not implemented in redevelopment projects.

- Conflicting objectives within the public space
- The complexity of sustainability within the municipal organisation
- Applicability of sustainable transitions and related solutions
- Complex municipal organisation
- The opportunity and pitfalls of pilot projects

When sustainable solutions are implemented, it occurs within the safe environment of a pilot project. However, as multiple interviewees indicate, there are limited lessons learned from the pilot projects. Causes that municipalities cannot learn from sustainable solutions, scale up beyond pilot projects, compete with non-sustainable solutions and eventually alter regime levels. The indicated approach to "learn" from these pilot projects and the performance of sustainable solutions to conduct it elsewhere is via monitoring and evaluation. It is indicated that the monitoring and evaluation process will also support the other encountered challenges.

Municipalities have experimented with monitoring and evaluation however is lacking implementation. Therefore, a root cause analysis is performed on literature and interviewees to identify possible causes. Ten

potential root causes have been identified with multiple related causes. In this explorative research, it is impossible to conclude which root causes are decisive. However, among ten identified possible root causes, three causes were repeatedly notified: Governmental/institutional cause, Lacking Parameter & Framework and Basics of monitoring.

Why is it important to address this matter?

It is crucial to address the stated challenges that limit the implementation of redevelopment projects in the public space. The potential of the public space and redevelopment projects is seriously underexposed within the scientific and governmental fields, such as policies and strategies. Therefore, it is plausible to conclude that the problem definition is a knowledge gap that requires attention even though the precise problem definition lacks verification by most municipalities. For instance, it is not even mentioned once in the Climate Plan of the Netherlands, while the sustainability transitions require incremental adjustments to the public space to include all transitions. In addition, around 43% of the urban area in the Netherlands, equivalent to 225.000 ha, is public space. The above and below-ground public space will be under immense pressure in the coming years due to necessary redevelopment, simultaneously providing a window of opportunity to include sustainability transitions. Besides the scientific and political relevance, there are social relevance and dilemmas in the public space.

Answering Sub-question 2

To address the stated problem, a potential solution is inventoried.

What are the essential requirements to compose the Monitor and Evaluation blueprint?

The answering of the sub-question is divided into two sections. First, the outline must be determined to determine which requirements are relevant.

Outline of the M&E blueprint

The first section elaborates on the desired artefact to address the stated knowledge gap by developing a robust, systematic, and integral system for effective monitoring and evaluation to enable learning. A system for monitoring and assessment that applies to all Dutch municipalities is not feasible within the given time; a Monitoring and Evaluation (M&E) blueprint will be developed. In addition, each municipality is different due to size, political perspective, physical circumstances, and specific challenges and has other priorities. Moreover, complicated definitions cannot be provided since different perspectives exist on multiple topics. Despite the required flexibility and adaptability, the standardisation approach of monitoring and assessment tools is lacking. And lastly, technological solutions make it difficult to oversee the possibilities. Therefore, an M&E blueprint will be developed. A sequenced approach includes all appropriate steps, guidance and minimal requirements that a municipality can subsequently follow. In turn, municipalities provide substance to the system with a method for each step relevant to their policies with stated ambitions and existing strategies.

Elicit requirements

It is essential to determine two types of requirements: Structural & Design requirements and Functional requirements**.**

- Structure & Design: Requirements that indicate how the M&E system should be structured and designed

- Functional: Requirements that indicate the functionalities an M&E system should provide. Functional requirements are used to determine the necessary steps.

Three steps were taken to determine the requirements for the M&E blueprint. First, inventory the requirements via addressing the root causes in chapter 3, a structured literature review, three case studies and the opinion of the interviewees. The inventorying resulted in 14 essential Structural and Design requirements to develop and design the M&E blueprint. Besides, 145 Functional requirements are relevant for implementing the M&E blueprint. The requirements were handled in four steps: 1) inventory all requirements, 2) remove duplicates & concise formulation, 3) adjust requirement number & classification, and 4) remove duplicates, add source and determine Structural & Design and Functional classification.

Answering Sub-question 3

How should a Monitor and Evaluation blueprint, architectural and functional, be developed?

Developed M&E blueprint

The M&E blueprint answers the sub-question; it should be developed following the interest and opinions of various stakeholders and consider existing solutions. The M&E blueprint in PowerPoint provides a robust, systematic, and integral process that project managers (operational level) can use in collaboration with the tactical level to create their M&E system that effectively monitors and evaluates applied sustainability measures within (pilot) redevelopment projects. The M&E is robust because it can be applied to every municipality and give it its twist. Systematic because it contains a structured process with steps. And integral because it includes various sustainability transitions that are taking place within the public space.

Functional description

The users of the M&E blueprint are within the municipal organisation. However, determining who should be appointed as the user was complex because it transcends multiple departments and levels. There are three types of users based on the municipality's structure: strategic, tactical, and operational. The tactical level should be appointed as the executive user and support the project managers at the operational level. The tactical level overviews the various redevelopment projects and can quickly provide feedback to both the strategic and operational levels. The project managers on the operational level should use the M&E blueprint. The M&E blueprint enables municipal (project) managers to develop a tailored system for their municipality, enabling them to monitor and evaluate sustainability solutions in redevelopment (pilot) public space projects. Collaboration between the layers is essential.

Implementing the M&E blueprint is related to the project phases of a redevelopment project. The following phases are defined, and associated steps are stated: *Initiation phase:* Step 1 (M&E start assessment & agreements), *Plan study:* 2 (Define Boundary and Key Performance Indicators), 3 (Minimal data requirements) & 4 (Selecting targets), *Plan developing/design phase, Realisation phase* and *Using/maintenance phase*: steps 5 (Monitoring), 6 (Store and Calculate), 7 (Dispatch) and 8 (Report and evaluate). Steps 9 (Sustaining the system) and 10 (Data governance & Safety) should be considered throughout the project phases.

The M&E blueprint delivers a structured stepwise approach to include monitoring and evaluation within the project phases of redevelopment projects. It enables an opportunity to fill the urge to effectively monitor and evaluate applied sustainability solutions in (pilot) redevelopment projects of the public space and alter regime levels.

Architecture

The following architecture is chosen based on brainstorming potential structures in *5.1* (based on requirements for Structure and Design and arguments from interviewees) and subsequently optimised via the focus group discussion.

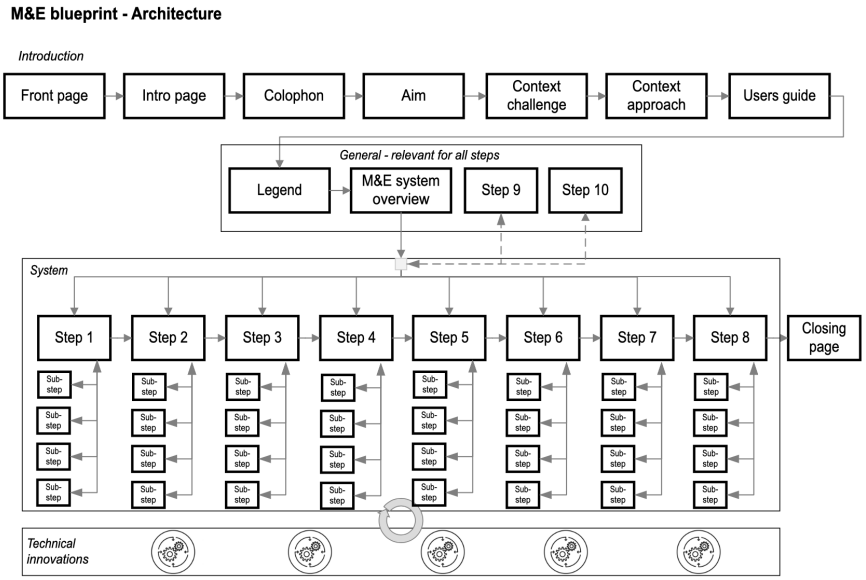


Figure 92 – Architecture of the M&E blueprint (author creation)

Answering Sub-question 4

What are the users' (municipalities) opinions regarding the developed M&E blueprint?

It is impossible to draw any fundamental conclusions on the M&E blueprint based on the six respondents of the survey. This would require additional respondents and especially project managers. However, the survey provided some points of interest. First of all, the recorded video presentation was clear and straightforward. Besides, there is overlap between the identified problems (3.1); at the same time, additional problems are suggested. The suggested problem is mentioned in section 3.1. Besides, it is indicated that the problem that is experienced might differ.

None of the respondents feels that their arguments or requirements (section 4.2 and section 5.2) are missing. Alternatively, the M&E blueprint lacks any (major) features or information. However, the 15-minute video makes it hard to identify missing minor features. Lastly, it is interesting to conclude that all respondents are interested, and most are able and willing to discuss the M&E blueprint further. That might also be the reason that these respondents filled in the survey. The persons who did not respond to the e-mail and reminder e-mail might not be interested in using the M&E blueprint. According to the above-stated elaboration, it is viable to state that the opinions regarding the M&E blueprint are positive to explore and use the M&E blueprint.

Additional respondents' answers must provide sufficient insight if the M&E blueprint addresses the stated problem and meets the stated expectations and desires. However, that was not feasible within the limited time frame.

7.2 Answering Research question

What is causing that sustainability transitions are not implemented in redevelopment projects, and how can a robust and effective Monitor and Evaluation (M&E) blueprint be composed to learn from pilot redevelopment projects, enabling the broader implementations of sustainable solutions?

Multiple reasons are identified that are causing sustainability transitions are not implemented in redevelopment projects in the public space. The following causes are defined; conflicting objectives within the public space, the complexity of sustainability within the municipal organisation, the applicability of sustainable transitions and related solutions, complex municipal organisation and the opportunity and pitfalls of pilot projects. It is stated and verified that pilot projects are vital for the test implementation of sustainable solutions. However, sustainable solutions are not implemented beyond these pilot projects. It is determined that the broad concept of monitoring and evaluation could enable municipalities, especially project managers of redevelopment projects, to learn from the sustainable solutions implemented in redevelopment pilot projects. However, ten root causes have been identified that are causing monitoring and evaluation not to occur yet.

A possible solution is developed to overcome these challenges for monitoring and evaluation, enable learning from these pilot redevelopment projects, and enable the broader implementation. A robust, systematic, and integral system is composed for effective monitoring and evaluation to enable learning. Based on the 14 structural and design requirements, many options exist to compose an M&E system. Each municipality is different due to size, political perspective, physical circumstances, and specific challenges and has other priorities. Therefore, it is chosen to develop an M&E blueprint.

The M&E blueprint in PowerPoint provides a robust, systematic, and integral process that project managers (operational level) can use in collaboration with the tactical level to create their M&E system that effectively monitors and evaluates applied sustainability measures within (pilot) redevelopment projects. The M&E is robust because it can be used by every municipality and give it its twist. Systematic because it contains a structured process with steps. And integral because it includes various sustainability transitions that are taking place within the public space. The M&E system must be used in redevelopment projects to 'monitor and evaluate' the performance of sustainable solutions and learn from it (referring to the ten steps of the M&E blueprint).

