



Pre-Study – Scientific framework:

**Methods and tools for
incentivising the use of
smart sustainability
services**

Deliverable 2.1

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List of abbreviations

ADEME	French Environment and Energy Management Agency
BE	Behavioural Economy/Economics
BCT	Behavioural Change Techniques
DOW	Document of Work (contractual work plan)
GHG	Greenhouse Gas
HCI	Human-computer-interaction
NFC	Near-field-communication

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Administrative Information

Basic information on the SimpliCITY project and the present deliverable:

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more details see DOW page 21). It is planned as input for forthcoming activities in the WP 3, 4 (SimpliCITY platform architecture and development), WP 5 (Community Engagement), WP 6 (Pilots)

EXECUTIVE SUMMARY

Objective of the study

Recently, smart city initiatives substantially gained in importance and popularity. The goal of living a sustainable life concerns citizens as well as governments.

This study deals with a new approach of motivating and guiding people's decisions in the direction of using sustainable solutions. The aim of this study is to firstly generate insight on the success factors and enablers of digital behaviour-based interventions for smart city services; secondly, find appropriate methods and tools to incentivize people by means of a digital environment to change people's behaviour (lifestyle) in the long-term by the use of ICT, and, thirdly, to identify parameters for smart city business models in this context.

Behavioural economics aims to understand different behaviours in everyday life and decision-making processes of market participants. This sub-field of economics develops methods and incentive schemes which increase the probability of people choosing the desired option. Nudging and gamification are tools for behavioural change and can therefore be implemented in smart city initiatives. Goals such as the reduction of carbon emission, the use of more energy efficient services and the support of local consumption are addressed in a playful way incorporating digital services. The digital environment serves as an enabler of arousing citizen's interest and changing their decisions to reach the desired outcomes.

SimpliCITY serves as a pilot project and aims at providing evidence-based results on the use of gamification and nudges. Those results will be necessary to animate other cities to take action regarding sustainable smart city initiatives. By **providing insights into behavioural theory, incentivisation methods and business models relevant for the domain of smart city initiatives and expanding sustainability services**, this study paves the way for further project work such as the intervention designs, platform design and functionalities and guidelines for involving providers of smart city services.

Added value of behavioural insights and methods for smart city management

In smart city initiatives city governments can use "soft" measures of nudging to promote desired behaviours. Active involvement of citizens in initiatives can strengthen their trust in reliable city governance and allow public bodies extend their knowledge base regarding perceived social or environmental issues.

Nudging and gamification can be used as methods for smart city management. An initiative run by Nudge Lebanon in cooperation with the local electricity supplier successfully implemented a nudging campaign to improve the timely payment of electricity bills. Nudges were added to the usual reminder messages which motivated, rewarded or criticized households verbally for paying their bills in time. In case of motivation and using specific rewards the payment habits of the households were improved significantly.

Issues such as sustainable mobility and disadvantages of car use can be addressed by gamification. Quizzes and knowledge games can successfully draw attention to those topics in the first phase of launching new services. In the second phase, information about alternatives should be prepared by linking timetable information apps of public transport

providers or bike-routing apps. Individuals switching to the preferred alternative should be rewarded and provided with further challenges to maintain their motivation.

Nudging and gamification combined with innovative IT solutions like web and mobile applications greatly expand the number of people that can be reached.

Incentivisation methods and implications for designing intervention activities

Incentives can be seen as a method to change behaviours and decision-making processes. A distinction is made between **monetary incentives, such as payments or other rewards, and non-monetary incentives, including tangible, social and topic-related incentives.** **Nudging, as one specific form of a choice architecture,** and **gamification** are two popular incentive schemes which encourage people to decide upon the desired option.

Nudges are used to influence people's behaviour **without prohibitions or regulations.** They are a tool of promoting specific decisions that are beneficial for the individual or society. Nudges do not restrict the individual's freedom of choice. They are not mandatory. Nudges rather are a way of redesigning the options such that the individual makes the desired decision. Often, influencing people's decision-making involves a change in the physical environment. For example, presenting options in a different order (e.g. in supermarket) affects purchase decision without limiting the individual's freedom of choice. Those nudges can be avoided without too much effort but nevertheless are effective most of the times.

The use of game design elements in non-game contexts is a method of increasing people's motivation and gaining attraction and interest in specific smart city issues. In smart city initiatives, gamification supports the objective of rising citizen's engagement and participation regarding the promotion of sustainable mobility behaviour, energy consumption or health initiatives. **Gamification aims to activate either intrinsic or extrinsic motivation.** In the intrinsic case, this involves arousing curiosity or interest in a playful way. In terms of extrinsic motivation games are designed with the intention to reward or penalise materially. In any case, gamification intervention aims to increase motivation what implies that the game should be designed neither too easy nor too difficult.

Ethical considerations

The ethical question of nudging and gamification is addressed by coping with concerns about **transparency and cognitive decision making.** Ethical problems may arise if methods are designed in a non-transparent way and/or exploit psychological processes, meaning that they take advantage of non-reflected, quasi-automatic decision-making. For all methods used in SimpliCITY special attention should be given to a **reflective (cognitive) process and transparency. Display of results needs to be either anonymised or based on informed consent.**

Lessons learned or gamification from the best practise case studies

There is **little evidence for long-term effects of typical nudging methods and gamification** to be found in general, the domain of public health as prominent exception. Persistent treatment effects and long-term behavioural changes are reported rather seldom, only under conditions of **repeated applications.** Methods accomplishing lasting changes in behaviour often address people at an emotional level. For example, a **gamification design combined with social comparison techniques works well.**

Lessons learned from 14 best practise case studies

The study provides an analysis of research and living labs projects which have trialed and explored the use of various ICT-based incentivisation approaches. Based on these findings and expert recommendations (derived from interviews), the study works out implications for new smart city initiatives such as SimpliCITY. SimpliCITY can use the insights especially the evaluation results of already experienced projects that have tried with different means and reward mechanisms to influence people's behaviour towards sustainable transportation decisions, local consumption and social inclusion. The **fourteen described best practise case studies cover all three pillars of the SimpliCITY pilots: bike mobility, local food consumption and social inclusion.**

Regarding sustainable mobility and transport decision, webbased applications serve either as an information tool or as tracking device. By informing commuters about transport alternatives and rewarding the choice of sustainable means of transport, digital services might be able to make positive behaviour changes. Information that contains decision of others can influence people's behaviour significantly (Sustainable transportation behaviour). Similarly, **information about consequences of certain decisions may lead to a desired change in behaviour** (Reduction of electricity consumption), however, care has to be also taken about unintended consequences of the desired behaviour (boomerang effect). Simple reminders in form of push notifications or text messages can incentivise a certain behaviour (Eco-Friendly Shopping Bags). Web applications can be designed in a way to not only provide information but also to gather data. The gathered information can be used for developing an infrastructure which encourages sustainable transportation (Bike Citizens).

In many cases, games are designed to reward a desired choice. People can collect **bonus points (STREETLIFE, goodbag)** or receive **financial incentives (Cycling Kilometric Allowance)**. Incorporating competitive elements might work well but have a rather short-term effect (Frequent Biking Challenge, 10.000 steps challenge). The **intervention design of SimpliCITY should guarantee lasting effects without relapse to previous behaviour.** Most implemented projects suggests that the **time frame of the intervention needs to be sufficiently long to achieve a long-term behavioural change (Frequent Biking Challenge).**

The second pillar of SimpliCITY is intended to promote local consumption. In this field, web application are often designed to focus on individual consumer needs. Individual data gathering enables a personalised dietary recommendation and give advice and tips about products and producers (**SmartAPPetite**). In SimpliCITY this mechanism could be used to promote local suppliers such as farmer markets.

SimpliCITY also addresses social inclusion. An increasing number of authorities offer the possibility of citizen engagement in public discussions and decisions via digital services. **For citizens, digital platforms serve as a mouthpiece. For the governments, they constitute a tool to spread information.** They facilitate a joint discussion and the inclusion of a high number of citizens. These platforms may provide the possibility of voting, taking part in surveys, giving feedback on certain government actions, collecting ideas, informing about events or decisions (**CitizenLab, Implication Engage Barnet**). The inclusion of game features increases the probability of people's engagement in social activities. Riddles, quizzes and videos may attract people's attention to social and environmental problems and solutions. For an even higher success rate, the game is probably best designed if social action or engagement is rewarded (Tribal Planet).

Recommendations

- In smart city initiatives city governments instead of legal regulation of citizen's behaviour can use "soft" measures of nudging to promote desired behaviours (e.g. biking instead of using the car).
- Incentivisation methods work well when the costs and benefits of an option can be compared with minimal cognitive effort (the best intuitive way to capture the assessment of the effect of a given decision).
- A mix of incentivisation instruments is essential for inducing successful, long-term sustainable behavioural change.
- Nudging, the instrument of designing choice architectures, is one method among others; it is important that a nudge offers several choice options of which the most likely to follow decision is obvious;
- The impact of an incentivisation intervention design needs careful planning: An intervention design is successful, only, when its effect will last, when the intervention has ended. Repeated application may be necessary to achieve long-term effects.
- Gamification design works well in combination with social comparison techniques, e.g. leader boards. To change behaviour it should meet the emotional prerequisite.
- Non-transparent forms of nudging should be avoided in general as these can have very negative effects, including that citizens do not accept and support behaviour change policies.
- Methods for SimpliCITY must be designed in a transparent way and as a reflective, cognitive decision-making process. Display of results of identified participants must be avoided (e.g. anonymization) or be based on informed consent of the participants.
- Digital services, web and mobile applications greatly expand the number of citizens that can be reached and involved as well as enable novel forms of nudging such as competitions and other game-like methods.
- The evaluation of SimpliCITY should focus on the effects of nudging and gamification when applied as digital services. Evidence-based results of SimpliCITY will be essential to animate other cities to take action regarding smart city initiatives.

1 Objective of the study

An increasing number of people are living in cities and urban surroundings. It is expected that by 2050 about 68% of the world's population will live in cities. Urban growth is currently estimated at 3 million people per week (UN, 2018). In order to manage this huge number of citizens, governments have already launched multiple smart city initiatives, developing new Internet of Things applications, wireless networks or innovative web- and mobile-based applications. These technologies enable citizens to live a more sustainable life, which aims at producing less carbon emission, using more energy efficient services and supporting local consumption and a more inclusive lifestyle (Harter et al, 2010; Cohen, 2017). Smart city services include analogue as well as digital offers and cover a wide variety of application areas, such as mobility, energy, social services, governability/public services or waste management.

These innovative IT solutions and services have become only successful with smart city visionaries and lead-users yet, and are failing to reach the early majority of not so technology savvy and enthusiastic citizens. The problem is that many of the newly developed smart city services, which can be regarded as “hybrid services”, (serving both individual customer needs and common goods) are not linked to initiatives focusing on raising people's awareness, promoting and rewarding individual behavioural change (Kazhamiakin et al., 2016).

These problems mentioned above require innovative solutions, because otherwise public smart city services miss the mark. User-centric design and behavioral economics insights are seen as powerful solution to overcome the lack of users and close the gap between early adopters and the early majority. Insights especially from nudging, as one strand in behavioural economics (Thaler & Sunstein, 2009), have established itself across various sectors in governance and policy instrumentation. However, there is still no systematically analysis of how to use nudging in the field of smart urban sustainability (Esmark, 2017). While there are already many guidelines for implementing nudges in offline environments (e.g. placing healthy food at eye level in supermarkets), digital nudging has recently become the focus of interest for digital user interface designers (Schneider et al., 2018). Scientific results and evaluated success stories are still limited. The aim of this study is to generate insight on issues, such as:

- What are the success factors and enablers of digital behaviour-based interventions for smart city services?
- Which methods and tools are appropriate to incentivize people by means of a digital environment are appropriate to change people's behaviour (lifestyle) in the long-term by the use of ICT?
- Which parameters are important for evaluating effects by such applied methods and tools?

This study serves to provide a thorough understanding of the theoretical models and insights into (digital) incentivisation methods, commons-based business models and the relevance of principles of behavioural design for sustainability services and target-group specific innovation barriers and learning goals. It is intended to lay out scientific foundations in the interdisciplinary field of SimpliCITY and should then be used and integrated in planning the intervention designs, platform functionalities and the guidelines for better uptake of smart city services to be developed in other work packages.

2 Methodology and structure

The study used a mix of methods for identifying relevant methods and best practise examples which are useful in the specific context of smart city ambitions and activities. Based on an in-depth literature analysis, an intensive screening of databases about European and internationally publicly and privately funded projects was carried through. Thereby we firstly used a keyword search relevant for the three application areas of SimpliCITY: bike mobility, local food consumption and social inclusion and, secondly, selected the vast volume of project reports according to the criteria whether the project has acquired impact data and/or quantified evaluation data. In addition to this, we investigated the issues of organisational success factors for designing and implementing digital incentivisation methods by using data-based applications by conducting interviews with application providers and smart city managers (e.g. former EU project Streetlife).