The M&E blueprint follows the interest and opinions of various stakeholders and considers existing solutions. The steps are based on 145 functional requirements collected during the explorative study. Based on the demonstration via a recorded video presentation of the developed M&E blueprint, municipal managers identified via a survey the potential of the blueprint to learn from pilot redevelopment projects, enabling the broader implementations of sustainable solutions. However, based on the study, it is impossible to draw any fundamental conclusions about the M&E blueprint. The number of respondents on the survey was too low and representative of all municipalities. This would require additional respondents and especially project managers. However, based on the respondents is viable to state that the opinions regarding the M&E blueprint are positive to explore and use the M&E blueprint. In addition, the M&E blueprint must be demonstrated within a specific municipality to determine if it is composed sufficiently, and which improvements are necessary. Simultaneously to determine improvements, research is necessary on each specific sub-question addressed in this explorative study. Verifying challenges experienced by municipalities and composing the M&E blueprint to address the identified challenges.

M&E blueprint Summary

The conducted explorative study aimed to clarify why the implementation of sustainability transitions among project managers of municipalities is lacking and develop a robust, systematic, and integral system

for robust and effective monitoring and evaluation to enable learning. The M&E blueprint is composed and developed to tackle the stated problem definition in chapter 3. The composing is based on the outline and requirements from chapter 4, and development occurred in chapter 5. In chapter 6, the developed M&E blueprint is demonstrated to municipalities and briefly evaluated.

The M&E blueprint is a separate PowerPoint document from this explorative study. The M&E blueprint is, therefore, a simplification of the results presented in this explorative study. The M&E blueprint consists of the necessary information for all the steps and enables municipal managers to develop a municipal-specific M&E system. The PowerPoint is designed as an application like a system which can be used in presentation mode to navigate through the M&E blueprint. Although, it has to be stated that the M&E blueprint is the first version and therefore requires follow-up studies, demonstration in redevelopment projects to generate feedback and simplification of the information within the M&E blueprint.

7.3 Conclusion of the explorative study

The results of each sub-question indicated a fraction of the main question. A combination of the results would thus answer the main question. However, it is necessary to indicate that the conducted study was explorative to indicate potential reasons why the sustainability transitions in redevelopment projects lack implementation within the redevelopment projects of the public space. Based on the defined problem, a solution is subsequently developed to tackle the identified challenges and enable the broader implementation of sustainable solutions. Since it is explorative, each interim result requires deepening and elaboration.

It can be concluded that multiple challenges need to be overcome. Although, that is part of the transition. In the coming years, the implementation of sustainable transitions and related solutions should be increased to achieve the stated sustainable ambitions in 2030 and 2050. This explorative study has indicated the potential of redevelopment (pilot) projects in the public space to include sustainability solutions and the causes that limit the implementation of sustainability. The first version of an M&E blueprint is created, enabling project managers (operational level) to use it in collaboration with the tactical level to create their M&E system that effectively monitors and evaluates applied sustainability measures within (pilot) redevelopment projects. Therefore, demonstrating the M&E blueprint to a solution that can overcome the stated challenges, implement sustainable solutions, learn from them, scale up to other redevelopment projects, compete with non-sustainable solutions and eventually alter regime levels into sustainable ones.

8.

Chapter 8: Discussion

Chapter 8 discusses the limitation of the conducted explorative study, made alterations and reflection. The limitations of the study are discussed in section 8.1. During the conducted study, multiple substantive alterations have been made in contrast to the presented approach in the submitted research proposal; these alterations are elaborated in section 8.2. Besides the results presented in this explorative study, the MSc thesis stimulates personal development and research capabilities. To enable development, a reflection is provided in section 8.3.

8.1 Discussion on the conducted study

The explorative study is described and conducted as concisely as possible. However, multiple limitations are inflicted with framing the problem, methodology, results, and M&E blueprint that must be addressed. These are partly related to this study's explorative nature and the author's research capabilities.

Approach

As indicated in the preface, for the past 3,5 years, I have been working for a consultant and engineering firm advising Dutch municipalities on how to include sustainable transitions and solutions within redevelopment projects of the public space. Causing possibly that to be biased toward a specific result. Besides, as indicated throughout the explorative study, implementing sustainability transitions during public space redevelopment is scientifical, governmental, and socially underexposed. The amount of literature on framing the problem this study address is limited. Therefore, this study is seen as explorative. And to fill in this information gap regarding the redevelopment of the public space, assumptions regarding the problem definition were initially made. These assumptions were based on my experiences and narrow contact with various municipalities (interviewed in this study). To a certain level of abstraction, it was possible to scope and define the problem with literature. However, the municipal officials had to verify the problem. However, this verification was done in Chapter 3, meaning that chapters 1 and 2 were presuming results and were written toward the verified problem of chapter 3. Due to the explorative nature of this study, it is acceptable; however, it impacts the credibility of the stated knowledge gap in chapters 1 & 2. In addition, since I operated in the same field as the conducted study and made assumptions based on my experience, the study's reliability is also impacted.

Methodology

The used research methodology Design Science Research was not critically analysed. This means that the methodology was chosen because it would fit the aim of the research, and it was used in similar published research papers. However, it was indicated by the supervisors that this research methodology has potential shortcomings. Such as it misses iterative loops to verify the results by stakeholders involved in the study. The methodology was not thoroughly analysed and compared to other methods. Causing that there is a probability that there were better suiting methodologies to achieve the aim of this study.

Six data collection methods were performed to collect needed data. It was not possible to define all required data collection methods upfront. Due to the number of user data collection methods, the results can be ideally verified by data collected from different methods as proposed by the research methodology.

However, due to the amount of other data collection methods within the study period, not every data collection method might be performed as initially thought. They were potentially impacting the validity of the provided results per sub-question.

The methodology's main shortcoming is that it lacks iterative loops from results to the stakeholders. At the same time, an explorative study needs to verify the indicated results among stakeholders. The limited verification is a point of discussion among most of the results below.

Limitation of results

Within the results, multiple limitations are identified and indicated below.

Problem definition

The presented problem definition in section 3.1 is used as a theorem within this explorative study. However, it is essential to consider the following limitations. In adopting the problem definition, merely a tiny fraction of seven municipalities it interviewed. It is therefore unreasonable to represent all 345 Dutch municipalities within the problem statement. Additionally, it is relevant to emphasise that reality is often much more unruly and complex than stated in the explorative study. It is plausible that there are many more aspects/challenges relevant which have not been considered in the definition of the problem.

Root causes

In chapter 3.3, the causes for lacking monitoring and evaluation were provided separately by interviews and literature. Based on these causes, root causes were determined. However, initially, these root causes were not verified with the interviewees.

Outline and requirements

The outline is based on a mix of arguments made during the interviews and literature. However, the chosen outline is not verified by the relevant stakeholders in this explorative study. It causes that each involved stakeholder might not desire the outline.

Multiple shortcomings can be stated when considering the requirements. The inventoried requirements are not verified with, for instance, the stakeholder in this study. Most requirements are derived from case studies. Nonetheless, it is unknown if case studies I & II deliver and function the way they describe. Another limitation is that requirements from the inventorying steps in section 4.2 are derived from a specific case study context, causing the requirement to only be relevant in that particular context.

Developing the M&E blueprint

Regarding section 5.2 & 5.3. The first and second focus group discussions (municipality & consultants) were not further involved after they provided feedback. A feedback loop to participants in previous feedback groups was missing. Therefore, the participants could not observe if their arguments had been considered, nor could they respond to arguments provided in other focus group discussions. This has impacted the reliability of the M&E blueprint because I could be selective by choosing the statements/arguments of participants conforming to my perspective on how the M&E blueprint should be developed and eventually function.

In addition, I included only one municipality within the focus group discussion because this municipality was specifically developing an approach to narrow the strategic sustainability ambitions. The inclusion of only the municipality is not representative at all.

Evaluation of the M&E blueprint

Unfortunately, the number of respondents on the survey was too low to draw any valid and credible conclusions about the M&E blueprint. The provided feedback only indicates possible improvements and positive feedback.

Limitation of M&E blueprint

Functional requirements implementation

The functional requirements are adopted from the inventory in 4.2. Coherence between the requirements was lacking. The requirements were ordered in a logical sequence per step to counter this shortcoming. However, this was based on assumptions from the Author based on the sequence of requirements in the analysed case studies. The sequence of requirements, stated as Approach, is not verified with users or other stakeholders. During the focus group discussion, verifying these assumptions was impossible. The participants could not verify since the concept of M&E within municipalities is underexposed and requires additional attention. The lack of verification reduces the validity and reliability of the indicated approach and requires addressing in follow-up studies.

Lacking examples

The M&E blueprint lacks specific examples, such as principles, persons, agreements, and technological solutions. At this stage of an explorative study, it was not possible to identify such concrete examples. What will cause users might miss the purpose of a step or related sub-steps. If possible, examples from case studies have been included. The lack of examples makes the M&E blueprint distant, intangible and lacks incentives. This would require attention in follow-studies.

Technological solutions

Technological solutions are included within the M&E blueprint to ease or perform a step. The included technical solutions within the current version of the M&E blueprint are minimal. As indicated in focus group discussion 3, IT solutions are challenging to implement within municipalities. There are many non and IT solutions available and applicable to meet the desires of a specific Step. Relevant (IT) solutions could be recommended per step. However, it is not possible within the current stage of the M&E blueprint to identify relevantly (IT) solutions per step.

These limitations require attention in a follow-up study. The following study elaborates on the alterations made during the explorative study in contrast to the research proposal.

8.2 Iterative loops with alterations

During the study, multiple substantive alterations have been made in contrast to the presented approach in the submitted research proposal. The reason for these alterations was to specify the study's focus, which was necessary due to the study's explorative nature, which led to a broad topic. The alterations were iterative since the derived conclusions from interviewees, feedback, and results sharpened the formulation in the preceding chapters and the approach in the coming chapters. Initially, the study's introduction (Chapter 1) was based on assumptions that had yet to be proven. As the preface states, these assumptions were based on my experiences as a municipal sustainability advisor. The general topic, including sustainability transitions and related solutions within redevelopment projects of the public space, is both scientifically and within municipalities, underexposed. Therefore, assumptions had to be altered in a later phase of the project. These alterations aimed to improve the final version of the thesis project and the M&E blueprint.

This sub-chapter clarifies the implemented alterations that influenced the final thesis document and M&E blueprint. This is relevant because this thesis project is seen as an explorative study, meaning that the

modifications of chosen directions or choices in this study could differ in follow-up studies. Besides, the alterations could be further explored in follow-up studies. The eight implemented significant alterations with clarifications are stated below. The alterations are methodology, content or structural related.

Changing approach from triangulation to verification (methodology)

A limitation of the used Research by Design methodology is that it neglects to verify the interim results. Instead, it focuses on using mixed data collection methods, also known as triangulation (Johannesson & Perjons, 2014). The study followed the triangulation approach and led to the initial verification of interim results not being shared among involved municipalities. Therefore, it remained unknown if the interim results, for instance, the problem definition, were recognised by the involved municipalities. After a discussion with the supervisors and provided feedback, it was decided to include verification when possible. It was explicitly introduced in Chapter 5 (Design and Develop M&E blueprint) and Chapter 6 (Demonstrate and Evaluate M&E blueprint). In Chapter 5, the M&E blueprint optimisations occurred with feedback from the focus group discussions. In Chapter 6, a survey was formulated, including questions on the stated problem definition, if specific mentioned requirements in the M&E blueprint were met and if the developed artefact meets the desires of the municipalities. These questions refer to the previous chapters and try to verify the interim results of included participants. This shortcoming is addressed in the discussion as well.

Specify the scope of the study on sustainable solutions (content)

The focus of the study was initially on the Monitoring and Evaluation of sustainability transitions in redevelopment projects in the public space in general. However, after discussions with interviewees and supervisors, it was decided to specify the scope. It was argued that an area-oriented approach did not meet the approach stated in Geels's multi-level perspective transition theory (2002). As discussed in the introduction, the sustainability transitions interplay between landscape level, existing and desired regime levels and niche level innovations. Accordingly, the focus should be on niche-level innovations, such as sustainable solutions to alter non-sustainable regime levels. The area-orientated approach would be too superficial. In addition, interviewees argued that it would be too complex to evaluate the collected data and represent an entire project area. There are too many side effects that should be considered. Therefore, it was chosen to specify the scope of sustainable solutions as part of the sustainable transitions framed as niche-level innovations.

A shift in M&E blueprint users (content)

In the thesis document, a shift occurred on whom would be the ultimate users of the M&E blueprint. It was initially assumed that the users would be the municipal managers of redevelopment projects (operational level) since these managers are responsible for implementing sustainable solutions in redevelopment projects. However, during the interviews and especially the focus group discussion (1 & 2), it was indicated that a municipal manager could not consider all sustainable solutions and stated abstract ambitions within a local redevelopment project. It was argued that the tactical level should be included and supervise the use of the M&E blueprint within the redevelopment (pilot) project of the public space. The steps of the M&E blueprint must be guided from the tactical level, such as by municipal advisors or asset managers.

The potential of Pilot redevelopment projects (content)

In addition to the scope of redevelopment projects, it was determined to focus on the pilot redevelopment project. I discovered by accident how significant these pilot projects are as a “breeding ground” for the inclusion of sustainability solutions as part of multiple transitions beyond the pilot project. My laptop crashed with all transcribed interviews. Unfortunately, I had to transcribe these interviews again. During the transcribing, I encountered many times across multiple interviews that interviewees mentioned that pilot projects were used to "experiment" with sustainable solutions. In these pilot projects, additional budget is available, and solutions may not reach their potential. These experiments aim to learn from the niche level innovations such as sustainable solutions and implement them elsewhere. However, as indicated by interviewees, this learning curve does not currently occur, resulting in the sustainable solutions not being implemented beyond the pilot projects. Therefore, monitoring and evaluating these (pilot) redevelopment projects became essential.

Dividing requirements (content)
After feedback from the supervisors was determined to divide the inventoried requirements in sub-chapter 4.2. It was decided that the requirements would split into Structural & Design requirements and Functional requirements. The number of requirements (145) made it incomprehensible to determine which requirements were relevant for constructing the M&E blueprint and which were appropriate for the content. The requirement was divided per inventory step in Chapter 4.2

Restructuring activities chapter 5 (structural & content)
The four sub-activities in Chapter 5 were altered during the data collection of Chapter 4. During the interviewees with municipalities, it was hard for municipalities to imagine how sustainable solutions should be monitored and evaluated in the desired future situation. Therefore, the original second sub-chapter (Assess and Selecting), as proposed in the methodology by Johannesson & Perjons (2014), is absorbed in the combination of the sub-chapters; Develop prototype from sketch (5.2) and Justify and Reflect (5.3). Instead of using criteria preformulated by the users, sub-chapter 5.2 and 5.3 co-occurred, allowing subsequent development of the M&E blueprint via optimisations.

It was chosen to perform a solo imagination and brainstorming on the architecture and functional design. The generated ideas are optimised using the feedback from municipality managers, consultants, and developers to build a prototype. The arguments are weighed against previous statements during the various sessions and are substantiated why they are refuted or accepted. Thus, the sketch was simultaneously optimised multiple times to a prototype and justified and reflected upon.

To conclude, the *assess and selecting* sub-chapter was replaced with activities that optimised an idea to a sketch via multiple sessions to a prototype and finally to a first version of the artefact.

Mentioning transitions in the introduction (structural)
After receiving supervisor feedback, it was chosen to extensively clarify the sustainable transitions within the introduction instead of Chapter 3. It was argued that the thesis document's reader should immediately understand the sustainability transitions addressed in this study. The relevant sustainability transitions in the public space were based on the interviewees' input, which was part of the research methodology for sub-questions 1 and 2 (Chapters 3 & 4).

The interview results elaborated in Chapters 3 & 4 were used to describe the transitions in the introduction. Initially, the determination of relevant sustainability transitions was based on assumptions and literature which had to be proven by municipalities. Thus, the elaboration of transitions in the introduction was included after the formulation of sub-question 1 and 2.

Mentioning Case studies in the introduction (structural)
Initially, the three case studies were introduced in Chapter 4.2. However, as discussed with the supervisors, the case studies provide proof of the potential for monitoring and evaluating sustainability. For municipalities, monitoring and evaluation were seen as challenging to implement and achieve at the time of interviewing (March/April 2022). Besides, these case studies provide significant input in the designing and developing of the M&E blueprint. Because of the prominent role case studies have within this study, the cases were introduced in the introduction.

8.3 Reflection

For the past two years, during the MSc MADE program, we performed research in groups, and during the MSc thesis, I performed for the first time a solo study. I have a practical background (bachelor's at the

university of applied sciences), where I did not conduct research. During the writing of the thesis, I had to encounter multiple obstacles. These obstacles are formulated below. With each obstacle is described how I handled it during the thesis phase and how I will try to prevent it from occurring following time.

Verification

Verification is the essential element I learned while performing the explorative study and writing the thesis. Verify the approach, knowledge gap, methodology, results or M&E blueprint. Verifying involved stakeholders is crucial in addressing a problem and delivering desired results. A follow-up study should revolve around verification.

The size of the thesis and conducted study

I chose this specific topic, Monitor & Evaluate the impact of sustainability solutions in redevelopment projects of the public space, as my MSc thesis topic because it is a challenge I encounter on a daily base. However, I became overconfident in addressing the broad knowledge gap as indicated in the introduction and specifically in chapter 3 within the given period. It was an immense effort and took some time to elaborate on the explorative study. And still, I have not been able to cover it all sufficiently. Therefore, in a follow-up study, I need to scope the project to an achievable extent and discuss this with supervisors and colleagues.

Pre-study & choosing supervisors

I did a pre-study to determine the relevant topic and contacted potential supervisors. The pre-study stated that the MSc thesis was preliminary, focusing on the concept of IoT to monitor and evaluate the impact of sustainability solutions in redevelopment projects of public spaces. Based on these presumptions, I contacted supervisors. However, as turned out during the research proposal and study, there is a considerable knowledge gap regarding redevelopment in the public space, sustainability in the general area and monitoring and evaluation. The lack of information made it impossible to remain focused on the concept of IoT. Therefore, it was chosen first to conduct an explorative study to identify the knowledge gap and highlight the possible steps to address it. In a follow-up study, I should invest more time in the pre-study to define the knowledge gap and consider the available information.

Critically select methodology

Since it was my first-time solo conducting a study, I was not critical in selecting a research methodology. Causing that after a while, I had to counter multiple shortcomings (as discussed in the discussion) that could have been prevented by assessing the possible methodologies critically. In a follow-study, the critical selection of the method requires additional attention.

Limited feedback

During the conducted study, limited feedback was provided. Causing that I was left on my own in this study. I should have asked my supervisors for more feedback at the beginning of the thesis phase. Besides, I could have discussed it with students or colleagues more often. Verifying if I was on the right track and brainstorming on tackling obstacles during the explorative study.

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Appendices

Appendix I - Interviews

Every Dutch municipality has formulated sustainability ambitions that are in line with the (inter)national mitigation and adaptation ambitions. Redevelopment projects in public spaces have been identified as the ideal opportunity to combine renovations and at the same time realize sustainability ambitions. Municipalities implement 'sustainability' measures in renovation projects, but the impact of these renovation projects on municipal sustainability goals is unknown. Local monitoring and evaluation are therefore crucial. However, there is a scientific and practical knowledge gap here. Despite many scientific efforts, there is still a lack of a systematic Monitoring and Evaluation framework for measuring sustainability in public space redevelopment projects. And to give substance to this, I would like to ask you some questions. My goal is to develop an ideal monitoring and evaluation framework that can be used to record impact. and thereby evaluate policy, policy and measures

Q1: What's your function? What kind of projects does that include?
Q2: Do you work on public space projects?
Q3: What do you think is the importance of public space?
Q4: How are those projects related to sustainability?
Q5: Is this in line with the municipal sustainability ambitions? What are these ambitions based on
Q6: Do you also have sustainability goals in your projects?
Q7: Do you check whether your projects/municipal objectives are being achieved?

If answer yes
Q8: How do you check?
Q9: What's going well with monitors?
Q10: What could be better?
Q11: Why isn't this happening yet?
Q12: Do you evaluate project outcome monitoring?
Q13: How do you do this?
Q14: What's going well with evaluation?
Q15: What could be better?
Q16: What do you think is essential for adequate monitoring?
Q17: What do you think is essential to be able to evaluate adequately?
Q18: What do you think are the biggest barriers to adequate monitoring and evaluation?
Q19: Do you have any recommendations for the study?
Q20: Can you recommend colleagues for whom an interview would be interesting?

If answer no
Q8: Why don't you check this?
Q9: Do you think this is necessary to check?
Q10: What do you think are barriers to doing this?
Q11: How could an M&E system help with this?
Q12: What are the minimum requirements of such a system?

Personal communication, I1, 2022

Sustainability

It is of course the standard tune People Planet profit. However, I see that it's often very technical and object-oriented, while the social side is often underexposed, so to me it's the broad definition of sustainability. So, how can we all, humans and not humans, take advantage of it in the future and live a good life on this planet. It is not just about sustainability, because the natural systems remain intact. But that social aspect gets attention, and not one of them takes off with the win.