In the following the study is organised in the following chapters:

- Chapter 3 describes the fundamental principles of behavioural science and behavioural economic approaches and works out delineations for methods and tools for behavioural change in general.
- Chapter 4 deals with the different incentivisation methods and tools to design an intervention aiming at changing citizen's behaviour. It provides an overview on Behaviour Change Techniques (CBT) in the context of smart city examples and focuses on nudging and gamification as specifically instrument for an intervention design.
- Chapter 5 discusses the very important issues of ethical implications of nudging, as one prominent method of incentivisation;
- Chapter 6 provides a strength-weakness-threats and opportunities-analysis of how and when best to use a nudging principle;
- Chapter 7 gives firstly an overview of all identified best practises, providing short information, and, secondly gives an in-depth insight into ten elaborated and analysed best practise case studies. Each case is summarised with lessons learned and implications for the SimpliCITY project.
- Chapter 8 investigates the basic parameters of a smart city business model and especially highlights the elements of a successful design of a platform-based business models and works out success factors for the SimpliCITY platform. It also provides concrete practical experience of four smart city business models already put into practise.

Finally, we summarise the implications of the findings for the SimpliCITY project work and provide a glossary to be used for a common understanding of terms within the SimpliCITY consortium.

3 Insights from behavioural science for changing citizen behaviour

Behavioural science has a longstanding tradition in investigating the effects of citizen's behaviour already. However, while there have been many experiments in different fields (e.g. energy conservation, or health sector), they have addressed **mainly short-term behaviour changes**, and most studies examined the outcome only once. Moreover, this examination is usually done shortly after the intervention and neglects dynamic long-term effects. The reasons for this are manifold and include the possibility that such long-term effects are outside the research scope of scientists (Alcott & Rodgers, 2012). Usually, the challenge of long-term effects comes in two parts: habits and habituation. The former "concerns the ability of behavioural interventions to have lasting effects on people's lives by making them change their behaviour not just immediately after an intervention but in the longer term" (Halpern & Sanders, 2016: 63). According to Frey and Rogers (2014), more work is needed to identify such changes.

The current evidence is limited and often not promising. While short-term effects may be sufficient in an academic setting, additional research is necessary in a policy context. Habituation describes what happens when people are exposed (repeatedly) to the same behavioural intervention. This area also needs further research, because these kinds of interventions become more commonplace, but the effects are not yet known properly (Halpern & Sanders, 2016).

Persistent treatment effects in the form of long-term behavioural change are rare. Besides of energy efficiency, persistent treatment effects can be found in a health program designed to help people quit smoking (Volpp et al., 2009). Frey and Rogers (2014) propose **a four-pathway framework for persistence** (see Table 2). As stated by the authors, "treatment-effect persistence exists when those who received a treatment continue to behave differently in relation to a target outcome after the treatment stops, as compared to those who never received the treatment at all" (Frey & Rogers, 2014: 173). A treatment can be a program (e.g. a nudging campaign), procedure or any action performed to alter people's behaviour.

Table 1: Framework for persistence pathways in health (Source: Frey and Rogers, 2014)

Pathway	Description
Habit	Treatment produces an automatic tendency to repeat a particular behavioural response, triggered by a stable context in which the behaviour is performed
Changing How or What People Think	Treatment permanently changes an element of how or what people think (e.g. beliefs, identities, interpretations) that is causally consequential for the target behaviour
Changing Future Costs	Treatment induces people to perform behaviours that change the costliness of a future target behaviour; the treatment may decrease the costs of performing a target behaviour, or increase the cost of failing to perform a target behaviour
External Reinforcement	Treatment induces people to perform a behaviour that then exposes them to on-going external processes (including social processes) that they would

not have been exposed to otherwise; these external processes cause the changed behaviour to persist

3.1 Ecological decision making based on behavioural economics

The *homo economicus* is the central assumption of the classic economics, a perfect, rationale calculator that maximizes his self-interest and acts without emotions. While this picture of a human is distorting, it was and is of great help for economic modelling. Without these assumptions, the outcome of economic models and experiments are unpredictable and results not applicable. Models are useful, because they simplify the reality and do not aim to rebuild the reality on a scale 1:1 (Beck, 2014).

There are three central assumptions on which this view of humanity of the economy is based:

- *Unbounded rationality*: Humans strive for the optimum, because they are rational utility maximisers. They do not face cognitive limitations, make no mistakes regarding perception or information intake, and do not make systematic mistakes due to the lack of rationality.
- *Unbounded willpower*: If the *homo economicus* sets a target, he will achieve it. He does not have emotions or self-control issues and therefore pursuits the optimisation of his utility.
- *Unbounded selfishness*: Humans maximize only their own utility. The utility or preferences of others and fairness do not play a role (Mullainathan & Thaler, 2000; Beck, 2014).

3.1.1 Behavioural economics as multidisciplinary approach

Behavioural Economics is a sub-field of economics which builds on multidisciplinary research in areas such as economics, psychology and neuroscience. It aims to understand how people behave in everyday life and how they make decisions in markets in which they face limitations and complications (Mullainathan & Thaler, 2000).

Compared to traditional economic research, which assumes that people base their decisions on the rule of maximizing utility, behavioural economics differs in two ways.

- Firstly, behavioural economics does not assume that people are good utility maximisers and that this is their only goal. However, people have psychological biases (e.g. loss aversion), limited cognitive abilities and they do care about the preferences of others and about values like fairness.
- Secondly, while traditional economics relies on theoretical models to test hypotheses, behavioural economics uses empirical tools (e.g. experiments) for that (Miller et al., 2015). Traditional economists assumed that economic sciences cannot conduct controlled experiments like the natural sciences because they are unable to control the environmental conditions sufficiently. In recent years, methods have been developed with which experimental economic research can be conducted and experiments are now an integral part of economics (Beck, 2014).

Behavioural economics does not reject economic foundations like those established by neoclassic economists. Rather it modifies standard assumptions and adds greater psychological realism. One example is the inclusion of fairness in economic actions, which are

per se not included by classics. Many ideas in behavioural economics are not new, but are rooted in other fields of economics. Before psychology has emerged as distinct discipline, economists as Adam Smith with his book *The Theory of Moral Sentiments* in the year 1759 came up with profound psychological principles about individual behaviour (Camerer & Loewenstein, 2011). Smith was a pioneer of acknowledging that human (economic) decision-making can be characterized as "imperfect" and is affected by other values (e.g. fairness and justice).

In the year 1955, Herbert Simon denied the infinite decision-making capabilities, claiming that people are limited by the degree of information, availability of time for their decisions and by other cognitive and procedural limitations. He called this finding *bounded rationality* and disagreed with the classical economists' assumption of unbounded rationality (Miller et al., 2015). In 1979, Kahnemann and Tversky presented their *prospect theory*. According to their findings, people suffer from cognitive biases. These biases affect their economic decision-making. Other economists followed with new models and an increasing number of books, special issues of journals and papers on behavioural economics have been published (Camerer & Loewenstein, 2011).

With reference to the central assumptions of the homo economicus (see above), behavioural economics disproves them in the following way:

- *Bounded rationality*: People make mistakes, especially in the intake and processing of information. Due to this limited ability, people use heuristics (simple problem-solving mechanism). These heuristics may result in behaviour patterns that deviate from economic rationality and lead to systematic errors.
- *Bounded willpower*: People move inconvenient decisions, postpone diets or neglect their pension plan. They know about the long-term effects of different actions, however act differently in the short term.
- *Bounded selfishness*: People are not exclusively egoistic, but care about their fellow humans and include values like fairness or justice in their decisions (Beck, 2014).

3.1.2 Different fields of application of behavioural economics

According to Beck (2014), there are three main areas, where behavioural economics can be applied:

- *Behavioural finance*: As one of the most prominent offshoots of behavioural economics, behavioural finance deals with different phenomena, which are mostly contradicting classical economics. The reason for this is twofold. Firstly, there exists much data to test hypothesis within this area. That is crucial for behavioural economics as has been already described above. Secondly, behavioural finance has great practical relevance. Many asset managers and institutional investors try to use the findings of behavioural economics to improve their portfolio performance. Used in the right way, so the theory, one can earn cash with the insights of this discipline. Some applications in the field of behavioural finance are the idea of inefficient markets, anomalies or arbitrage.
- *Social policy*: Ideas for the application of psychological principles can also be found in social policy, especially in the areas of savings and access to banks, health programs, distribution and health politics, poverty, social transfers and pension plans. There are

different principles within behavioural economics (e.g. prospect theory, framing) that are applicable to problems within these fields.

- *Liberal paternalism*: The core idea of liberal paternalism is to use the findings of behavioural economics to guide the behaviour of citizens in the state. The underlying premise is that people sometimes make wrong decisions that they would not make if they had complete information, unlimited cognitive abilities, unlimited rationality and unlimited willpower. Using governmental interventions without coercion can help to guide people's decisions into the right direction. Because this area of application is of significant interest for this report, more information will be provided in the following chapters.

3.1.3 Delimitation of fields of interests

Behavioural economy, behavioural insights and nudging are currently widely used buzz words and are often used synonymously. Despite their similarities, the three subject areas differ as follows:

Behavioural economy is a scientific discipline that uses psychological insights into human behaviour in order to explain economic relationships and the process of decision making. Behavioural economy results from multidisciplinary research in areas such as economics, psychology and neuroscience and aims to understand how people behave in everyday life and how decisions are made.

The term **nudging** was originally defined by Richard Thaler and Cass Sunstein as “any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives. To count as a mere nudge, the intervention must be easy and cheap to avoid. Nudges are not mandates. Putting fruit at eye level counts as a nudge. Banning junk food does not.” Nudging is one of several behaviours by which policy makers seek to induce people to “better choose” without using bans or other costly and time-consuming alternatives.

Behavioural insights provide knowledge for nudges but go beyond the boundaries of nudging as the insights can also be integrated into "traditional" forms of intervention, such as regulations, incentives or information duties. Since behavioural insights are used as input for processes, they do not initiate a specific type of output and in some situations even suggest that no or conventional intervention is the appropriate solution (Lourenco et al., 2016).

3.2 Implications for SimpliCITY

- Incentives work well when the costs and benefits of an option can be compared with minimal cognitive effort (the best intuitive way to capture the assessment of the effect of a given decision).
- A mix of instrument is essential for successful, long-term sustainable change;
- Nudging is one instrument among others; it is important that a nudge offers several options of which the most likely choice is obvious; no option is a forbidden possibility.

- Effect of an incentivisation design needs careful planning: An intervention design is successful, only, when its effect will last, when intervention has ended.

4 Methods and tools for behavioural change

“All nudges are incentives, but not all incentives are nudges.”

(Schweyer, 2017, p.6)

This chapter describes the different types of incentives, which can be mixed in an interventions design which last over a specific period of time.

4.1 Definitional approaches

According to Lu et al. (2018) and based on the Oxford standard dictionary, an incentive is

“a thing that motivates or encourages someone to do something”.

Economic incentives play an important role within behavioural economics, because they are used as an effective tool to change behaviour (McKenzie-Mohr & Schultz, 2015). Incentives work particularly well, when individual people evaluate their costs and benefits of their actions on a regular basis. They are mainly taxes, fines, subsidies or grants, whereby a distinction between *negative* and *positive* influences is made (Ly & Soman, 2013). Negative incentives put the focus on the failure of an individual to adopt a desired behaviour. They discipline the individual by withdrawing the reward, believing that this will encourage the adoption of the desired behaviour (Jochelson, 2007).

Positive influences (e.g. subsidies and grants) should provoke positive behaviour (Ly & Soman, 2013) and reward individuals directly for a desired behaviour or outcome (Jochelson, 2007). Another often seen classification of incentives is between *monetary* and *non-monetary* incentives (see above). While the first group is described extensively in literature, less is known about the effects or drawbacks of non-monetary incentives.

Besides the change of behaviour induced by incentives, they also can bring various side effects. Firstly, issues about the durability should be mentioned. As stated by McKenzie-Mohr & Schultz (2015: 41),

“repetitive behaviours that are changed through incentives typically revert back once the incentive is removed”.

There is also an over justification effect observed, meaning that the behaviour falls below its initial level once the incentive is removed. Secondly, the specificity of the change is a further limitation. Behaviours that are changed through incentives typically do not spill over into other domains (Schultz, 2010). An example is the offering of an incentive for the purchase of energy-efficient lightbulbs. The effect of this changing behaviour will generally not spill over into other energy-efficiency behaviours, like e.g. turning of the computer when leaving the office. However, there are documented examples of rebound effects. This means that a person who buys and installs a more energy-efficient appliance uses it more often, because of its higher efficiency. Due to these side effects, incentives should be used sparingly and they typically work best when costs are identified as barrier to the action (McKenzie-Mohr & Schultz, 2015).