Transitions

- I often see that the technical solutions for all the transitions we are dealing with are clear. But that's only one side of the story. The social side and the social domain are quickly forgotten. We can make all homes more sustainable, but how do we ensure that everyone actively participates and that it is financially feasible for everyone? In this way you will find subsidies, regulations, but also acceptance and participation.
- Moreover, within the public space we have to deal with conflicting objectives. For example, many municipalities want to make the city greener. But then you have to deal with a parking standard of 2.2 and the occupancy rate of 0.75, which they do not want to change.
- Some people have too much power which hinders change.
- Many municipalities want to make the city greener. But then you have to deal with a parking standard of 2.2 and the occupancy rate of 0.75, which they do not want to change.
- In addition, the entire subsurface is full of cables and pipes that cannot be moved because they have not yet reached the end of their life cycle. Then the integration of the various assignments goes wrong and the different domains also get stuck.
- In addition, we all have a different view of sustainability.
- Everyone really wants to move forward, but you have to make fundamental choices that hurt, such as a parking ban. We are really in a time where we have to make some very fundamental choices. That is not very pleasant for politicians, because you know that it will cost your job as a politician if you make really fundamental choices.
- Transitions start with niches where changes take place, and if they are successful, they continue. Ultimately, it speeds up and creates a system-level structural effect. So I think these kinds of complex changes work on many levels at once, in many domains, always through small things or niches first.

Pilots

The only problem is that it is teeming with experiments, pilots and living labs. But what we do not have in order is the learning capacity of these pilot projects. We close a pilot and move on to the next pilot. We must learn lessons from such a pilot or experiment with an evaluation framework and disseminate the information. Otherwise, the next person is just reinventing the wheel. That learning effect, because that's what they're intended for, we experiment to see if it works and what we can learn from it to scale it up or apply it elsewhere.

Ambitions

In the 1990s, a company developed several approaches in which they explained the different uses of the space and the quality it produces. That is project dependent and context dependent. At the front end of the project, they determined when they felt the project was a success. This works better than saying what is everyone's definition of sustainability. By doing it, you will find that there are different interpretations. You have to be alert to this; otherwise you'll run into it, and you'll get huge fights just very instrumental if it's about overrated or something about standards.

Monitoring

What I see is that technical tracking doesn't always work. Because people's perceptions can be very different
We are bursting with data, but how do we handle it smartly? When you talk about monitoring, it's also just a question: is the data we collect enough or do you need other data, and how do you get it? Do you also need to do crowd source data? Those would all be questions that still remain.

Public space management – Practical - Scientific

- There is already a lot of knowledge about public space, but not explicitly aimed at management. That's what we see. Public libraries have been written about the energy transition. When it comes to planning and

design, there is much more to an integrated approach than to management. Due to the knowledge gap in the management of public space, we have set up the Managing Public Space foundation with the accompanying research program. It is still relatively underdeveloped to look at it from that management perspective.

- We didn't decide ourselves that we wanted a public space program manager; that is what municipal administrators of the municipality have come up with from practice. They said they're stuck and don't know how to do it
- do, and that they don't have the people who have the necessary level of thinking to think about it properly.
- Initially, we did the initial exploration, and then you went looking for the knowledge gap, which turned out to be some kind of deep-sea trough. There is just a lot that is not yet known.
- Public space managers lack knowledge and expertise to tackle the challenges in public space and, for example, sustainability.
- As you see more problems and more complexity, we can say it's a wicked problem. Of course then the tendency is to talk very loudly; this is so complicated that we can't solve it. But of course you can do something. It's just not the case that there is only one solution. There are multiple solutions, and they all have pros and cons. That is characteristic of wicked problems.

Tackling wicked problems in public space

But that's my impression from what I've seen so far. The context has changed every time. The people are different; the assignment is different every time, and the physical spaces are different. So literally nothing compares one to one. You always have to make it specific and not only physically but also socially specific.

M&E blueprint

So that's what I just referred to; I think it's not so much about a fixed framework but more about a procedure on how to arrive at such a framework. That is in any case project-specific and another area-specific procedure that you have. A framework in which you clarify a project is an approach in which the result is slightly different every time. That procedure may differ slightly depending on the situation. Keep it simple.

Research approach

You can approach this in two ways, or you can get over it, and you do a kind of exploration, then you don't have to go that deep. Or you take an aspect and go in depth. In a field where not much is known yet, such as the management of public space, it is often the tendency to first get an overview.

Personal communication, I2, 2022

Public space

Public space is a place that serves the functioning of society. The public space is a place where people can move and stay. But giving can also add a lot of value and contribute to other goals. So we have social goals like social cohesion and the like, but you also have economic goals. For example, it has no monetary value because transport can take place. Nevertheless, the design and management of public space can also affect the private properties adjacent to that public space, which can increase in value. This means that with the management of public space you are not only responsible for the public space itself, but also in the service of other people and their private property. This can also be negative; for example, the value of a house can fall economically. But it can also affect the functioning of the private properties themselves, such as making sure that they don't overflow because you have ensured that the water in public spaces is drained.

Transitions

- In the social and technical transitions you see that a social transition goes much faster than the technological transitions.
- Public space is a place that serves the functioning of our society, which states that it facilitates both technical resources and technical needs, and at the same time also the social need, i.e. the non-technical such as social cohesion, social security. The whole ride that you get inclusivity is that you can participate in society, you can stay there, it makes you healthy, all those things.
- The sustainability transitions have major physical implications for public space, all the more so because they have to be realized mainly technically in public space.

- In any case, I see social sustainability that public space can facilitate by creating a meeting place.
- It is more that there is a social component in all these transitions. In practice, a lot of thought is still being given to the quantitatively measurable elements. What are the technical factors? It is not the case that there is still a social transition next to it. Is that this social component occurs in all those transitions, but is relatively underexposed in the management of public space.
- The social aspects have a faster turnaround time than the technical aspects

Public space management

- Public space must always serve the values we want to pursue. Yes, one of those values is now sustainability. It could be something else in the future.
- You especially see that the management world is underexposed.
- Governance is at the service of the political system. Management is not very aware of the political choices they make.
- Because the challenges within Dutch management are currently too much focused-on implementation and too little politically aware, only the competences of the implementation and management group are that they cannot think strategically. If you can't think strategically, you could never make the political translation. In the long run, it will be a challenge to determine whether you will achieve your goals.

Barriers to Monitoring and Evaluation

The lack of knowledge about monitoring has to do with the lack of understanding, for example, of what those social components are. Because we know that they are there, and the municipal authorities know too little about them. But we don't know exactly what all these are.

Monitoring and evaluation blueprint

What you are going to develop monitoring and evaluation system should become more of a process.
A certain political perspective (social justice, utilitarianism, liberal vision) means that different design criteria are relevant to your system with a specific perspective. For example, in Social Justice design everyone is entitled to the same public space of the same quality. With utilitarianism, for example, you place greenery in places where you have the highest value for society as a whole. From a liberal, you'll look more like we're going to identify the green on some main structure, so the law of the fittest.

Approach thesis

Approach and emphasize your thesis on a large scale and be explorative.

Personal communication, I3, 2022

Sustainability (transitions)

- We quickly apply sustainability during the maintenance that is carried out and which machines are used.
- The market must be challenged to become more sustainable through benefits, for example, financial.
- As a management department, we also investigate sustainability transitions and their application. For example, we can switch the electricity grid to direct current to apply the energy transition. We always had a budget for this.
- We have learned that naming transitions and objectives and not elaborating them concretely in appealing examples does not work. For instance, no biodiversity solution will be applied without a clear example of what biodiversity is.
- We feel that in one transition, such as in biodiversity or climate adaptation, we can have much more input than, for example, in the energy transition. We are not a network operator, only the owner of the space.

Public space management

- Above all, we tried to challenge the contractor to become more sustainable. For example, the contractor receives a price advantage in a tender if he applies sustainability measures.
- We as a management department are very conservative; for example, you think that disconnection should occur here, but who will maintain the mud pool that can arise.
- Management sometimes asks for conflicting choices about sustainability transitions. Here we ran into the sewage system. That sewer could be renewed, making it much smaller, but this is 75% cheaper than replacing it. In the context of climate adaptation, this can lead to problems with water management.

Monitoring and evaluation

- The considerations about management and sustainability are not yet sufficiently substantiated because parameters and specific indicators are still lacking.
- If clear parameters are missing and an unsustainable measure is much cheaper. Then sustainability is the first thing that flies out the door.
- Sustainability must be placed more emphatically and more specifically on the policy agenda. I see this is achieved faster with daily maintenance and management than with the replacement specification. Because it can be done with relatively small measures, you can use it in daily care, including applying environmentally friendly paint on a bridge pipeline. You do it in the replacement assignment because you quickly achieve circularity and reuse.
- At a strategic level, real attention must be paid to sustainability.
- Each target group (strategic, tactical and operational) is entitled to, for example, its dashboard with results. The result must be tailored to the target group.
- Until now, monitoring has mainly focused on technical inspections and experiences. How residents or users experience the public space. Reports in the general general general public area are used to break things down to perception measurements (Citizen Science). That is very specific to how you experience the sustainability objectives, which is done via a survey.
- The municipality has not had such a positive experience regarding specific sustainability goals.

Additional minimum requirements

- The entire organisation needs to be involved and not just a sustainability manager.
- It is essential to give a representation of the whole process.
- Let's look beyond the direct contacts and put the responsibility on those who have to make the decisions.

Personal communication, I4, 2022

Public space

The public space is where a city functions, where people move and meet each other, where nature can develop, and sustainability also plays an important role. The public space is also focused on the vital systems, i.e. the lifelines of the city, so what is considered normal.

Sustainability transitions

When I talk about five transitions, I'm always talking about the energy transition; which is looking for new energy systems—the mobility transition means fewer cars, more bicycles and an active mode of transport. Circularity is not an end in itself but a kind of means to achieve other goals. But economic use of our raw materials and subsequent reuse of raw materials is practically reflected in projects. Biodiversity is a high objective to increase the species richness and robustness of the natural systems in the city. And climate adaptation. But that's more about responding to what's coming our way, but they're also robust about water conservation and water safety issues.

I think the transitions are central everywhere, but the attention in other municipalities may be slightly different. The degree differs per city, and you also see a big difference in implementation between those five transitions.

Ambitions

- Defining ambitions is at a generic level, and if we look at the transitions. In 2030 we must use 50% less fossil raw materials. Ten target species for biodiversity should be central, so statements have been made about species at the meta-level. But there has never been a baseline measurement, so you don't know what that 50% means.
- The ambitions all remain pretty abstract.
- Having all those individual goals is nice, but tensions arise with concrete projects in local areas. For example, in the case of biodiversity, you would like to have rough grasses, but from another point of view, you want all entrances to be lit for social safety.
- Checking whether ambitions are realised is still in its infancy. Generally, at the start of a project, we collect as much as possible what all aspirations are. This works well within the tubes of all groups. But it doesn't go well when you talk about those transitions. Because all those transitions are organised separately and have

separate programs. In addition, many of those transitions are not yet ready to properly determine what is possible at a particular location.

Monitoring and evaluation
Recording progress during projects is essential. What is being achieved in terms of KPIs? We often see an imbalance between the high abstract goals and what can be applied locally in projects.
In an individual project, it can be established what has been achieved. Only for one area is less CO2 emissions or an improvement in biodiversity dependent on many external factors and can only be measured on a larger scale after years. This isn't happening now when it should be.