Furthermore, the concepts of “incentive”, “reward” or recognition are often used synonymously. Even though the concepts are highly interrelated, it is possible to differentiate them according the following criteria. Incentives focus on future actions and aim to encourage a certain behaviour whereas rewards are an appreciation for an accomplished behaviour or are a

potential reinforcer. The concept of recognition, including monetary and non-monetary incentives, refers to crediting encouraging and appreciating individuals or a group of people, who contribute through their behaviour and their efforts to a certain goal or success (Yavuz, 2004). As rewards and recognition are both concepts to induce action, they can be analysed under the broader category of incentives. All these concepts are quite elaborated within the scientific and the practitioner's world in the context of employee motivation. While other thematic areas such as citizens engagement or motivational change of behaviour in terms of sustainability are almost unexplored: *"All nudges are incentives, but not all incentives are nudges."* (Schweyer, 2017, p.6)

4.2 Overview of different types of incentives

4.2.1 Monetary incentives

Monetary or financial incentives are payments made to encourage desired change, however there are different types of rewards besides direct payments. They can be in cash (e.g. bonuses or discounts) or in kind (e.g. goods or services). Same as described above, financial incentives can be positive (rewards) or negative (penalties) (Hall, 2009). In the scientific literature monetary incentives are especially present in the fields of health and employee motivation. For the latter Buchan et al. (2000) show a range of potential monetary incentives (see list below) to our knowledge, there is no general classification of monetary incentives. According to Buchan et al. (2000) there are the following types of monetary incentives for increasing motivation in the field of employee motivation:

- Pay
- Other direct financial benefits
 - Pensions
 - Illness/ health/ accident or life insurance
 - Clothing/ accommodation allowance
 - Travel allowance
 - Child care allowance
- Indirect financial benefits
 - Subsidised meals/ clothing/ accommodation
 - Subsidised transport
 - Child care subsidy/ crèche provisions

According to Hall (2009: 12), there exist certain conditions under which financial incentives can be effective in promoting behaviour:

- Cost as a barrier to the use of a service (e.g. charges for immunisations or child visits);
- Desired behaviour change is simple and one-time rather than complex and ongoing;
- Financial incentive reinforces other strategies for change;
- Incentive is not delivered in a negative or demeaning way.

4.2.2 Non-monetary incentives

Non-monetary incentives do not involve any direct payment of cash and can either be tangible or intangible. In general, non-monetary incentives are classified as

- tangible non-monetary incentives,

- social non-monetary incentives, and
- “topic”-related non-monetary incentives (e.g. job-related non-monetary incentives).

Tangible non-monetary incentives refer to tangible items such as key rings, coffee mugs, gift certificates, discounted goods or free tickets. Social non-monetary incentives are related with social activities and gestures and appreciations. Job or topic-related incentives have the potential to motivate people intrinsically. According to a classification (Yavuz, 2004, p. 45) non-monetary incentives can be divided like the following:

Table 2: Classification of non-monetary incentives (Source: Yavuz, 2004, selected, own representation)

Tangible non-monetary incentives	Social non-monetary incentives	Job-related non-monetary incentives
Free food/ beverages	Friendly greetings	Meaningful work
Food baskets	Smile	Job enrichment (responsibilities and variety of tasks)
Desk accessories	Pat on the back	Goal setting
Wall plaques	Feedback about performance	Participation in decision making
Trophies	Verbal recognition or praise	Growth opportunities
Clothing (T-Shirts with logos, etc.)	Informal recognition like a thank you note	Promotion
Club privileges	Letter of commendation/ appreciation	
Tickets to events/ movies/ theatre/ sport	Public recognition in a meeting, newsletter, bulletin board, etc.	
Celebrations	Participant of the month award	
Tickets/ vouchers redeemable at local stores	Invitations to coffee/ lunch	
Gift certificates	Compliment on progress	
Key rings		
Newspaper or magazine subscription		

Further non-monetary incentives can be found in reward systems such as goodbag (<https://www.goodbag.io>) which aims to engage people in environmental protection by using different incentives such as vouchers or rebates for local shops when shopping with using the goodbag which is equipped with a NFC chip. Additionally, each goodbag includes a code which allows people to plant a tree in Sambia (WeForest project). In selected partner stores people receive additional codes if they spend a minimum amount for planting trees. The number of trees planted can be seen on the web platform.



Figure 1: Example non-monetary incentives; Source: <https://www.goodbag.io/trees#>

4.2.3 Regulation

Regulation is a concept that is hard to define and means different things to different people and organisations. The term is used for a variety of discursive, theoretical, and analytical purposes (Levi-Faur, 2010). According to Ly & Soman (2013: 6), “restrictions, bans, compliance rules, and similar forms of regulation impose behavioural limitations that individuals or corporations are expected to comply with”. Regulations are therefore helpful in situations, where the consequences of non-observance are negative or result in damage and impose a risk to society or environment. They are also useful when it comes to third party impacts, which are absorbed by the persons around a company and not by the persons of a company themselves.

OECD (2000) distinguishes between three different categories of regulations: *economic regulations*, *social regulations* and *administrative regulations*. Economic regulations like pricing, competition, market entry or exit intervene directly in market decisions and a reform aims to increase economic efficiency. That is achieved by reducing barriers to competition and innovation and by improving regulatory frameworks for markets functioning. Social regulations aim to protect health, safety, the environment, and social cohesions. That means public interests. The economic effects of such regulations might be substantial, but may be secondary or unexpected. Administrative regulations are so-called paperwork and often administrative formalities. With this type of regulation, governments intervene in individual economic decisions. As stated by den Hertog (2010), regulations mean the employment of legal instruments. These instruments are implemented to reach social-economic policy objectives and have certain characteristics: “individuals or organizations can be compelled by government to comply with prescribed behaviour under penalty of sanctions” (den Hertog, 2010: 3). This

means that regulations establish clear protocols and expectations of what is expected of a particular individual or company (Ly & Soman, 2013).

There are certain limits to effective governmental regulation that restrict regulators in what they can do. Firstly, a detrimental aspect of this policy instrument is the cost of (ensuring) compliance with regulations (Ly & Soman, 2013). The regulator is normally constrained by the available resources and the costs of rule-making and rule-enforcement. Additionally, the implementation can be very time-intensive and be accompanied by serious resistance. Secondly, regulations have to comply with valid economic and other laws which they cannot overrule. Regulations are therefore often confined to particular cases. Thirdly, regulations might impact existing political or civic organisations so that other instruments are preferable. Lastly, the values of the society need to be considered. If regulations are not in accordance with these values the greater the risk of non-compliance (Porket, 2003).

4.2.4 Information and awareness building

Information ensures that people make better decisions, so-called informed decisions. Information and education programs are often used in e.g. personal healthcare and saving programs, where learning and individual knowledge needs to be enhanced (Ly & Soman, 2013). Public information campaigns are one method to shape public attitudes, values and behaviour, and to reach some desirable outcome. Examples for such campaigns aim to appeal the “right” behaviour, like eating nutritious food, avoid illegal drugs, recycle trash, and so on (Schans & Optekamp, 2016).

4.3 Nudging as specific incentivisation instrument

4.3.1 Concept and aspects of nudging

In recent years, there is a growing interest in the concept of nudging. The concept is discussed in different scientific communities as well as by practitioners such as private and public organizations. Governmental units such as the initial Behavioral Insights Team (Nudge Unit) of the UK government or the White House Social and Behavioral Science Team in the United States, nudge labs and consultancies such as the Abdul Latif Jameel Poverty Action Lab (J-PAL) or ideas 42, and of course many companies are using nudges to achieve a desired behaviour of citizens or customers.

Basically, the concept describes how people can be steered in particular directions such as avoiding unhealthy food or reducing energy consumption, without taking them the possibility to go their own way. Based on insights from behavioural economics, which describes how behavioural changes are triggered by gentle incentives, nudges are used to influence people's behaviour without resorting to other methods such as commandments or prohibitions or economic incentive systems (Ly & Soman, 2013).

Nudging is seen as an instrument to promote behaviour that is beneficial for individuals or the society, and is mostly applied by policy makers to increase policy effectiveness or by companies for the development of communication strategies in shops, (neuro) marketing campaigns or for shaping buying behaviour through in-store space layout and management (Mont et al., 2014).

Nudging is defined as

“any aspect of the choice architecture that alters people’s behaviour in a predictable way without forbidding any options or significantly changing their economic consequences. To count as a mere nudge, the intervention must be easy and cheap to avoid. Nudges are not mandates. Putting fruit at eye level [to attract attention and hence increase likelihood of getting chosen] counts as a nudge. Banning junk food does not.”

(Thaler & Sunstein 2009: 6)

Instead of imposing restrictions or economic incentives, **nudges influence behaviour by changing the way decisions are made**. While a significant change in economic incentives is not considered a nudge, a nudge can be used to highlight an economic incentive and possible outcome.

Nudges are a relatively new tool, but they become part of the policy makers' toolbox, as they have been shown to have a significant impact on peoples' behaviour. In some cases, nudges are easier to implement than regulation or economic incentives. The goal of many nudges is to make peoples life simpler, safer or easier (Sunstein, 2014). For example, in order to reduce pollution and fuel consumption, policy may consider solutions that will drive up gasoline prices. However, drivers are against such price changes and it would be difficult for politicians to adopt such a policy without being criticised by their voters. The use of a nudge can be easier to implement and still lead to significant results. While nudges are effective at changing behaviour, their effectiveness depends strongly on the context. Therefore, it is important to choose an evidence-based approach to the design of nudges. Government agencies should

have access to a database or create a database documenting different nudging strategy and the conditions under which these strategies worked or did not work (Ly & Soman, 2013). Furthermore, nudging tools should be seen as a complement to traditional policy instruments and not so much as a substitute for regulations and laws or economic tools (Lehner et al, 2015).

It should be emphasized in particular that nudges are not mandatory and can (at least theoretically) be avoided (“opting out”). The primary goal in the field of nudging is to actively shape the decision-making environment. Even though, some nudges can be seen like a soft way of paternalism, because they steer people in a specific direction, nudges are designed to preserve full freedom of choice (Sunstein, 2014), the individual's freedom of choice remains formally unaffected (Kreuzberger, 2017). In most cases, the decision-making context is redesigned in such a way that the desired behaviour is also the most pleasant and simplest for decision-makers (Traxler & Hurrelmann, 2016). One well-known example of nudging is its use to improve eating habits, where in supermarkets or canteens healthy dishes with fruit and vegetables are placed within easy reach, while unhealthier dishes are located further up or in the back and can therefore only be reached with greater effort (Meske, 2017).

Two important aspects that need to be built into the basic practice of nudging are

- **transparency and**
- **evaluation of effectiveness.**

It is essential that the action (nudge) should not be hidden, e.g. an employer adopts a program that automatically enrolls people in a pension program (Sunstein, 2014). The extent of behavioural change achieved through nudging, and whether a behavioural change is long-term or temporary, depends heavily on the area in which and how it is applied (Samson, 2016).

4.3.2 Use by governmental agencies

Nudging has become very popular among policy makers because it allows influencing people's behaviour with low-cost methods instead of laws, bans, taxes or other difficult to implement measures. The take-up of nudging is also generally in line with the shift of welfare states towards “less state” (regulation) and “more market” (choices). In addition to the promise of “cheap government” it allows public policy offering choice in increasingly heterogeneous societies that no longer tolerate “one size fits all” policies (Lodge & Wegrich, 2016). These advantages have brought together different political camps and governmental agencies in countries worldwide under the banner of behavioural economics and nudging.

In recent years many governmental agencies have set up “nudge units” or contracted leading consultancies to provide policy-relevant insights and guidance on how to apply nudges. Important drivers of using behavioural insights in public policy interventions have been international policy agencies and organizations who recommended it to national actors, especially the Organisation for Economic Co-operation and Development (OECD) and the World Bank.

The OECD has been a highly active promoter since 2012, brought together policy-makers and researchers, and sponsored studies with a focus on behavioural economics and behaviourally informed environmental, consumer and other policies (e.g. Shogren, 2012; Lunn, 2014; OECD 2017a/b; OECD 2018: 147-162). The World Bank devoted its World Development Report 2015 *Mind, Society and Behaviour* to the use of behavioural insights (World Bank, 2015), and in the

same year brought together earlier activities in this field in the Mind, Behavior, and Development Unit (eMBeD). In 2018 the unit had a record of 85 completed and ongoing projects across 65 countries (Dalton, 2018; examples see Calvo-González & Zoratto, 2017).