- This is partly due to the municipal organisation's fragmented departments and transition programs.
- The minimum requirement for the M&E would, in any case, be a multi-year programme.
- It takes into account confounding factors that affect the results
- It also has to be in all kinds of places in the city. An area-oriented approach is necessary because the city centre differs significantly from a garden city or packing area.
- I would also keep it out of the administrative wind. These transitions all have a lead time of several years, and if there is a director who sees terrible numbers, he can stop it or negatively influence it.
- In addition to sub-areas, also on the main structure in the city

Personal communication, I5, 2022

Transitions
I see circularity returning as a transition within the municipality, so using materials is an essential aspect of sustainability. In climate adaptation, we look at the prevention of desiccation and the prevention of flooding due to wet situations; heat stress plays a role in this. But we also look at related issues, such as the digitisation and development of 5G and glazing in public spaces. These are general developments of various elements. We must not forget biodiversity and, for example, mobility and the energy transition; these must also be completed.

Ambitions
We intend to examine the results of our projects. That is also a search for which objectives can be formulated based on ambitions established at the strategic level (management). I haven't been with the council for a long time. Still, in the run-up to the elections, the board has recently started to become a bit hesitant board has recently begun to become a bit hesitantdubious about the run-up to the election polls.

Monitoring and evaluation (requirements)
- If we can provide insight into the impact of our activities, we can gain citizens' trust.
- It is good to provide even better substantiation of our approach and activities. I am convinced that it is good to make things visible. After all, the unknown makes unloved anyway. So both physically visible and active outside. I think that's one of the most important things.
- But we also share and display the right correct information in a digital world. This is what we as a government are guided by.
- There is much local knowledge; it is necessary to acquire it. I think it's good to work there with a platform where people can also express their ideas in a good way and see that they are listened to.
- Projects are already evaluated based on predetermined objectives. I assume that evaluation is part of that cycle of activities. In our systems world, it's often Deming's plan-do-check-act circle and isn't quite round. We are still very good at doing and planning things, which is relatively easy for us, but checking and acting are often underexposed.
- This is seen as even less relevant and an obstacle to progress. It's time-consuming. It would therefore help to do as much automation as possible.
- Most importantly, we talk to each other and have the resources to facilitate that. This also allows us to reflect on policy.
- In general, you see that participation and participation have the necessary impact on projects in terms of lead time. And the challenge in this, I think, is to communicate promptly, certainly as a municipality as a government in general, about intended plans and the starting points used.
- It must serve a purpose; if it is formulated in advance, there is a risk that you will want to collect too much information and thereby lose the effectiveness and efficiency of your registrations.

- The political wind must also be involved in the monitoring and evaluation.
- It must provide insight on a strategic, tactical and operational level. It is essential to determine what is being contributed and towards which objectives. But the hierarchy in this should be clear: in this way, we have included this indicator at the parent level.
- Ultimately, a particular system must be robust to ensure continuity.

Personal communication, I6, 2022

Sustainability transitions

- We can distinguish the following transitions: climate mitigation, climate adaptation, circularity and then biodiversity and living environment as a whole, so that includes air quality, but also odour nuisance and wind nuisance – including mobility.
- Sustainability is often introduced too late in the process.
- Sustainability is still too non-committal.

Ambitions

- We have set goals, but they are sometimes vague and not concrete. There are no precise indicators attached to it, which can be frustrating. Setting the ambitions always happens at a different level than the people who have to implement them. So you can set up a highly climate-adaptive street, but if you don't know how much heat stress is reduced or how much water is stored or drained, you don't know what the effect is. This is partly due to indicators we do not have clearly. Only for co2 because it is required by law and recorded in our policy documents.
- The translation of the very woolly part of we must meet something specific. That ambition is there, but how you translate this into practice, that step has not yet been taken.
- For example, we now report percentages on projects that colleagues or we have done sustainably, but nothing else happens as long as it is considered good enough.

Public space management

- We are busy but don't know what we are doing or the effect.
- Public space is a bit of a lost child regarding sustainability.

Monitoring and evaluation

- We also make an annual evaluation. This also includes a so-called sustainability monitor. There is also much attention to mobility, i.e. how much has been emitted, for example.
- For our real estate, that is very fixed. But on projects in the public space, the sustainability goals are much less fixed there, and we have much less guidance.
- Our goal is to emit 49% less CO2 by 2030 and to close the ground balance more. But we never started monitoring, so we have no idea how we do that now.
- There is no baseline measurement or monitoring.
- I spend a lot of time on co2 monitors. The most popular indicator you can think of.
- Coming up with an indicator for an objective everyone agrees on is already tricky.
- The second concerns monitoring; where do you get all that data from?
- There is also the will and the pressure. If you've built a charming green street, why would you want to add something of a number to it? In any case, it looks good.
- Indeed, in a larger city, you have to deal with many connections within the municipality. They must all speak the same language.
- The political movement also influences to control something, for example.
- Nothing will happen if the municipality does not consider it essential, and therefore a budget is released.
- Difficult to decide what to focus on right now
- It would be relevant for us to know which buttons we can turn to get sustainability along.
- You can evaluate it somehow, but of course, they ask what you will review and what you consider essential, what weight you attach to it and how long is the run time.
- We do many pilots, but those pilots remain pilots. We have done many pilots, but we are not learning from them. We cannot guarantee the results and may have to handle them differently. Otherwise, we will not progress.

Personal communication, I7, 2022

Public space

- The importance of public space. It is the connecting space between the usually several buildings. So people travel from one place to another through public space. You can also stay there. All kinds of functions can be added to it. It offers underground room for all cables and pipes and allows trees or other greenery. Also, for animals, you name it. The public space is truly multifunctional.
- More and more space is being reserved for transitions such as energy transitions with the cables and pipes in public areas.

Transitions

- I am very involved in climate adaptation. In addition, the energy transition and use of materials. That also means a circular economy. Mobility and biodiversity are also expressed to varying degrees.
- We have a matrix organisation. We, therefore, work with a standard policy and have assignments, the essential points that politicians appoint. Thus, these tasks are at odds with the line organisation. To this end, a program organisation has been set up to organise these transitions and support them with knowledge and expertise.
- The transitions are applied at different rates. This is due to the complexity of transition changes. For example, the energy transition must first be determined at the regional level. In addition, a heat network, for example, is a much larger, more significant investment than, for example, biodiversity.

Ambitions

Politics is leading in what the focus is on.

Monitoring and evaluation

- We thought, why should we first consider everything, for example, what those objectives should look like and what exactly the values we have to achieve. At the same time, we conducted a stress test and drew up an implementation program and how to assess it. So go measure. We're not done yet, but in the meantime, we've said we're going to experiment with all the projects we're working on and what's working and what's not. So not as an imposed objective, but with what are we going to do and what is possible. I also looked at what extra it takes to make it happen. So we've seen that as a learning process for the past four years.
- In the context of the Environment Act, we will have to monitor more and more.
- We have ongoing monitoring studies. I must say that we have also evaluated projects where things went wrong. This was especially the case because we had not communicated well with residents.
- We also poorly controlled several climate-adaptive measures, such as semi-paving. As a result, managers have resisted re-monitoring and evaluation over the past decade.
- We need to see how measures work when applied and after 5 to 10 years.
- For example, for biodiversity, a good baseline measurement is still missing. This makes it difficult to set goals.
- People are often not waiting for measures in their streets.
- Municipalities are not used to and may not be equipped to monitor and evaluate properly.
- One possible way to define goals is asset management tracking. We are already drawing up KPIs for this and looking at what is going well and is not going well with assets in public space.
- For example, we have been monitoring groundwater for 25 years because it is essential for our municipality. So there is an urgency to monitor.
- For example, in new projects, we are now going to will monitor and evaluate CO2, nitrogen and infiltration capacity. But this is still an experiment.
- It is acceptable for politicians and residents if we measure how we make choices.

Minimal requirements

- The processing time of monitoring is essential to take into account
- It is undoubtedly worth considering the cost; when it gets expensive, it's less attractive.
- System security is essential; it should consist of security features.
- Moreover, it should not be too complicated; we all need to be able to deal with it. For example, consider ArcGIS.
- It can also be a learning process and may require a culture change.

Personal communication, I8, 2022

Public space management

- We are involved in the design of the public space of streets and squares. This also applies to objects such as bridges. We mainly have new bridges. We don't have that much maintenance, but we do have quays and remediation, so we mainly focus on sustainable implementation, i.e. intelligent and clean working.
- The public space consists of roads, paving materials, squares and fields. Not the private lots.

Transitions

- We focus on five Planet themes; energy transitions, raw materials and materials, biodiversity, water (climate adaptation) and mobility. Here we have set ambitions for plot level and proven building plans. But also at a regional level. We also try that intermediate phase to see whether these goals have been achieved.
- An essential first step in achieving sustainability within any project. Within a municipality, several links must all be included.
- And that starts before the design phase. Transitions must already be included in this phase. Sustainability must, therefore, already be included in tendering and design.
- The conceptual framework has been drawn up to determine what we mean and have in mind with, for example, circularity. Ideally, LCA and MKI values can also be linked to this.

Ambitions

- Of course, we also show that we have achieved those goals.
- The smart goals we put together for each project cannot be reused. I run into that.
- I design the public space with 80% of circular materials.

Monitoring and evaluation

- The actual measurement of the targets set is still lacking. But we also have to do this together with parties and other departments.
- I think the benefits are already there if you can provide insight into objectives and ambitions up front. With which the design can be tested against, for example, circularity requirements or other sustainability requirements. For example, designers can also learn from this and incorporate principles into a subsequent project.
- The materials used as standard in the public space of the municipality have been worked out according to weight. Based on this, you can then get the percentage of which percentage of the public space is circular. Of course, there are still some hooks. We then also want to translate this monitoring into a design. With which designers can see how much % circular their design is. This can then be evaluated for further improvement.
- This is currently being applied in a specific project and can be seen as a pilot. It is the intention that the results of this pilot will be applied throughout the city. That is why monitoring and evaluating the applied transitions is so important. This way, you can learn and use it elsewhere.

Personal communication, I9, 2022

- The organisation is a matrix organisation; therefore, transitions transition at right angles. A sustainability program is a new branch of sport in this.
- The following topics are seen as part of the sustainability transitions. Energy transitions, circular economy, biodiversity, climate adaptation and mobility. These transitions require space in public space. However, it is already hectic here, so that requires coordination, especially in densely populated areas.
- There is also overlap between these transitions. They are not separate transitions.
- It is interesting to piggyback on the management tasks for these transition tasks. The manager is in control; they don't realise it yet.
- A roadmap has been drawn to integrate these transitions into public space and municipality-wide.
- There is partial monitoring. What strikes me in the sustainability world is that it is mainly based on healthy hobbyism and idealism. Lots of pilots, and let's try. co2 has been made reasonably transparent. For example, when we look at CO2 monitoring, it is often difficult to determine why a particular result is there. What were the relevant factors in this result?
- The actual linking that contributed to my measure slightly is complex. This can be easy to measure for energy but difficult for other actions; this is how my city has become climate-adaptive.