The European Commission has also been a front-runner in bringing behavioural insights into regulatory and other interventions, e.g. in areas such as consumer rights, health and food policies. European Commission policy initiatives are underpinned by studies conducted or overseen by researchers of its Joint Research Center (Troussard & van Bavel, 2018). A report of the Center issued in early 2016 presents a comprehensive review of the use of behavioural insights across Europe already around that time (JRC / Sousa Lourenco et al., 2016). It includes examples of more than 200 policy initiatives from across the 28 EU Member States as well as Iceland, Liechtenstein, Norway and Switzerland. On the take-up of behavioural insights by the European Commission and EU member countries see also Zuidhof (2016) and Veglianti (2017).

A survey of OECD Research found that in August 2018 worldwide there were 202 units which applied behavioural insights to public policy interventions, about 150 established within governmental agencies (Naru, 2018, provides a mapping such groups). A survey in 2014 identified only 51 units which directed interventions centrally, thus today the number of governmental units is about three times larger (Whitehead et al., 2014; see also Whitehead et al., 2018). A survey report of OECD Research and the London School of Economics, in collaboration with ideas42 and the European Nudging Network (TEN), describes the implementation of behavioural insights by 60 responding units (OECD, 2017b; see also Afif et al., 2019, who describe several units in 10 countries).

The OECD survey received 159 cases where behavioural insights have been applied to policy interventions of which 113 cases across 10 policy domains are described in the survey report (OECD, 2017b). This overview of cases is illustrative rather than exhaustive because the Behavioural Insights Team (BIT) alone has since 2010 directed over 400 randomised controlled trials nudging studies (Sanders et al., 2018).

In summary, what started about 10 years ago with the path-breaking book of Thaler and Sunstein (2009) and some first “nudging units” is not a marginal development any more. Many governmental agencies now use behavioural insights for nudging people towards politically preferred behaviours. As stated in the OECD survey report, “Behavioural insights can no longer be seen as a fashionable short-term foray by public bodies. They have taken root in many ways across many countries around the world and across a wide range of sectors and policy areas” (OECD 2017b: 13).

4.3.3 Examples of nudging methods

There are many methods which are being used in different forms of nudging. Sunstein (2014) provides a list of 10 methods which he and other experts see as most effective:

Table 3: Overview – The 10 most effective methods and tools for nudging (based on Sunstein, 2014; Thorun et al., 2016; Mont et al., 2014)

Nudge	Examples	Short description
Default rules	Automatic enrolment in programs	Default rules are some of the most effective nudges. People often take the path of least resistance, prefer not to act unless they have to and procrastinate. Areas of application are usually fields like health, savings or education. Unless active choosing, which is also a type of nudging, is involved, some default rules are essentially inevitable. It might be an argument, that it makes sense to let people make an active decision, instead of relying on default rules. In certain contexts, it is ineffective and burdensome as well as time-consuming to require people to choose.
Simplification (& framing information)	Simplification of the application mode for funding	Complexity is a serious problem, because it causes confusion, it increases expenses, and it discourages people from participating. Programs or initiatives should always be easy navigable and intuitive. Especially for forms and regulation, simplification should have a high priority. The effects of simplification are often underestimated. Simplifying information and understanding in which context it is presented may change people choices drastically. Simplification is often used together with framing which means phrasing of information in a way that activates certain values and attitudes of individuals.
Use of social norms	Emphasising what most people do, e.g. most people plan to vote; nine out of ten hotel guests reuse their towels	A very effective method in different forms of nudging. It informs people that most others behave as is proposed by the nudge. Such information is most powerful when it is as local and as specific as possible. The use of social norms can reduce illegitimate behaviour or behaviour that is harmful to others. This form of nudges is also suitable

		for undesired behaviour. In this case it is about highlighting not what most people actually do, but what most people think people should do (“90% of the people in Ireland believe that people should go to vote”).
Increase in ease and convenience	Making low-cost options or health food visible by placing it at eye-level	People tend to make the easy choice. Therefore, in a nudge it is important to reduce potential barriers and make it “easy” and “fast”. Resistance to change is often a product of perceived difficulty or ambiguity. An add-on is to make the choice also fun.
Disclosure	Disclosure of external costs, e.g. the total environmental costs of alternative mobility options; communication of the total cost of a credit card	This type of nudging is particularly effective in the area of interested consumers who make informed decisions. The basic requirement for this is to make information understandable and easily accessible.
Warnings, graphic or otherwise	Warnings or graphics e.g. on cigarette box	When dealing with serious risks, warnings and graphic, either private or public, are a suitable nudge. In order to get people’s attention, large fonts, bold letters and bright colours are effective. But attention is a scarce resource, and warnings are attentive to that fact. Attention has to be paid, because people tend to respond to warnings counteracting them toward unrealistic optimism. People might respond to warnings by discounting them. In this case, it is recommended to experiment with more positive messages (e.g. rewards for the preferred behaviour, even non-monetary like congratulations in apps).
Pre-Commitment strategies	By which people commit to a certain course of action, e.g. www.stickk.com (stickK, is an app/platform that promises people to support in achieving life, business, health, and career goals. Created by behavioural economists at	Many people have specific goals, like stop drinking/ smoking, exercise more, but their behaviour falls short of those goals. But if people pre-commit to engage in a certain issue, they are more likely to reach their goals.

	Yale University, the free goal-setting platform influences behaviour change through loss aversion and accountability.)	
Reminders	Reminders per email or text message	People tend to miss deadlines, paying bills or taking medication. This is often due to procrastination, forgetfulness or lack of time. Small memories can stimulate action. A very similar approach is "prompted choice". People do not have to choose, but are asked whether they want to choose (e.g. clean energy/new energy provider, privacy settings on the PC or whether they want to become an organ donor).
Electing implementation intentions	„Do you plan to renovate your house?“ “Do you plan to vote?“	People are more likely to engage in an activity if someone elicits their implementation intentions. A simple question about future conduct can have significant effects. Furthermore, it can be helpful to activate people’s self-esteem.
Informing people of the nature and consequences of their own past	Feedback about energy consumption	Companies, public and private institutions have a large amount of personal information and data at their disposal and can therefore draw conclusions about past decisions. Disclosing these past decisions can help people learn from them and improve current decisions and make them in the best possible way.

Also, often classified as a “nudging element” is changing physical environments (Goldberg & Gunasti, 2007; Mont et al., 2014). The physical environment has been acknowledged to have a significant impact on people’s individual choice. People allow the physical environment to influence their choices, especially in low involvement decision-making situations. One common example thereof is the retail store or supermarket where people make their daily purchases. A research study conducted in 2008 by Pucher and Bühler aimed to identify significant factors for an increase in cycling as means of transport in Denmark, the Netherlands, and Germany. One of their findings was that the most important policies to increase the share of cycling in total transport is related to changes to the physical environment. According to the study, the most important policies are the provision of separate cycling facilities along busy roads and intersections, traffic calming efforts in residential neighbourhoods, the provision of enough parking spaces for bicycles and the integration of biking with the public transport (Pucher & Bühler, 2008).

4.3.4 Behaviour Change Techniques in context of smart citizen behaviour

While the table above describes some of the most effective nudges, the following list gives an overview of nudges clustered according to the objective or target they are striving for. The Behaviour Change Technique Taxonomy (BCTT) was developed by the University College London within a major research project. The project aimed i) to develop a reliable and generalizable nomenclature of behaviour change techniques as a method for specifying, evaluating and implementing complex behavioural change interventions, and ii) to achieve its multidisciplinary and international acceptance and use to allow for its continuous development. The research methodology consisted of three stages. Within the first phase the nomenclature was developed. Experts in behaviour change then defined the key attributes of each technique and how it related to and differed from others by using the Delphi method. Within the second stage, the nomenclature was tested. Trained experts used the nomenclature to code published descriptions of complex interventions. Reliability between experts, over time and across types of user, was assessed. Furthermore, the study assessed whether using the nomenclature to write intervention descriptions enhances the clarity and replicability of interventions. Finally, the third phase developed a web-based users' resource of clearly specified and non-redundant techniques, and an interactive web-based platform.

The results of the research project, the behavioural change techniques have been hierarchically clustered and defined. The following paragraphs provide an overview of the BCT taxonomy and are extended with examples. Some of the examples have been adapted according to the focus areas of the SimpliCITY project. A list of all BCTs with newly worked out examples from the areas of incentivising bike mobility, sustainable consumption or social inclusion is provided in the annex of the study

Table 4: Behavioural change techniques (BCT) (Source: Michie et al., 2014)

Cluster	Behavioural change techniques
Goals and planning	(1) Goal setting (behaviour) (2) Problem solving (3) Goal setting (outcome) (4) Action planning (5) Review behaviour goal(s) (6) Discrepancy between current behaviour and goal (7) Behavioural contract (8) Commitment
Feedback and monitoring	(1) Monitoring of behaviour by others without feedback (2) Feedback on behaviour (3) Self-monitoring of behaviour (4) Self-monitoring of outcome(s) of behaviour (5) Monitoring of outcome(s) of behaviour without feedback (6) Biofeedback (7) Feedback on outcome(s) of behaviour
Social support	(1) Social support unspecified (2) Social support (practical)

	(3) Social support (emotional)
Shaping knowledge	(1) Instruction on how to perform behaviour (2) Information about antecedents (3) Re-attribution (4) Behavioural experiments
Natural consequences	(1) Information about health consequences (2) Saliences of consequences (3) Information about social and environmental consequences (4) Monitoring of emotional consequences (5) Anticipated regret (6) Information about emotional consequences
Comparison of behaviour	(1) Demonstration of the behaviour (2) Social comparison (3) Information about others' approval
Associations	(1) Prompts/ cues (2) Cue signalling reward (3) Reduce prompts/ cues (4) Remove access to the reward (5) Remove aversive stimulus (6) Satiation (7) Exposure (8) Associative learning
Repetition and substitution	(1) Behavioural practice/ rehearsal (2) Behavioural substitution (3) Habit formation (4) Habit reversal (5) Overcorrection (6) Generalisation of the targeted behaviour (7) Graded tasks
Comparison of outcomes	(1) Credible source (2) Pros and cons (3) Comparative imaging of future outcomes
Reward and threat	(1) Material incentive (behaviour) (2) Material reward (behaviour) (3) Non-specific reward (4) Social reward (5) Social incentive (6) Non-specific incentive (7) Self-incentive (8) Incentive outcome

	<ul style="list-style-type: none"> (9) Self-reward (10) Reward (outcome) (11) Future punishment
Regulation	<ul style="list-style-type: none"> (1) Pharmacological support (2) Reduce negative emotions (3) Conserving mental resources (4) Paradoxical instructions
Antecedents	<ul style="list-style-type: none"> (1) Restructuring the physical environment (2) Restructuring the social environment (3) Avoidance/ reducing exposure to cues for the behaviour (4) Distraction (5) Adding objects to the environment (6) Body changes
Identity	<ul style="list-style-type: none"> (1) Identification of self as a role model (2) Framing/ reframing (3) Incompatible beliefs (4) Valued self-identity (5) Identity associated with changed behaviour
Scheduled consequences	<ul style="list-style-type: none"> (1) Behaviour cost (2) Punishment (3) Remove reward (4) Reward approximation (5) Reward completion (6) Situation-specific reward (7) Reward incompatible behaviour (8) Reward alternative behaviour (9) Reduce reward frequency (10) Remove punishment
Self-belief	<ul style="list-style-type: none"> (1) Verbal persuasion about capability (2) Mental rehearsal of successful performance (3) Focus on past success (4) Self-talk
Covert learning	<ul style="list-style-type: none"> (1) Imaginary punishment (2) Imaginary reward (3) Vicarious consequences

The group **goals and planning** includes behavioural change techniques (BCT) that refer to set a goal defined in terms of either the behaviour or the targeted outcome. Additionally, it includes techniques for analysing factors that influence the behaviour for setting strategies to overcome the barriers or to increase facilitators and for prompting detailed planning of

performance of the behaviour including the context, the frequency, the duration and/ or the intensity such as planning the performance of a physical activity like running, at a particular time (e.g. before work) on certain days of the week. Furthermore, it refers to techniques that draw attention to the discrepancies between a person's current behaviour and the person's previously set outcome goals, behavioural goals or action plans. This BCT is most likely to be combined with further BCTs such as feedback on behaviour, review of behaviour goal(s) or review outcome goals. Moreover, behavioural contract and commitment are included to this group, referring to a written specification of the targeted behaviour and to a (re-)affirmation statement indicating commitment to change the behaviour (both linked to goal setting (behaviour)) (Michie et al., 2013).

The **feedback and monitoring** group suggests to monitor a person's behaviour by other people as well as by the person itself as part of a behaviour change strategy. The BCT group includes recording of the behaviour outcome coupled to an evaluative feedback on the behaviour itself and on the outcome, which e.g. may be to inform a person about how much weight they have lost, or inform the person about their blood pressure with help of an external monitoring device. If the outcome is related to some positive reinforcement by others, it can be linked to the BCT social reward (Michie et al., 2013).

The BCT group **social support** considers three forms of social support, which can be unspecific, practical, or emotional. The unspecified support includes encouragement and counselling directed at the behaviour, whereas practical social support provides practical help to perform the respective behaviour. An example of emotional social support would be to bring a friend or a partner to the colonoscopy appointment (Michie et al., 2013).

The fourth group **shaping knowledge** emphasises on informing people about how to perform the behaviour and on how to detect antecedents as key moments to predict future performance of the behaviour. The following BCTs suggest alternative explanations on the cause of the behaviour and consider collecting and interpreting data in order to establish hypotheses about the behaviour (Michie et al., 2013).

The focus of the cluster for **natural consequences** lies on providing information about arising consequences upon performing the behaviour and on how to monitor such. Whereat, the goal is not only to provide information about e.g. health consequences, emotional consequences, or social and environmental consequences, but also to put special emphasis on the memorability of the indicated consequence of performing the behaviour, such as showing pictures of health consequences on cigarette packets. A further target is to monitor a person's emotions upon attempts of performing the behaviour and to raise awareness of future regrets provided by performing an unwanted behaviour, e.g. the degree of regret a person will feel if they do not quit smoking (Michie et al., 2013).

The cluster **comparison of behaviour** discusses the comparison of a person's behaviour to an observable sample (e.g. film, picture) or to other people's performance. Further, information on others' approval (or disapproval, respectively) on the person's behaviour is provided (Michie et al., 2013).

The BCTs contained in the **associations** group involve stimuli from outside to prompt or cue behaviour. Such environmental or social stimuli have to be induced (can imply reward) and are then gradually withdrawn. The access to a certain situation, which can generate rewards, can be avoided as to prevent a person from performing unwanted behaviour. Further, the exposure to a stimulus reducing the performance of an unwanted behaviour can be arranged or aversive

stimuli have to be removed in order to facilitate the behavioural change. In order to reduce the response to a feared stimulus, people can be repeatedly exposed to such situations. The associative learning technique aims on linking a neutral stimulus to a stimulus already provoking certain behaviour until the neutral stimulus itself induces the behaviour (Michie et al., 2013).

Repetition and substitution of a performance can make the person change their habits and behaviour. In order to increase a person's habit or skill, a performance can be practiced several times in a context where it is not necessary to perform, or it can be repeated always in the same context until the context elicits the behaviour. Further, behaviour can be replaced by a desired one or the performance of wanted behaviour can be extended to new situations. After performing unwanted behaviour, people can be asked to perform the desired behaviour in an exaggerated way. While starting with an achievable task, the intensity of the task should gradually increase (Michie et al., 2013).

The cluster **comparison of outcomes** includes small techniques from providing people with information from credible sources in order to find a decisional balance by identifying reasons (pros/cons) to change the behaviour to a comparison of the future outcome of changed versus unchanged behaviour (Michie et al., 2013).

Another BCT group contains techniques aiming at **rewards and threats**, which can be material, non-specific, social or so-called self-rewards/self-incentives. Such positive reinforcement is reached by incentives and further by rewards, whereas either the effort or the outcome can be incentivised or rewarded. Finally, information is provided about future punishment or removal of the reward upon unwanted behaviour (Michie et al., 2013).

The following BCT group highlights the importance of **regulations**. In order to accomplish behavioural changes, pharmacological support can be provided, negative emotions should be reduced and mental resources have to be conserved. Besides, paradoxical instructions can be given so as to engage in unwanted behaviour with the aim of reducing it (Michie et al., 2013).

The chapter **antecedents** treats the restructuring of the physical as well as the social environment of a person in order to facilitate the performance of the wanted behaviour or to construct barriers in order to prevent unwanted behaviour. Further, it includes techniques to avoid the exposure to social cues inducing unwanted behaviour or to find distraction from undesired behaviour. In addition to objects added to the environment (providing information, e.g. booklet is not sufficient), the person's body structure can be altered (e.g. by training) in order to facilitate the behaviour change (Michie et al., 2013).

The next group focuses on the person's **identity** within the context of BCTs. In addition to the identification of self as a role model, this includes also the framing or reframing of the person's perception regarding certain behaviour, e.g. reducing sedentary behaviour rather than increasing activity. Moreover, discrepancies between a person's behaviour and their self-image are highlighted. Self-affirmation through valuing a person's self-identity as well as discovering a new self-identity through behavioural changes is encouraged (Michie et al., 2013).

Scheduled consequences can be the withdrawal of something valued upon performance of unwanted behaviour, punishment or removal/adaptation of the reward. Rewards can be approximated, e.g. gradual rewarding, arranged following the final component of the behaviour or given situation specific, e.g. rewards for eating at mealtimes but not between meals. The

techniques include counter-conditioning as well as differential reinforcement, which implies rewards for actions incompatible or alternative to previous responses or unwanted behaviour. Finally, the reward frequency is reduced or the punishment is removed (Michie et al., 2013).

Strengthen a person's **self-belief** is part of the next behaviour change strategy. In this context it is important to verbally persuade a person about their capability (arguing against self-doubt) and further make them imagine the successful performance of the behaviour. Then, the person is advised to think of previous situations when successfully performing the behaviour and to focus on their past success. Finally, people should be encouraged on positive self-talk before and during the behaviour (Michie et al., 2013).

Covert learning presents the topic of the last BCT group where the methods of imaginary punishment or rewarding are tackled. People are advised to imagine the performance of certain behaviour and the following unwanted punishment or wanted pleasant consequence, respectively. Attention is also drawn to the consequences for others when they perform the behaviour, e.g. positive comments of colleagues (Michie et al., 2013).

4.3.5 The nudging process

Different nudges are required for different targets and within different contexts. Therefore, it is essential to design an effective nudging strategy in the first place. An analysis of the context and the task is required to identify how people make decisions or what are the usual behavioural habits in typical circumstances. Then the key heuristics and influences that may affect the decision outcome need to be identified (Ly et al., 2013).

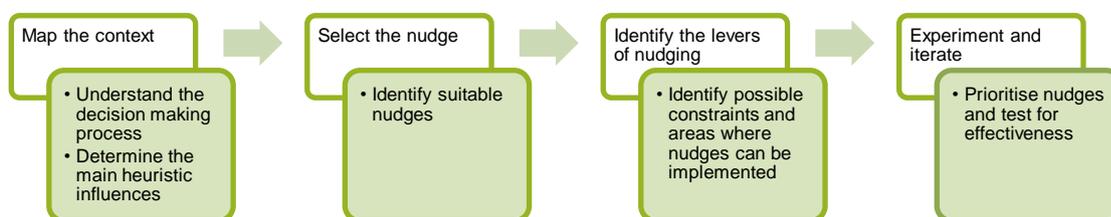


Figure 2: Nudging process (Source: Ly et al., 2013)

(1) Mapping the context

In the first step it is important to analyse the decision-making process in order to identify factors that are crucial for taking the decision. These factors represent areas where a nudging might be successful and yield quick dividends. Questions that need to be answered within this step cover four different aspects of the decision-making process:

- The property of the decision (incl. understanding the incentives and motivations associated with the decision and how much attention the decision receives)
- Information source (how is the information gathered and presented?)
- Features of the individual's mind-set (is the outcome of the decision influenced by emotions?)
- Environmental and social factors (for example peer pressure or a lengthy application process)

After that, a map of the decision-making process should be made, which outlines the critical actions within the process. One of the biggest challenges within this step is to trigger an awareness of the importance of the selected topic (e.g. health or sustainability). The desire to achieve an outcome (e.g. live more sustainable, save more energy, save more money) could be the result of a life event (e.g. marriage, new apartment) that motivates a person to complete the needed actions. Therefore, life events are considered as good moment to nudge people to action (Ly et al., 2013).

However, it is not self-evident that nudges are likely to work. Therefore, it has to be analysed for what behaviours nudge instruments usually are applied. As suggested by Thaler and Sunstein (2008) nudges are appropriate when the choices that are made have delayed effects or when the decisions are complex or infrequent and thus learning is not possible, when there is no feedback available, or when the relation between decision and outcome is ambiguous. Furthermore, nudges are likely to be successful in situations where no choice is actually made, and where it is appropriate to speak of routines or habitual behaviours. It is estimated that about 45% of people's everyday actions are no choices at all, but habits or routines (Verplanken & Wood, 2006), as in the example of leaving the lights on when going to another room or accelerating heavily when driving the car (Mont et al., 2014). These examples, show that major parts of people's behaviours are not actively reflected which makes it the primary application area for nudging initiatives. Therefore, nudge interventions are most appropriate in so-called "low-involvement" decisions, where little conscious deliberation is involved, and in high-involvement decisions that have a high degree of complexity and are unfamiliar to the decision-maker.

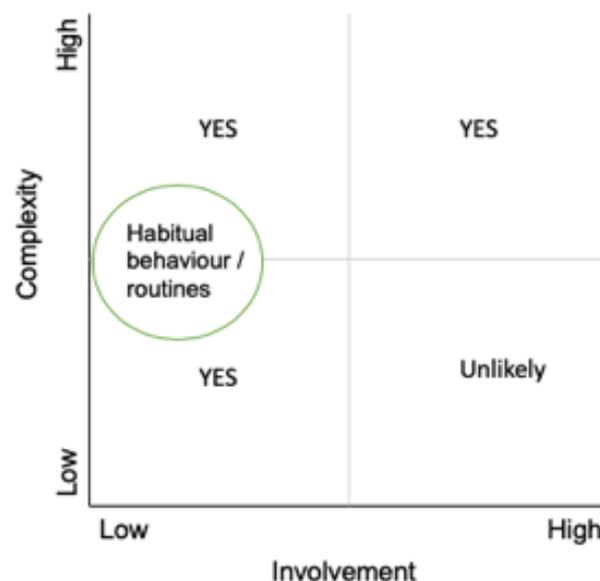


Figure 3: Areas in which nudging is likely to be effective (Source: Mont et al., 2014; own representation: P.Stabauer)

According to a research study from the USA (Costa & Kahn, 2013), nudges are more likely to be effective if they are perceived as legitimate or when they are so unobtrusive as to be virtually invisible. Furthermore, nudges are more likely to be effective if they are in line with people's ideal choices and values (Mont et al., 2014).

(2) Select the nudge

Nudges should be implemented at the bottlenecks within the decisions-making process. In thinking through a solution to the bottlenecks that an individual might face, it is recommended to consider the following four questions:

- Are individuals aware of what they need to do but unable to accomplish it, or does a desired behaviour or action need to be activated?
- Are they motivated enough to impose a nudge on themselves?
- Is the action more likely to be taken with increased cognition, or are individual currently hampered by cognitive overload?
- Is the desired action not being accomplished because of a competing action or due to inertia? Consequently, should the aim be to discourage the competing action or encourage the target action?

When it comes to nudging, it is obvious that there is no “one-size-fits-all” solution. But a growing number of people, organisations and nations deal with nudging and an increasing number of examples of successful nudging initiatives are available (Sunstein, 2014). Moreover, many nudging initiatives do not only build on one method or tool, they are based on a combination of various elements that are often interrelated. Finally, nudging interventions suggested by Thaler and Sunstein (2008) also involve active information processing (Ölander & Thøgersen, 2014; Mont et al., 2014). The table below lists various behavioural influences and heuristics that could cause potential bottlenecks.

Table 5: Behavioural influences and heuristics (Source: Ly et al, 2013)

Behavioural influences	
Status quo	An individual’s preference to maintain their current state, even if a change in the circumstances would provide better options.
Endowment effect	The inclination to value and pay more for an item that is already in possession than for an item that has yet to be attained.
Loss aversion	A tendency of individuals to be more attuned to losses than gains.
Confirmation bias	A predisposition to accepting information that confirms one’s opinion or conclusions rather than information that is contradictory.
Mental accounting	Money is mentally allocated to several “accounts” such as clothing or entertainment rather than being perceived as fungible.
Willpower	Individuals only have a certain amount of willpower at any given time and that willpower needs to be replenished periodically.
Hyperbolic discounting	To value benefits that are reaped now more than benefits reaped in the future. Costs that are paid in the future are not felt as deeply costs that are paid now.

Choice overload	The presence of too many choices for a particular decision, making it difficult to evaluate and decide.
Information overload	The presence of too much information in the environment, preventing the individual from evaluating and making a good decision.
Heuristics	
Availability bias	Information that readily comes to mind used to make a decision rather than using a comprehensive set of facts that evaluates all opinions.
Representativeness	The use of similar attributes to judge the likelihood of an event occurring. This is in contrast to using a more comprehensive approach that would utilize statistics to determine likelihood.
Anchoring and adjustment	To make an estimate by applying adjustments to a particular relevance value.
Social proof	When individuals look to the behaviour of their peers to inform their decision making, and their tendency to conform to the same behaviour their peers are engaged in.