- Municipalities often try to link static data, citizen science and symbol monitoring. So the wolf is back in the Netherlands. That's an excellent symbol. That says more, for example, than that we have improved biodiversity.
- The monitored data is also evaluated. For example, we look at where we were four years ago.
- We don't go through a daily run but look at where we are now every year. And we evaluate that. Then we look at how we can improve certain things.
- How specifically we monitor and evaluate depends on how important it is at a strategic level.
- Monitoring is more than numbers; for example, it can be about symbolism or other numbers.
- Accountability is important. Sustainability is very much about behaviour; gaming is fun. That game element should be used to collect behavioural information. The gaming element is still underexposed.
- I would rather have four transparent indicators than fifteen that are not good.

Appendix II – Literature reviews

	Authors	Year of publication	Cited By	DOI	Catagories
1	Enayat A. Moallemi, Shirin Malekpour, Michalis Hadjikakou, Rob Raven, Katrina Szetey, Dianty Ningrum, Ahmad Dhiaulhaq, Brett A. Bryan,	2020	16	https://doi.org/10.1016/j.oneear.2020.08.006	1. Inclusion of stakeholders
2	Hasan A.M. Hamdan, Poul Houman Andersen, Luitzen de Boer,	2021	4	https://doi.org/10.1016/j.scs.2021.102776	1. Lacking governmental action 2. Failing of assessment tools
3	Johannes Halbe, Georg Holtz, Sampsa Ruutu,	2020	10	https://doi.org/10.1016/j.eist.2020.01.008	1. Complexity of transitions
4	Christina Theodoraki, Léo-Paul Dana, Andrea Caputo,	2022	1	https://doi.org/10.1016/j.jbusres.2021.11.005	1. Research gap
5	Chris J. Martin, James Evans, Andrew Karvonen,	2018	158	https://doi.org/10.1016/j.techfore.2018.01.005	Remove
6	Jean-Baptiste Bahers, Aristide Athanassiadis, Daniela Perrotti, Stephan Kampelmann,	2022	0	https://doi.org/10.1016/j.landurbplan.2022.104376	Remove
7	Thomas Bauwens, Daan Schraven, Emily Drewing, Jörg Radtke, Lars Holstenkamp, Boris Gotchev, Özgür Yildiz,	2022	2	https://doi.org/10.1016/j.rser.2021.111999	1. Lacking parameters & framework
8	Helena Solman, Mattijs Smits, Bas van Vliet, Simon Bush,	2021	10	https://doi.org/10.1016/j.erss.2020.101876	Remove
9	Igor Martek, M. Reza Hosseini, Asheem Shrestha, David J. Edwards, Stewart Seaton, Glenn Costin,	2019	15	https://doi.org/10.1016/j.jclepro.2019.03.277	1. Lacking parameters & framework 2. Lacking monitoring approach
10	Ebru Susur, Emrah Karakaya,	2021	4	https://doi.org/10.1016/j.eist.2021.02.001	1. Complexity of transitions
11	Aleid C. Groenewoudt, Henny A. Romijn,	2022	1	https://doi.org/10.1016/j.eist.2021.10.027	Remove

12	Stefano Poponi, Gabriella Arcese, Francesco Pacchera, Olimpia Martucci	2022	2	https://doi.org/10.1016/j.resconrec.2021.105916	1. Lacking parameters & framework 2. Lacking monitoring approach
13	Linda E. karjalainen, Sirkku Johola	2021	1	https://doi.org/10.1080/01441647.2021.1879309	1. Lacking monitoring approach 2. Inclusion of stakeholders 3. Lacking parameters & framework
14	Carlos Tapia, Linda Randall, Shinan Wang, Luciane Aguiar Borges	2021	6	https://doi.org/10.1016/j.scs.2021.103130	1. Lacking consensus 2. Lacking monitoring approach
15	Saskia E. Werners, Edward Sparkes, Edmond Totin, Nick Abel, Suruchi Bhadwal, James R.A. Butler, Sabine Douxchamps, Harrhy James, Nadine Methner, Jana Siebeneck, Lindsay C. Stringer, Katharine Vincent, Russell M. Wise, Mark G.L. Tebboth,	2021	1	https://doi.org/10.1016/j.envsci.2021.09.017	1. Research gap 2. Failing of assessment tools
16	Thomás Hák, Svatava Janousková, Bedrich Moldan	2016	447	https://doi.org/10.1016/j.ecolind.2015.08.003	1. Lacking parameters & framework
17	Jacqueline M. Klopp, Danielle L. Petretta	2017	165	https://doi.org/10.1016/j.cities.2016.12.019	1. Lacking parameters & framework 2. Lacking monitoring approach
18	Pramit Verma, A.S. Raghubanshi	2018	118	https://doi.org/10.1016/j.ecolind.2018.05.007	1. Lacking governmental action 2. Lacking monitoring approach 3. Inclusion of stakeholders 4. Lacking parameters & framework 5. Research gap 6. Failing of assessment tools 7. Lacking consensus
19	Michael Saidani, Bernard Yannou, Yann Leroy, Francois Cluzel, Aliss Kendall	2019	246	https://doi.org/10.1016/j.jclepro.2018.10.014	1. Lacking consensus 2. Research gap 3. Lacking monitoring approach 4. Lacking parameters & framework
20	Asterios Papgeorgiou, Maryna Henrysson, Cali Nuur, Rajib Sinha, Cecila Sundberg, Fedra Vanhuyse	2021	5	https://doi.org/10.1016/j.scs.2021.103378	1. Lacking consensus 2. Lacking monitoring approach 3. Lacking parameters & framework

21	Apollonia Miola, Fritz Schiltz	2019	65	https://doi.org/10.1016/j.ecolecon.2019.106373	1. Lacking consensus amount of frameworks 2. Lacking monitoring approach 3. Lacking governmental action
22	Aapo Huovila, Peter Bosch, Miimu Airaksinen	2019	152	https://doi.org/10.1016/j.cities.2019.01.029	1. Lacking parameters & framework 2. Lacking consensus

Literature review 2

	Authors	**Year of publication**	**Cited By**	**DOI**
1	Muhammad Ikram, Marcos Ferasso, Robert Sroufe, Qingyu Zhang,	2021	15	https://doi.org/10.1016/j.jclepro.2021.129090
2	Meike Löhr, Camilla Chlebna, Jannika Mattes,	2022	1	https://doi.org/10.1016/j.eist.2021.12.005
3	Werner Rolf, Katharina Diehl, Ingo Zasada, Hubert Wiggering,	2020	10	https://doi.org/10.1016/j.landusepol.2020.104823
4	Clarissa A. González Chávez, Maria Holgado, Anna Öhrwall Rönnbäck, Mélanie Despeisse, Björn Johansson,	2021	1	https://doi.org/10.1016/j.procir.2021.11.048

Appendix III – Define requirements

Functional requirements				
Number	Requirement	Topic	Source	Steps
1	The M&E system should include a zero-measurement and understanding of the current situation, also known as a baseline within each specific project.	Basics of monitoring	Root Causes	Minimal data requirements
2	The M&E system should describe a minimal period of subsequent and continuous monitoring with intervals of a month to provide sufficient insight.	Basics of monitoring	Root Causes	Minimal data requirements
3	The M&E system should consist of quantitative data however when there is not sufficient quantitative data, qualitative data will be considered. Additional, procedure on the use of qualitative data is required.	Basics of monitoring	Root Causes	Minimal data requirements
4	The M&E system should guide how to homogeneous monitor all the relevant concepts of sustainability	Basics of monitoring	Root Causes	Define Boundary and Key Performance Indicators
5	The M&E system should provide consensus in an integrated way on what sustainability is	Governmental/ institutional consensus	Root Causes	M&E start assessment & agreements
6	The M&E system should elaborate on how to define the transitions.	Governmental/ institutional consensus	Root Causes	Define Boundary and Key Performance Indicators
7	The M&E system should state what are the relevant targets are for operational goals, indicators and KPIs for a specific redevelopment project	Governmental/ institutional consensus	Root Causes	Selecting targets
8	The M&E system should obligate elaboration between stakeholders (partners and departments) of Monitor and Evaluate per project.	Governmental/ institutional consensus	Root Causes	Minimal data requirements
9	The M&E system should provide a clear indication or/and overview of which persons within a project/municipality should be involved and their function	Governmental/ institutional consensus	Root Causes	M&E start assessment & agreements

10	The M&E system should enable interaction between multiple scale levels (city-region-project)	Applicability	Root Causes	Report and Evaluate
11	The M&E system should take into account the local challenges and spatial, politacl and technical circumstance that are relevant for the sustainable solutions	Applicability	Root Causes	Define Boundary and Key Performance Indicators
12	The M&E system should describe how to include local stakeholders in formulating targets for goals and indicators	Stakeholders	Root Causes	Selecting targets
13	The M&E system should describe how the evaluation of monitored results is communicated to local stakeholders in a redevelopment project of the public space	Stakeholders	Root Causes	Report and Evaluate
14	The M&E system should indicate the degree of possible municipal influence	Governmental/ institutional consensus	Root Causes	M&E start assessment & agreements
15	The M&E system should estimate the processing time of design and implementation.	Governmental/ institutional consensus	Root Causes	M&E start assessment & agreements
16	The M&E system should facilitate an approach to reach a consensus regarding Requirement 5 up to 8	Practicalities	Root Causes	Define Boundary and Key Performance Indicators
17	The M&E system should gauge the relevant roles and responsibilities and available existing structures to monitor and evaluate goals (who are relevant, is there a political agenda etc.).	Governmental/ institutional consensus	Case Study	M&E start assessment & agreements
18	The M&E system should inventory the current capacity of managers or public servants in a municipality to monitor and evaluate adequately (technical and managerial skills, available technology, financial resources and experience)	Governmental/ institutional consensus	Case Study	M&E start assessment & agreements
19	The M&E system should identify the specific stakeholder representatives of each relevant stakeholder group and the significant concerns of that group to include and reconcile their interests.	Stakeholders	Case Study	M&E start assessment & agreements
20	The M&E system should translate occurring municipal problems/challenges into desired outcomes/improvements.	Consensus on outcomes to M&E	Case Study	Define Boundary and Key Performance Indicators

21	The outcomes presented in the M&E system should be disaggregated sufficiently to capture only one improvement area in each outcome statement.	Consensus on outcomes to M&E	Case Study	Store & Calculate
22	The M&E system should define indicators to measure progress in inputs, activities, outputs, outcomes, and goals.	KPI & Objectives	Case Study	Define Boundary and Key Performance Indicators
23	The M&E system should measure KPIs regularly, predetermined basis.	Basics of monitoring	Case Study	Monitoring
24	The M&E system should define desired targets into the minimal amount of SMART (operational) goals, performance indicators and KPIs (iterative process).	KPI & Objectives	Case Study	Selecting targets
25	The M&E system should follow a trade-off between CREAM guidelines for operational goals, indicators and KPIs to set feasible targets throughout the minimal period – Clear (precise and unambiguous), Relevant (appropriate to the subject at hand), Economic (available at a reasonable cost), Adequate (provide a sufficient basis to assess performance) and Monitorable (Amenable to independent validation).	KPI & Objectives	Case Study	Minimal data requirements
26	The quantitative indicators used in an M&E system should be reported in terms of a specific number (this includes number, median or mean) or percentage.	KPI & Objectives	Case Study	Minimal data requirements
27	The M&E system should imply qualitative indicators and thus qualitative assessments which have compliance with quality or level. It provides insight into, among other things in, changes in institutional processes or behaviours of individuals.	KPI & Objectives	Case Study	Minimal data requirements
28	The performance indicators of an M&E system should be relevant to the desired outcome and not affected by other issues tangential to the outcome.	KPI & Objectives	Case Study	Define Boundary and Key Performance Indicators
29	Proxy indicators in the M&E system should be used where data for direct indicators are not available or when data collection will be too costly. (“Better to be approximately correct than precisely wrong”).	KPI & Objectives	Case Study	Define Boundary and Key Performance Indicators
30	The M&E system should include all perspectives when formulating substantive, technical and policy indicators that need to be considered when determining indicators.	KPI & Objectives	Case Study	Define Boundary and Key Performance Indicators
31	The indicators of the M&E system need to be a direct reflection of the outcome itself.	KPI & Objectives	Case Study	Define Boundary and Key Performance Indicators

32	The M&E system should require at least three measurements to establish a baseline.	KPI & Objectives	Case Study	Minimal data requirements
33	The M&E system should collect only data that is necessary.	Basics of monitoring	Case Study	Data governance & Safety
34	The M&E system should use existing and available data as much as possible if it is trustworthy.	Basics of monitoring	Case Study	Data governance & Safety
35	The targets of an M&E system should be short-term targets (3-4 years) on the path to achieving an outcome.	KPI & Objectives	Case Study	Selecting targets
36	The M&E system should work with interim targets when using long term targets.	KPI & Objectives	Case Study	Selecting targets
37	The M&E system should require flexibility while setting targets because resources may be cut out during the period.	KPI & Objectives	Case Study	Selecting targets
38	The M&E system should consider a range when using new indicators.	KPI & Objectives	Case Study	Define Boundary and Key Performance Indicators
39	The targets of an M&E system should not inflict by political winds.	KPI & Objectives	Case Study	Selecting targets
40	The M&E system should make use of an Overall Performance-Based Framework. The completed matrix of outcomes, indicators, baselines, and targets. Performance targeting is critical to the process of reaching outcomes.	KPI & Objectives	Case Study	Define Boundary and Key Performance Indicators
41	The M&E system should enable objective choices at the project, program, and policy levels.	Evaluation	Case Study	Report and Evaluate
42	The M&E system should enable transiting information of results both horizontal and vertical through an organisation. To pragmatically enable managers to make resource allocation decisions, rethink causes of a problem, identify emerging problems, support decision making, support public sector reform and innovation, build consensus within the organisation and answer management questions.	Evaluation	Case Study	Dispatch
43	The M&E system should identify the demand for desired results information at each level.	Basics of monitoring	Case Study	Define Boundary and Key Performance Indicators
44	The M&E system should indicate the responsibility (ownership) of the monitoring elements at every level (what is relevant data, when and how collected, who collects and reports it and for whom is data collected).	Basics of monitoring	Case Study	Minimal data requirements

45	The M&E system should be applied to partnership efforts. Partnerships can be created within the own department, organisation or beyond.	Basics of monitoring	Case Study	M&E start assessment & agreements
46	The M&E system should appoint a responsible champion to stress that sufficient data is adequately generated, shared and reported.	Basics of monitoring	Case Study	Data governance & Safety
47	The M&E system should include constant improvements. Therefore, it is vital to consider the new advances in management and technology.	Sustaining	Case Study	Sustaining the system
48	The M&E system should be based on reliable (stable and consistent), valid (directly and succinctly), and timeliness (frequent, current and accessible) performance data to maintain credibility.	Basics of monitoring	Case Study	Minimal data requirements
49	The M&E system should analyse performance data over time to compare present data and identify trends and other changes.	Basics of monitoring	Case Study	Report and Evaluate
50	The M&E system should include a monitoring strategy consisting of a distinct data collection and analysis plan. Consists of units of analysis, sampling procedures, data collection instruments, frequency of data collection, data analysis method and interpretation, responsibilities, partners for who is the information, dissemination procedures and follow-up findings).	Basics of monitoring	Case Study	Monitoring
51	The M&E system should pre-test the data collection instruments and procedures to identify unusual external factors that could influence the value of variables.	Basics of monitoring	Case Study	Monitoring
52	M&E should emphasise building sources of ongoing evaluation information instead sporadic individual evaluation	Evaluation	Case Study	Report and Evaluate
53	The M&E system should determine the required type of evaluation. There is no size fits all template (performance logic chain assessment, pre-implementation assessment, process implementation evaluation, rapid appraisal, case study, impact evaluation and meta-evaluation).	Evaluation	Case Study	Report and Evaluate
54	The M&E system should consider if monitored information is usable, it must contain six characteristics – impartiality (free of political bias), usefulness (relevant, timely, understandable and address the asked question), technical adequacy (meet relevant technical standards), stakeholder involvement (stakeholders are consulted and involved), feedback and dissemination (sharing information), and value for money (spend essentially but no more)	Evaluation	Case Study	Minimal data requirements

55	The M&E system should formulate a communication strategy in advance to determine the use of M&E findings (demonstrate, convince, educate, explore and investigate, document, involve, gain support and promote understanding), the target audience, central purpose to deliver the message and who will receive what information, in what format, when, who will prepare and deliver.	Reporting	Case Study	Report and Evaluate
56	The M&E results should be short and relevant to the target audience.	Reporting	Case Study	Report and Evaluate
57	The M&E results should highlight the implications of recommended actions.	Reporting	Case Study	Report and Evaluate
58	The presentation of results from the M&E system should be in a clear and understandable form (avoid acronyms and jargon).	Reporting	Case Study	Report and Evaluate
59	A written summary of the M&E system result should contain an introduction, summary, present data on findings selectively and understandable and conclusions connected to evidence on the performance.	Reporting	Case Study	Report and Evaluate
60	An executive summary of an M&E system result should be four pages (maximum) and present significant findings, recommendations, background, the purpose of the study and briefly address significant questions, issues, and research questions.	Reporting	Case Study	Report and Evaluate
61	The oral presentation on the results from an M&E system should be simple, straightforward, and tailored to the audience.	Reporting	Case Study	Report and Evaluate
62	The visual presentation of the results from an M&E system should highlight attractive key and performance findings in charts, graphs and maps.	Reporting	Case Study	Report and Evaluate
63	The M&E system should have a vital and recurring role in evaluating policy and programs to achieve organisational learning. M&E systems can be an institutionalised form of learning and knowledge when the knowledge is disseminated and available to users.	Reporting	Case Study	Sustaining the system
64	The M&E system should encourage the political environment on continuous reporting.	Reporting	Case Study	Sustaining the system
65	Implementing an M&E system should be structured and therefore requires establishment within legislation and regulations.	Governmental/ institutional consensus	Case Study	Sustaining the system
66	The M&E system should clearly define the functions of relevant people within an organisation regarding collecting, analysing, and reporting the performance of data and targets.	Sustaining	Case Study	M&E start assessment & agreements

67	The M&E system should promote and encourage the various departments within an organisation to maintain communication.	Sustaining	Case Study	M&E start assessment & agreements
68	The M&E system should protect initiators, users and stakeholders from political reprisals.	Governmental/ institutional consensus	Case Study	M&E start assessment & agreements
69	The M&E system findings on performances should be transparent and subject to independent verification.	Practicalities	Case Study	Minimal data requirements
70	The government department linked to the M&E system findings should not be exempted from the accountability of stakeholders.	Practicalities	Case Study	Define Boundary and Key Performance Indicators
71	The government or organisation implementing an M&E system should consist of technical and managerial skills.	Practicalities	Case Study	M&E start assessment & agreements
72	The inclusion of the M&E system should provide incentives (rewarding, addressing problems, value learning and budget savings are shared) to encourage the use of performance information and keep managers and stakeholders on track.	Practicalities	Case Study	Sustaining the system
73	The M&E system should be based on an agreement between the relevant partners on all definitions and calculations.	Governmental/ institutional consensus	Case Study	Define Boundary and Key Performance Indicators
74	The defined calculation methodology and KPI parameters of an M&E system should be applied throughout the entire project lifecycle to ensure that data is monitored consistently and accurately.	Governmental/ institutional consensus	Case Study	Store & Calculate
75	The M&E system should be adapted minimally to perform statistical analysis and report data after each project and compare.	Governmental/ institutional consensus	Case Study	Sustaining the system
76	The necessary data of the M&E system should be measured directly at the source of interventions by 'hand' or automated measuring systems indicating the system's value, operating performance, and capacity.	Basics of monitoring	Case Study	Monitoring
77	The monitoring data of the M&E system should be detailed to minimise monitoring faults due to a lack of data.	Basics of monitoring	Case Study	Minimal data requirements
78	The M&E system should persist that data owners include all monitored metadata, including data collection sheets.	Basics of monitoring	Case Study	Monitoring
79	The M&E system should compare datasets over time, and places and record the variances which influence the data results (such as weather conditions).	Basics of monitoring	Case Study	Monitoring
80	The M&E system should determine the monitoring focus for each project (e.g., focus on building, energy supply units, etc.).	Basics of monitoring	Case Study	Define Boundary and Key Performance Indicators

81	The M&E system should monitor existing systems or project performance one year prior to proposed interventions.	Basics of monitoring	Case Study	Monitoring
82	The M&E system should include identifying each measurement unit of each KPI	Basics of monitoring	Case Study	Define Boundary and Key Performance Indicators
83	The M&E system should collaborate closely between M&E project leaders and impact/data owners before monitoring starts.	Stakeholders	Case Study	Selecting targets
84	The M&E system should document all key points and project partner experiences to maximise consistency and improve replication over various projects to guide the users.	Sustaining	Case Study	Sustaining the system
85	The data collected with the M&E system should be managed efficiently to predict maintenance, detection of failures and improvements.	Basics of monitoring	Case Study	Store & Calculate
86	The M&E system should obligate that the KPI owner ensures that intervention impacts are recorded correctly and available.	KPI & Objectives	Case Study	Minimal data requirements
87	The M&E system should obligate that the KPI owner agrees to the KPIs' definition, description, and calculation method.	KPI & Objectives	Case Study	Minimal data requirements
88	The M&E system should obligate that the KPI owner reviews the monitoring data's accuracy and relevance.	KPI & Objectives	Case Study	Minimal data requirements
89	The M&E system should obligate that Data owners are responsible for managing monitored data from project interventions.	KPI & Objectives	Case Study	Minimal data requirements
90	The M&E system should obligate that data owners should protect personal data.	Data protection & privacy	Case Study	Data governance & Safety
91	The M&E system should obligate those data owners should follow the principle 'as open as possible and as close as necessary to ensure the safe sharing and usage of project data.	Data protection & privacy	Case Study	Data governance & Safety