Identify the levers of nudging

At this stage of the process it is important to identify the constraints such as costs and resource availability and possible levers for nudging in order to speed up the development process. This part of the process is dependent of the type of nudges identified in the previous step. Furthermore, it is recommended to check whether the following options are available:

- Implementation of an automatic enrolment process.
- Offering a default option or changing an existing default option.
- Modification or change the current choices that are available to the individual.
- Simplification of the process that facilitated the decision-making process.
- Use of technology to reduce the cost (per individual) or improvement of the scalability.

(4) Experiment and iterate

Prioritise nudges

After identifying the right type of nudge and potential levers for nudging, a prioritisation of nudges is essential. It is possible to combine nudges, but it is useful to prioritise. Beside the costs for the nudging initiative, which are as well an important selection criterion, the following points need to be considered:

- Which bottlenecks does the nudges address? Nudges need to be prioritised based on where the bottlenecks are in the decision-making process. It is recommended to

choose nudges that resolve bottlenecks that are further upstream on the decision-making process.

- Relative reach. Self-imposed nudges such as pre-commitment may not reach as many people as default or automatic enrolment.
- Interventions like automatic enrolment have a high adoption rate but may lead to everyone accepting the same terms and benefits. It is essential to consider that the target audience have different behavioural preferences and needs.
- The long-term effectiveness of the nudge and whether the intervention could lead to the development of new, more beneficial habits.

Test effectiveness

For the evaluation of the nudging process and the assessment of the impact it is important to test and document the effectiveness of the selected nudging strategy. Thaler (2012) provides two mantras for testing nudging strategies:

1. If you want to encourage some activity, make it easy, and
2. You can't do evidence-based policy without evidence.

When testing nudging strategies, both a process evaluation and an outcome valuation are needed. The outcome evaluation confirms that the nudge has led to the desired outcome, a process evaluation supports the underlying mechanisms. Randomization is critical for testing the effectiveness of nudges (no demographic biases, representative population, free of biases such as self-selection) (Ly et al., 2013). One primary goal of nudging is experimentation, with careful controls. One advantage of most of types of nudging is, that only a limited amount of time and budget is required and that it allows for continuous measurement and improvement, because nudging initiatives can often be implemented in existing initiatives with little expenses or efforts (e.g. sending out a letter to encourage people, it is easy to send out various versions of the letter and test if one of the variations is more effective) (Sunstein, 2014).

4.3.6 Digital nudging

Digital nudging is defined as

“the subtle way of using design, information and interaction elements to influence user behaviour in digital environments without restricting the individual's freedom of choice”

(Meske & Potthoff, 2017, p. 2589).

Digital environments are, same as offline environments, no neutral choice environment. Digital choice environments nudge people by deliberately presenting choices or organizing workflows, making digital nudging - “the use of user-interface design elements to guide people’s behaviour in digital choice environments” – a powerful tool in choice architecture (Schneider et al., 2018). There are already many guidelines on how to implement nudges within offline environments. Only in recent times, digital nudging became the focus of interest for designers of digital user interfaces. But it has to be considered, that guidelines that are used for successful offline nudging initiatives cannot always be directly transferred to the digital environment.

Digital nudging and persuasive technologies are often mixed up and used synonymously. There are many similarities between nudging and persuasion. The idea of persuasion and

persuasive technology per-se is not new, especially in the fields of information science and human-computer-interaction (HCI). Persuasive technology “is broadly defined as technology that is designed to change attitudes or behaviours of the users through persuasion and social influence but not through coercion” (Anagnostopoulou et al., 2018, p.1).

Research focusses on using design elements for influencing the decision-making process and changing people’s behaviour since the turn of the millennium (Meske & Potthoff, 2017). Persuasive technology is often understood as information technology that is exclusively designed for changing people’s behaviour. However, the implementation of persuasive elements in established information systems is not addressed in the first place. The following table exemplarily shows some similarities and differences between nudging and persuasive technologies according to Fogg (2003) (persuasive technology) and Thaler and Sunstein (2009) (Nudging).

Table 6: Similarities and differences between nudging and persuasive technology (Source: Meske & Potthoff, 2017)

Term	Artefact	Realm	Action	Aim	Target	Predict-ability	Limitation
Nudging is...	any aspect	of the choice architecture		that alters	people’s behaviour	in a predictable way	without forbidding any options or significantly changing their economic incentives
Persuasive technology is	any interactive computing system		designed	to change	people’s attitudes or behaviour		without using coercion or deception

For the development of the DINU model, presented in the next chapter, literature of nudging, persuasion and persuasive technology was screened, analysed and evaluated in order to combine the most important characteristics for nudging in the digital environment.

4.3.6.1 Design of digital nudging interventions

Below we outline the DINU model for designing digital nudges.

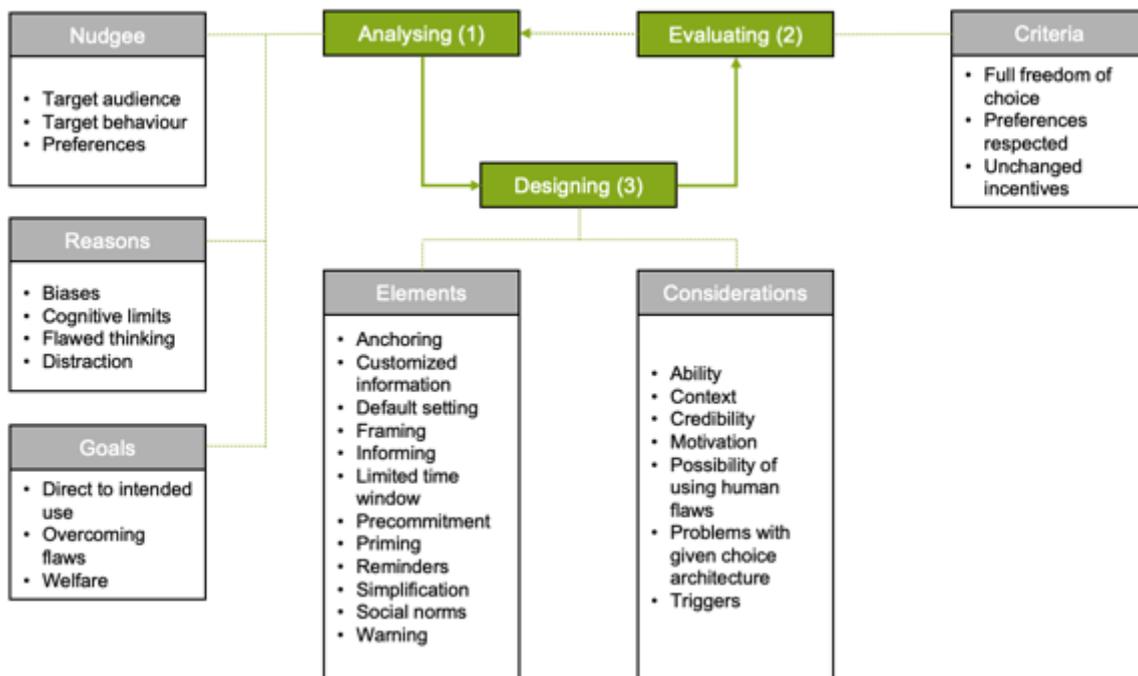


Figure 4: DINU-Model (Source: Meske & Potthoff, 2017, own representation)

During the first phase of **analysing** (1), a target behaviour for a defined target audience needs to be developed. Furthermore, the reasons for undesired behaviour, like a limited cognitive capacity need to be assessed, as well as goals for the digital nudging such as “overcoming flaws”.

In the next step, **designing** (2), suitable elements and situations regarding the pre-defined reasons, goals and characteristics of the nudge need to be defined. The following grouped elements (see Figure 4) include components from persuasion and nudging literature. Anchoring, customized information (tailoring), decision staging (tunnelling), default setting, framing, informing, limited time window, gamification (praise and reward), precommitment strategy, priming, reminders, simplification (reduction), social norms (social influence and comparison), and warning. Simplification, which is a helpful nudge in the digital environment, contributes to nudging only if it refers to the simplification of the decision environment by reducing distraction and not the options. Besides these elements, Meske and Potthoff (2017), propose hints and strategies based on theoretical finding, in order to select suitable nudges. The hints and strategies include the general ability (money, physical efforts, etc.), context, credibility, motivation, the possibility of using human flaws, problems with the given choice architecture and triggers.

In the third step, **the evaluation phase** (3), the designed and implemented digital nudge is being evaluated. Firstly, it should be assessed whether the target behaviour has been achieved or if it is necessary to modify the digital nudge. At this stage, also a reflection of the selected elements is recommended. Furthermore, unexpected facts can change the decision situation.

The use of nudges is strongly dependent on the given context. The DINU model can provide a framework for this in order to design appropriate measures. Last but not least, it is important to consider the ethical dimension of nudging, which is addressed in chapter five.

4.3.7 Example of a successful nudging intervention design

One interesting example of a successful nudging campaign is the design and implementation of a nudge successful nudging campaign was introduced by the non-governmental, non-profit organisation Nudge Lebanon. The organisation applies insights of behavioural economics to policy challenges in Lebanon focussing on the improvement of citizens-oriented policies and guiding people as well as organizations towards better choices for themselves and their communities (Nudge Lebanon, 2019).

One nudging experiment conducted by Nudge Lebanon in collaboration with the local electricity unit aimed to improve the timely payment of electricity bills and reduce the number of visits of the collectors.

In Lebanon subscribers of electricity services generally pay bills to collectors. Under the regulation of the governmental institution Electricity Du Liban, which controls most of the country's electricity system, bills are to be paid within 40 days of their issuance date. Collectors are required to visit their assigned subscribers for a maximum of two times, giving reminder slips to those who do not pay by the first visit, in which the amount due and the proposed date of the second visit is stated. In practice, more than 90% of subscribers pay within 40 days, but collectors make more than two visits to achieve that rate, adding considerable administrative and human costs to the collection process. Therefore, a randomized control trial was conducted in Saida City, in collaboration with Electricité du Liban and the assigned Service Provider, to examine the effect of adding simple nudge messages in the reminder slips on increasing payment of electricity bills by the second visit of collectors.

Design

The trial was randomized at subscriber level, whereby a sample of 429 participating households randomly received one of four slips from collectors:

- The *control slip*, which consist of the original reminder with no modifications
- The *hassle factor and loss aversion slip*, which lays out steps the subscriber has to follow in case of no compliance by the second visit and highlights the extra financial fees that will be charged
- The *social norm slip*, which reveals the high percentage of subscribers in the local community paying their bills on time. The message reads as follows: “More than 90% of the residents in your area pay their bills on time, will you be part of this group?”
- The *national pride slip*, which primes individuals to instil a sense of national responsibility, by including the Lebanese flag and using soft language that triggers a sense of patriotism. The message reads as follows: “Your country needs you, be a good citizen and pay your due electricity bill on time”.

Nudge Lebanon recorded, through collectors, whether households paid their dues on the first visit, either immediately or after receiving the reminder slips, or paid in the second visit.

Result and impact

As the following results show, the *national pride nudge* was the most successful one.

- 61.4% of those receiving the “National Pride” slip paid their bills by the second visit (significant at 5% level), which is 15% higher than payment rate of the control group;

- 60.2% of subscribers receiving the “Social Norms” slip paid their bills by the second visit (significant at 5% level), which constitutes a 13% improvement compared to the control group, and finally
- 55.3% of subscribers receiving the “Hassle Factor” slip paid their bills by the second visit (statistically insignificant), which constitutes an increase of 4% compared to control response rate.

Furthermore, results show that already small nudges, especially in the context of social norms and national pride can effectively change people’s behaviour and in terms of the study, speed up bill payment rates.

4.4 Gamification for changing citizen behaviour

Over the last few years, gamification, the use of game design elements in non-game contexts, has often been used as a method to increase citizens engagement and participation in smart city initiatives (Kazhamiakin et al., 2016) and for promoting sustainable mobility behaviour, energy consumption or health initiatives. Gamification is often-used in the context of supporting user engagement and enhancing service use. It is being used to increase user activity, promote social interaction, and foster quality and productivity of actions (Hamari et al., 2014).

Gamification, for example implemented through a smartphone app, can either activate intrinsic motivation (induces people to do things out of own interest, curiosity or social norms) whereby a modification of the behaviour by choice can be affected, or extrinsic motivation that is an impetus of motivation by external factors, material rewards or negative incentives like punishment (Engel, 2017, p.71).