92	The M&E system should inform and reach a consensus with each partner (KPI owner, data owner, departments, organisations) about their involvement in a particular KPI. To track progress and report on it following pre-defined guidance - Which datasets should be used, Where the data is originating from, How the data should be monitored and modelled, specify each KPI unit of measurement, the platform where the information will be stored and, in which format the partners will be able to view the captured data. Including the following details: definition, description, KPI and data owner, spatial scale and level of reporting, calculation methodology, calculation parameters, data requirements, reliability, and availability, the expected target, unit of measurement and the frequency of reporting.	Governmental/ institutional consensus	Case Study	Minimal data requirements
93	The M&E system metadata records should include sufficient detail about spatial information resources, allowing users to make accurate judgements on the content, quality, currencies and conditions of access and re-use.	Sufficiënt data sources	Case Study	Monitoring
94	The M&E system should apply the International Organisation for Standardization (ISO) standards when determining relevant data sources, goals, KPIs and indicators.	Sufficiënt data sources	Case Study	Minimal data requirements
95	The M&E system should agree on reporting frequency.	Evaluation	Case Study	Minimal data requirements
96	The M&E system should start directly after the completion of each specific sustainable solution.	Basics of monitoring	Case Study	Monitoring
97	The M&E system should assign the spatial scale to each KPI.	KPI & Objectives	Case Study	Define Boundary and Key Performance Indicators
98	The M&E system should determine the level(s) at which the KPI is reported.	KPI & Objectives	Case Study	Dispatch
99	The M&E system should develop a data management plan to formulate guidelines on how to achieve data governance, handling, management, security, and sharing.	Sufficiënt data sources	Case Study	Minimal data requirements
100	The M&E system should include regulations that state that organisations are obligated to inform participant data providers about who they are, the legal reason for using data, and processing participant data is not unnecessarily collected and stored.	Data protection & Privacy	Case Study	Data governance & Safety

101	The M&E system should obligate data collectors of KPIs to follow steps for compliance by adding necessary disclaimers and ensuring participants or data provides full consent where, why, what data is collected and how the data is used, stored, managed and kept.	Data protection & Privacy	Case Study	Data governance & Safety
102	The M&E system should appoint a Data Protection Officer (DPO).	Data protection & Privacy	Case Study	Data governance & Safety
103	The M&E system should obligate that the DPO share their information regularly with project partners to keep an open line of communication.	Data protection & Privacy	Case Study	Data governance & Safety
104	The M&E system should establish a risk profile (scale, sensitivity and protection required) of personal data to classify the potential losses of participants' data would leak.	Data protection & Privacy	Case Study	Data governance & Safety
105	The M&E system should include the Data protection by design principle to ensure that data privacy features and technologies are written into the project documentation or software at the beginning of a project. Everyone is responsible for the necessary security.	Data protection & Privacy	Case Study	Data governance & Safety
106	The M&E system should obligate data protection by default and set the service settings automatically on protection-friendly and only necessary data.	Data protection & Privacy	Case Study	Data governance & Safety
107	The M&E system should obligate the DPO to perform regular audits on data security.	Data protection & Privacy	Case Study	Data governance & Safety
108	The M&E system should store personal data safe with limited access.	Data protection & Privacy	Case Study	Data governance & Safety
109	The M&E system should include backup systems to prevent data loss.	Data protection & Privacy	Case Study	Data governance & Safety
110	The M&E system should consist of a Data Management Plan (DMP), representing the data governance guidelines.	Data protection & Privacy	Case Study	Data governance & Safety
111	The DMP of the M&E system should generate project data Findable, Accessible, Interoperable, and Re-usable (FAIR)	Data protection & Privacy	Case Study	Data governance & Safety
112	The M&E system should make captured monitoring data available to all project partners.	Data protection & Privacy	Case Study	Dispatch
113	The M&E system should divide KPIs into core themes which align with the project's specific objectives.	KPI & Objectives	Case Study	Define Boundary and Key Performance Indicators

114	The M&E system should establish clearness among stakeholders on the various roles of data owner and collector - Establish a straightforward process and methodology to collect the relevant data.	Governmental/ institutional consensus	Case Study	Define Boundary and Key Performance Indicators
115	The KPI owner within an M&E system is responsible for filling out the necessary information and submitting collected data.	KPI & Objectives	Case Study	Minimal data requirements
116	Project partners of the M&E system should provide feedback on the proposed KPIs to ensure alignment and understanding of what will be expected regarding actual data collection and capturing when interventions are implemented.	Governmental/ institutional consensus	Case Study	Define Boundary and Key Performance Indicators
117	The M&E system should determine core KPIs which apply to all projects (General technical, environmental, Economic, ICT and mobility KPIs).	KPI & Objectives	Case Study	Define Boundary and Key Performance Indicators
118	The M&E system should determine supporting KPIs which are supplementary to the Core KPIs - the supporting KPIs provide insight and additional metrics to consider the performance measurement of interventions.	KPI & Objectives	Case Study	Define Boundary and Key Performance Indicators
119	The M&E system should establish general reporting rules - the average value for an area for each KPI (mean), the variance that exists in the data for each KPI (standard deviation), facilitate comparison between KPIs (z-scores), structure and index score for each KPI and evaluating the relevance of KPIs to inform on the interventions potential contribution to eventual scale-up and/or replicate project interventions.	Reporting	Case Study	Report and Evaluate
120	The M&E system should identify what the relevant minimal contract requirements are for the monitoring and evaluation process.	Practicalities	Case Study	Minimal data requirements
121	The M&E system should identify the existing available data sources, and check if the existing that sources van be used to meet the contract requirements	Sufficiënt data sources	Case Study	Minimal data requirements
122	The M&E system should identify if there is information that cannot be collected via existing data sources	Sufficiënt data sources	Case Study	Minimal data requirements
123	The M&E system should consist of a data collection plan on how the information on targets can be collected, how often, and from which location.	Basics of monitoring	Case Study	Selecting targets
124	The M&E system should identify all the stakeholders participating in the project and their possibility to deliver data or participate in collecting it.	Stakeholders	Case Study	M&E start assessment & agreements

125	The M&E system should inventory what file types of the data sources are delivered in	Sufficiënt data sources	Case Study	Minimal data requirements
126	The M&E system should make agreements with data deliverers over the consistency of data delivery, period, and reliability	Sufficiënt data sources	Case Study	Monitoring
127	The M&E system should determine the desired file type in which all information must be formatted	Sufficiënt data sources	Case Study	Minimal data requirements
128	The M&E system should state where the collected or converted data must be dispatched to.	Practicalities	Case Study	Dispatch
129	The M&E system should state how often datasets must be sent to a centralized or decentralized database	Basics of monitoring	Case Study	Store & Calculate
130	The M&E system should maintain the credibility and legitimacy of the data sources by for instance adding a digital fingerprint	Data protection & Privacy	Case Study	Data governance & Safety
131	The M&E system should initiate a calculation strategy that indicates what outputs (indicators/KPIs) are relevant based on contract requirements or ambitions and state which data will be used to calculate output (values)	KPI & Objectives	Case Study	Report and Evaluate
132	The M&E system should determine in which applications the results must be visualised and how the results must be visualised	Evaluation	Case Study	Report and Evaluate
133	The M&E system should determine which output needs to be evaluated for each stakeholder	Evaluation	Case Study	Report and Evaluate
134	The M&E system should indicate with project partner what are the potential improvements	Sustaining	Case Study	Sustaining the system
135	The M&E system should add inspirational images and results to inspire and attract relevant municipal people.	Practicalities	Stakeholder I&O	Report and Evaluate
136	The M&E system should focus on concrete measures/ sustainable solutions instead of “adding green” use “four square meters of fescues (Festuca grass).”	Practicalities	Stakeholder I&O	Report and Evaluate
137	The M&E system should adjust the language to the target audience – tactical and practical municipal managers, policymakers, and councillors (strategic level).	Governmental/ institutional consensus	Stakeholder I&O	Report and Evaluate
138	The M&E system should monitor KPIs throughout the entire city; in this way, the results of a redevelopment project can be placed into perspective.	Practicalities	Stakeholder I&O	M&E start assessment & agreements
139	The M&E system should focus on an area-orientated approach, and the inner city is different from the outskirts.	Practicalities	Stakeholder I&O	M&E start assessment & agreements

140	The M&E system should operate independently from the administrative winds. To prevent the councilman stops the M&E when results are indicated	Governmental/ institutional consensus	Stakeholder I&O	M&E start assessment & agreements
141	The M&E system result should be made simplistic in a dashboard.	Evaluation	Stakeholder I&O	Dispatch
142	The M&E system should be transparent for all users and stakeholders.	Stakeholders	Stakeholder I&O	Dispatch
143	The M&E system should use symbols for communication instead of quantitative and qualitative data (return of animal species due to improving nature quality.	Evaluation	Stakeholder I&O	Report and Evaluate
144	The M&E system should not focus on all possible indicators but instead on 4/5 indicators that can be monitored and evaluated accurately.	Sufficiënt data sources	Stakeholder I&O	Store & Calculate
145	The M&E system should include a gaming aspect and tell stakeholders about the redevelopment projects.	Practicalities	Stakeholder I&O	Report and Evaluate

Appendix IV – Translation e-mail

Dear X,

As part of my Master's thesis (A blueprint for monitoring and evaluating the impact of sustainability measures in public space redevelopment projects), I was able to interview you on X. I have included the arguments, minimum requirement and/or feedback that emerged during this conversation during the various steps of my research.

At the moment I have been able to develop the Monitoring and Evaluation blueprint in draft version. Again, I look forward to your input. However, due to the limited time, I am unable to schedule another appointment. In addition, I can imagine that you may not be waiting for that so close to the holiday period.

That is why I decided to process the explanation of the M&E blueprint in a pre-recorded presentation (15min) and send it to me. In order to obtain your input, I have also prepared a survey of 7 multiple choice questions (+/- 3 min) that you can (ideally) fill in after seeing the presentation. I understand that it may be difficult to remember what you mentioned during our previous interview, so I have also made a short summary of the points you mentioned at the time.

Concrete:

- **View the presentation you will receive shortly via a WEtransfer link**
- **If necessary, read the summary of the interview held (see attachment to this e-mail)**
- **Answer a short survey via this link: https://www.survio.com/survey/d/O6S4N5J8A1K9J7Q3R**

Your input is extremely valuable!

After the holiday period I would like to show the M&E blueprint in detail and present the results of my thesis. You will receive my thesis after July 14 (then my defence).

Sincerely,

Jorg Hogerheijde