According to the flow theory proposed by Csikszentmihalyi (1975) the level of complexity matters for the choice of the elements for within a gamification approach. In others terms, a gamification intervention should be designed in a way that it is not too easy, so the game gets boring, nor should it be too difficult, so that users tend to resign. In order to reach the condition of flow, different game elements need to be combined. The following table presents an overview of game elements, intrinsic and extrinsic, that normally do not exist individually. In the gamification approach these elements are combined in a way they increase the motivation of the user (Engel, 2017). Often used gamification elements, were categorised into ten different motivational affordance categories. Most of them are also listed in the table below. Additional categories are points, stories and themes and clear goals. In literature, the most commonly found motivational factors tested in empirical studies are points, leader boards and badges (Hamari et al., 2014).

Table 7: Game design elements (Source: Engel, 2017, p.72; Hamari et al., 2014, p. 3027)

Game design elements	Motive/ motivational factor
Intrinsic motivation	
Levels/ progression	Achievement
Progress bar	Achievement

Challenges/ quests	Flow
Teams	Social network
Extrinsic motivation	
Collection	Rewards (e.g. physical rewards/ financial rewards)
Leader boards/ competitions	Rewards (e.g. social status)
Badges/ achievements	Rewards (e.g. certificates, medals)
Feedback	Rewards (e.g. commendation)

The use of different game design elements is also dependent on the target group and whether the gamer aims to play by him- or herself or in a team. For example, leader boards give an overview of the order and where the user stands compared to other players. When using leader boards, comparison to rankings, that often intensify the competitive pressure, it is possible to let people work as a team. Furthermore, being member of a group increases the motivation and the probability of mastering challenges or to help on oneself and others in the game (Engel, 2017, p. 71).

Gamification approaches are also dependent on their purpose and according to their context. Based on an in-depth literature analysis by Hamari et al. (2014) gamification is often used in the context of education and learning, followed by work and intra-organizational systems, but also in the context of sharing and sustainable consumption.

According to the “MAX-self-regulation model” (Bamberg, 2012) different phases can be determined during the behavioural change process. In the **first phase**, when intending to use a different means of transport, a person does not necessarily think about changing their behaviour. For the gamification design, this implies that elements should be used that playfully draw attention to the topic of sustainable mobility and further disadvantages of car use for health or the environment. For this purpose, quizzes or knowledge games with rewards are considered to be particularly suitable for this purpose. Within the **second phase**, people start thinking about really changing their behaviour, but do not yet know how. In this phase, people need to be prepared with information about alternatives to their current means of transport. Therefore, information about daily habits, like the usual means of transport, their everyday life ways and their commuting routes need to be collected in the beginning (e.g. when registering for the game). At this stage it is recommended to link the game with timetable information apps from public transport providers or with bike-routing apps. For using the suggested alternative, people might receive some kind of reward. Within the **third phase**, the targeted/ desired behaviour, e.g. cycling instead of driving with the car, is already occurring from time to time. In this case, an intervention needs to be made in terms of rewarding the targeted behaviour and providing challenges (transition to intrinsic elements). At this stage, it is recommended that the degree of difficulty is steadily rising (different levels). In the beginning of the intervention, car use for example, is accepted, but then more and more only the use of e.g. the bike leads to achievements and progress. In the last phase, the highest level, the bike is the only means of transport used. The overall aim is to maintain the behaviour of the last phase.

One example, presented by Engel (2017) is the integration of a map of road environment of the workplace in an app by using augmented reality elements. This map could be hidden gradually and shown when different bike lanes are used or different challenges are completed. When considering games and challenges like these, not only the intervention design needs to be thought out, but also external factors like seasons need to be considered.

Table 8: Game mechanics (Source: Bunchball, Inc., 2010)

Game mechanics	Human desires					
	Reward	Status	Achievement	Self-Expression	Competition	Altruism
Points	X	X	X		X	X
Challenges	X	X	X	X	X	X
Levels		X	X		X	
Leader boards		X	X		X	X

Innovative and often costly city policies, services and advanced IT solutions often fail if they are not combined with tools, methods and initiatives aimed to increase the awareness of citizens and changing people’s behaviour (Kazhamiakin et al., 2016).

Smart cities can be considered as a very complex conglomerate of people, information systems, services, sensors, smart objects and many other ICT and cyber-physical systems. This is just one reason why they are very challenging when it comes to raising awareness and indicating a long-term behavioural change. Challenges are not only due to new technologies but also from a governance and social point of view. However, not all of the above described methods and tools are suitable for changing people’s behaviour towards a more sustainable lifestyle. In order to promote and sustain behavioural change it is essential to recognize that using gamification as a persuasive technology within a smart city is fundamentally different from gamification of a stand-alone information system. It is also much more challenging, because in a self-contained system the objective is usually pre-decided, while in a city-wide application aimed to involve citizens a more open approach is required.

4.4.1 Gamification for sustainability

As mentioned in the previous section, gamification is used in various fields of application. One that is gaining in importance is sustainability, especially sustainable mobility. Many cities are facing problems related to high CO₂ emissions, traffic jams and insufficient parking spaces. Even though, cycling would be one option to overcome these challenges, and despite the documented advantages of cycling, many cities have only a small share of cyclists. People state that barriers like the negative image of cycling and cyclists per-se, low safety and the considered inconvenience, prevents them from biking (Scott & Span, 2009; Millonig et al.,

2016). The provision of a better biking infrastructure and better access to bikes, may support people to bike more, but will not overcome the barriers as they are based on emotional aspects and individual perceptions.

Motivational changes field of sustainable mobility. Recently, biking campaigns promoting playful elements like competitions, lotteries, team experience or awards are booming adding emotional quality to more rational arguments for biking like health benefits, time saving or climate change (Millonig, 2016). A study by Millonig et al. on motivational strategies to promote cycling has been performed in 14 companies. The researchers aimed to examine important motivational factors for employees to change their cycling behaviour. A tourney of 6 weeks duration comprising 4 categories of ranking was organised:

- *Bikers*: share of employees who reported that they were bike commuting per company (last week and total).
- *Average distance*: average distances biked by all participants per company (last week and total).
- *Total Distance*: total distances biked by all participants per company (last week and total).
- *Enthusiasm*: changes in the share of bikers per company (in total).

Participants registered on a website and reported their daily biking behaviour. Strategies and motivation to join the tourney differed from company to company:

- *Fun*: people enjoyed the opportunity to do something “cool” and entertaining, compare their results to other and have something to talk frequently talk about.
- *Team*: several companies expressed their hope to strengthen the team by joining the competition, improve wellbeing and also increase their exposure among the bike commuter community as a way of networking.
- *Higher goal*: a frequent motivation was to foster more sustainable ways of transport both among the employees but also for the city; in addition, there was also motivation to support research.
- *Bike enthusiasm*: most of the companies reported to have a significant number of regular bikers – higher than the share of biking in the local modal split – among their staff who are always interested in participating in biking initiatives.
- *Traffic “trauma”*: some companies were also encouraged by the idea to find ways to decrease motorized traffic by promoting cycling.

After the competition, results were compared to the post-intervention survey data. The Tourney was generally perceived as encouraging by the participants. 15 % of the participants biked more often than usual during the competition and 19 % planned to bike more often after the tourney ended. When it comes to the motivating factors for participating within the competition, results show that the collaboration within teams was the main driving factor for continuous participation. 41.7 % of the participants were motivated by their colleagues to join the competition. Personal health benefits present another important factor for the employees (shown in Figure 5).

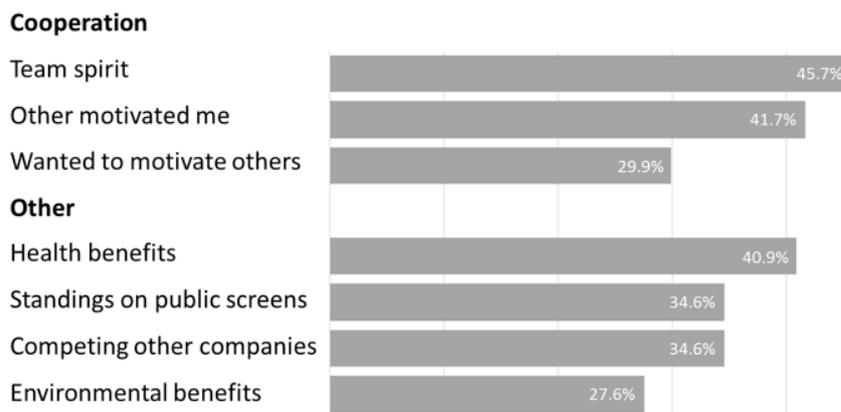


Figure 5: Motivating factors for employees to participate in tourney; Source: Millonig (2016)

Generally, the quality and intensity of motivational strategies for engaging their employees in the competition were strongly related to the level of personal engagement of decision makers. The study shows, that emotional factors like fun, personal engagement and team spirit have a larger impact on changing the biking behaviour than objective factors like health benefits or environmental reasons. These findings show, that gamification and socially engaging approaches can be useful for promoting behavioural changes for sustainable transportation beyond hard policy measures or tangible incentives (Millonig, 2016).

4.5 Implications for SimpliCITY

- Gamification meets the emotional prerequisite to change behaviour.
- Gamification design works well in combination with social comparison techniques, e.g. leader boards.
- Evidence-based results on the use of gamification effects within SimpliCITY pilots will be very important for motivation follower cities in up taking the approach.

5 Ethical evaluation of nudging in SimpliCITY

5.1 Use of nudging in SimpliCITY

SimpliCITY explores the potential of nudges to increase the use of city services in areas such as sustainable mobility and consumption of local products. Nudges aim to steer people towards decisions and behaviours which are deemed preferable for the wellbeing of the individuals and society, for example, cycling instead of using the car to improve health conditions as well as reduce CO2 emissions.

In the literature nudging is debated as potentially unethical because methods can be used which are not transparent and exploit psychological processes with the effect that people take decisions in a non-reflected, quasi-automatic way (Hansen & Jespersen, 2013; Hausman & Welch, 2010; Sunstein 2015).

In SimpliCITY none of these methods will be employed. The foreseen methods such as online challenges, competitions and other game-like methods are transparent regarding the aims and means that are being employed. These methods can be generally subsumed under the nudging method of social comparison because participants can compare their results to those of others.

While we see the nudging methods intended in SimpliCITY as not problematic in ethical terms, the research will still assess if any of the methods and specific techniques pose an issue when applied in practice. If this would be the case, an appropriate solution or alternative approach will be suggested.

5.2 Distinguishing types of nudges

Nudges use different techniques to steer the decision-making of people in a particular direction or affect behaviours directly. Characteristics of these techniques provide the basis to distinguish different types of nudges and to evaluate if these are appropriate in ethical terms.

In the discussion of nudges researchers and practitioners often refer to two distinctions which characterize the techniques that are being employed:

- if the techniques address “System 1” (automatic) or “System 2” (reflective) cognitive processes, and
- if the techniques work in a Transparent or Non-transparent way.

We briefly explain the distinctions “System 1” / “System 2” and Transparent / Non-transparent, and then use a matrix of these distinctions to discuss the different types of nudges. Thereafter we explain where the methods are positioned which will be trialled in SimpliCITY to increase the use of city services.

System 1 (automatic) versus System 2 (reflective)

The two systems theory of cognitive processes has been developed by Kahneman (2003, 2011). According to this theory the human brain works in two different ways:

- “*System 1*”: processes information fast, uncontrolled and effortless in a quasi-automatic way,
- “*System 2*”: processes information slow, controlled and effortful in a reflective way.

It is assumed that people make most judgements and choices of daily life quasi-automatically, i.e. without really making a reflected conscious decision. Automatic here means based on cognitive biases, heuristics and mental shortcuts, while reflective involves following rules of logical thinking, weighing the costs and benefits of various options, or other ways to reach a well-considered decision.

Transparent versus Non-transparent

The distinction refers to the intention as well as the means employed in a nudge:

- *Transparent*: the intention is clear and people are made aware or can easily identify the means employed to influence their decision-making or behaviour,
- *Non-transparent*: the intention is not disclosed and the means by which a certain decision or behaviour change is pursued remain hidden.

Obviously nudges with non-transparent conditions combined with triggering System 1 (automatic) cognitive processes are highly manipulative, while addressing System 2 (reflective) transparently regarding the intention and means appears as a legitimate way of trying to persuade citizens to take a particular decision or change a behaviour.

5.3 Matrix of types of nudges

Hansen & Jespersen (2013) combined the two distinctions in a matrix that allows grouping and evaluating different types of nudges. Table 1 presents the matrix, in which we included techniques that are often used for certain types of nudges, and examples from the literature (e.g. Elberg-Nielsen et al., 2016; Hansen & Jespersen, 2013: 20-23; Stanak & Winkler, 2015).

An important general aspect is that nudges addressing “System 1” are intended to influence behaviours directly while “System 2” nudges concern decision-making.

“*System 1*” – *transparent nudges* typically come in the form of a technical manipulation and are warning people (e.g. car alarms for seat belts), while “*System 1*” – *non-transparent nudges* aim to change people’s behaviour by changing the environment of choices (e.g. re-ordering the food in a canteen so that the healthier options are presented first).

“*System 2*” – *transparent nudges* are clear regarding the objective and means, where the latter typically is informing people (e.g. nutritional labelling of food products). “*System 2*” – *non-transparent nudges* address people’s reflective system but are not fully clear about the means that are employed to influence the decision-making (e.g. most people will not know about psychological effects of a default opt-in).

Table 9: Matrix of types of nudges (Source: Hansen & Jensen 2013, adapted and extended).

	System 1 (automatic) <i>Nudge affects behaviour directly</i>	System 2 (reflective) <i>Nudge affects choice directly</i>
Transparent <i>(by design)</i>	<p>Transparent influence of behaviour</p> <p><u>Techniques:</u></p> <p>Typically, in the form of a technical manipulation</p> <p><u>Examples:</u></p> <p>Car alarms for seat belts</p> <p>Provide larger household recycling than waste bins</p> <p>Change printer defaults from one-side to double-sided printing</p>	<p>Transparent facilitation of choice</p> <p><u>Techniques:</u></p> <p>Provide information, education and guidance</p> <p><u>Examples:</u></p> <p>Nutritional labelling of food products</p> <p>Information that most people pay their taxes in time (social norm)</p> <p>Comparison of own energy consumption to those of other people (social comparison)</p>
Non-transparent	<p>Non-transparent manipulation of behaviour</p> <p><u>Techniques:</u></p> <p>Change the environment (physical arrangements and/or objects) in which people make choices</p> <p><u>Examples:</u></p> <p>Narrow the side-lines on a road in order to get drivers to slow down</p> <p>Eliminate cues for smoking by keeping cigarettes and ashtrays out of sight</p> <p>Provide smaller plates in self-service restaurants to reduce food waste</p>	<p>Manipulation of choice</p> <p><u>Techniques:</u></p> <p>Various techniques, e.g. salience, framing, priming, default opt-in</p> <p><u>Examples:</u></p> <p>Making one option more salient than the alternative (salience)</p> <p>Framing one decision as involving a potential loss (activating people’s loss aversion)</p> <p>Default opt-in, where one must actively opt-out to prevent enrolment in a programme</p>

5.4 Critiques of non-transparent nudging

Alongside the enthusiastic communication of successful nudges by governmental agencies and consultancies there are many critical voices which caution that non-transparent nudging by governments might erode freedom of choice and values of a democratic society.

Proponents of policy-making by nudging argue that due to their “bounded rationality” (Simon, 1957; Kahneman, 2003) people take wrong decisions in vital matters and therefore must be nudged towards decisions and behaviours that are in their best. However, critiques emphasise

that also paternalistic policy-makers are subject to bounded rationality and act based on particular political interests and pressures (Mitchell, 2002; Rizzo & Whitman, 2009; Lodge & Wegrich, 2016; Viscusi & Gayer, 2015).

Despite claims to the contrary, nudging may not preserve freedom of choice as the “choice architectures” of nudges are generally designed to determine people’s decision-making in a predictable way (Grüne-Yanoff, 2012; Rebonato, 2013; Yeung 2016). This could create a slippery slope of public policy-making on which choices are limited by **increasingly restrictive “choice architectures”** (Rizzo & Whitman, 2009; Rebonato, 2013). Nudging can also produce problematic social control by invoking social norms, i.e. information about how the majority behaves, to bring others more in line with desired behaviours. This could lead to regular monitoring and paternalistic micro-management of citizens (Hausman & Welch, 2010; Jones et al., 2014).

Much of the debate on policy-making by nudging comes down to the distinction between transparent versus non-transparent nudges and the question if techniques employed in non-transparent nudges are acceptable in ethical and democratic terms. Proponents of nudging argue that non-transparent interventions are acceptable if it can be shown that these support the well-being of citizens and society (Thaler & Sunstein 2009; Sunstein, 2015a, 2015b). Their opponents maintain that public policy should avoid nudges that are questionable in ethical and democratic terms by using only transparent methods or regulatory measures to steer people to behave in a manner that ensures their own and society’s good.

Hansen and Jespersen (2013) suggest that in most situations non-transparent nudges should be considered as not acceptable. The reason is that citizens cannot act rationally if it is difficult or impossible to understand the intention and/or the means by which decisions are steered in a particular direction or a behavioural change is pursued. Furthermore, non-transparent nudging would not only manipulate choices in a manner that users cannot see, but also ascribe the responsibility for those decisions to the nudged individuals, decisions they might not have taken otherwise.

Ivanković and Engelen (2019) discuss in greater detail the importance of transparency of nudges in order to guide people in the right way to intended right choices and behaviours. Also other authors emphasise that attempts to change lifestyle choices and behaviours of citizens should have a transparent and coherent basis on which people understand the reasons for their decisions and how they enact them (e.g. Bovens, 2009; Hausman & Welch, 2010; Lin et al., 2017).

5.5 Nudging methods in SimpliCITY

The nudging methods that will be trialled in SimpliCITY to increase the use of city services belong to the “System 2” (reflective) and transparent methods. These methods encourage people to take a well-informed decision and change behaviours, for example, through an educational campaign, labelling (e.g. nutritional information labels), or information about what others do or don’t (social norms and comparison).

“System 2” and transparent methods can facilitate deliberate, reflective and reasoned decision-making by citizens. Therefore, these methods are the least debated forms of nudging and generally seen as ethically appropriate ways of trying to persuade citizens to take a particular decision and change behaviours (Hansen & Jespersen, 2013; Hausman & Welch, 2010; Ivanković & Engelen, 2019; Lin et al., 2017). Also surveys on citizen’s opinion about different

nudges show that the public supports these methods with much higher approval rates than other proposed forms of nudging (Reisch & Sunstein, 2016; Sunstein et al., 2018a, 2018b).

The methods foreseen in SimpliCITY are online challenges, competitions and other game-like methods which promote “System 2” processes in a transparent way regarding the aims (e.g. increase cycling of citizens instead of using the car) and means (e.g. a competition to promote that behaviour). These methods can be generally subsumed under the nudging method of social comparison because participants can compare their results to those of others.

Social comparison has often been used in programmes aimed to reduce home energy and water consumption (e.g. Allcott & Rogers, 2014; Ashby et al., 2012; Ayres et al., 2009; Datta et al., 2017; Ferraro & Price, 2011; Nolan et al., 2008; Schultz et al., 2007). In such programmes people receive consumption reports, including comparison to others in the town or neighbourhood, and tips how to consume less. The approach can yield significant reductions especially if repeated reporting leads people to gradually adapt their behaviour, e.g. develop different energy use habits, use energy-efficient lightbulbs or appliances, etc., for example in the OPOWER energy efficiency programme (Allcott & Rogers, 2014; Frey & Rogers, 2014).

Important differences of the SimpliCITY approach to these programmes are that the methods employed aim to *increase* citizen’s use of city services for sustainable mobility (bike mobility), local production & consumption, and digital social inclusion, and the platform that provides the functionalities for these methods allows *dynamic presentation* of the level of citizen’s participation online and on mobile devices.

In the presentation of participants’ insights in behavioural dynamics from nudge studies using social comparison regarding energy and water consumption must be considered. Social comparison can generate “boomerang effects” as participants with a favourable lower or higher activity may increase or reduce it when being exposed to information showing a different behaviour of a reference peer group. For example, low energy consumers increased their usage when being informed that others on average used more (Bittle et al., 1979; Brandon & Lewis, 1999). As emphasised by Schultz et al. (2007) such nudges require injunctive messages, e.g. an approval of lower than average energy consumption to prevent a “boomerang effect”. Bhanot (2017) in a nudge study on water consumption found that competitively-framed peer rank information can motivate those who rank well to work harder to reduce consumption while those with only small results may quit once they learn of their poor rank. Such dynamics should be considered in SimpliCITY when the goal for example is to increase biking instead of using the car.

Regarding the display of participants’ results ethical and legal requirements need to be taken account of. While display of aggregated and anonymized individual results does not pose an issue display of results of identified participants does, if it is not based on informed consent.

5.6 Implications for SimpliCITY

The implications for SimpliCITY can be summarised as follows:

- SimpliCITY explores the potential of nudging methods to increase the use of city services.
- The methods SimpliCITY trials belong to the “System 2” (reflective) and transparent methods which are not seen as unethical.

- The methods such as online challenges, competitions and other game-like methods promote “System 2” (reflective) processes in a transparent way regarding the aims and means that are being employed.
- These methods can be generally subsumed under the nudging method of social comparison because participants can compare their results to those of others.
- While we see the nudging methods intended in SimpliCITY as not problematic in ethical terms, the research will still assess if any of the methods and specific techniques pose an issue when applied in practice. If this is the case, an appropriate solution or alternative approach will be suggested.
- Regarding the presentation of participants’ results in activities such as competitions ethical and legal requirements need to be taken account of. Display of results of identified participants must be avoided (e.g. anonymization) or be based on informed consent of the participants.

6 SWOT analysis of nudging

The nudging methods described in this report show city governments and policy-makers various ways in which nudges can be employed to steer citizens towards decisions and behaviours that are deemed preferable for their wellbeing and society. For example, managers of city services that support city policies regarding sustainable development can use nudges to increase the use of such services. However, alongside the strengths and new opportunities these methods provide there are also weaknesses and threats that should be considered (cf. Mont et al., 2014, pp. 29-33). In the sections that follow we describe essential strengths, weaknesses, opportunities and threats (SWOT) of nudging, a discussion of aspects of a more technical character is provided by Mont et al. (2014: 29-33).

<p style="text-align: center;">Strengths</p> <ul style="list-style-type: none"> • Compatibility with ideals of the free market • Helps policy makers to relate complex policy making processes and goals to individuals' decision-making • For citizens: <ul style="list-style-type: none"> • guidance in difficult decision making process • possibility to reject choices (where contrary to the individual's preference) • Opt-Out option of nudging 	<p style="text-align: center;">Weaknesses</p> <ul style="list-style-type: none"> • Difficulty to design a intervention (reach desired effect) • Humans adjust and change their behaviour based on changes in their environment • problem for policy makers: nudge's full potential might be capitalised on after a certain adaptation period • Nudging is criticised for placing too much focus on the type of thinking – fast and automatic, while leaving the interaction unaddressed
<p style="text-align: center;">Opportunities</p> <ul style="list-style-type: none"> • Persistence in nudging can lead to cost effective achievements • ICT increases the effectiveness of nudging and makes it easier to customise nudging efforts to individuals • Usefulness of ICT to encourage more resource efficient behaviour in private households • Nudging can be used as direct and indirect tool to direct individuals in the desired behavioural direction 	<p style="text-align: center;">Threats</p> <ul style="list-style-type: none"> • Potential danger to the democratic processes at the basis of Western societies • Nudging might be seen as manipulative and an infringement on personal autonomy • Nudging can also be understood as unfair (when applied to common goals) • Nudging might be seen as easy and comfortable way out of cumbersome and controversial attempts to implement regulation and legislation

Figure 6: SWOT Nudging (based on Mont et al., 2014)

6.1 Overview of the SWOT analysis

Table 10: Tabular overview of the SWOT analysis

<p>Strengths</p> <ul style="list-style-type: none"> • Governments can avoid legal regulation and instead use “soft” measures of nudging to influence people’s decision-making and behaviour. • Relatively small cost of nudging, but often significant effects. • Nudges can provide citizens guidance regarding difficult decisions and behavioural changes. • Citizens can reject choices (opt-out) if they do not match with their preferences or perceive them not to be in their best interest. • Representative surveys confirm that a large majority of citizens approve of nudges if they are used appropriately. 	<p>Weaknesses</p> <ul style="list-style-type: none"> • Instead of tackling the deeper reasons of socio-economic and environmental issues (e.g. commercial strategies) governments try to reduce them with nudging. • Lack of decisive action of governments weakens their position and reduces citizen’s trust in reliable governance. • Experts doubt that nudging alone will solve critical health and environmental issues such obesity and climate change, for instance. • There is little evidence for long-term effects of nudges; repeated intervention will often be necessary to achieve significant results.
<p>Opportunities</p> <ul style="list-style-type: none"> • Governmental agencies can strengthen trust in their conduct through transparent processes and involvement of citizens. • Extension of the knowledge base of public bodies regarding societal issues and appropriate nudges by involving citizens, NGOs and other organizations. • Web and mobile applications greatly expand the number of people that can be reached and involved as well as enable novel forms of nudging. 	<p>Threats</p> <ul style="list-style-type: none"> • Non-transparent nudging by public agencies might erode freedom of choice and values of a democratic society. • It can reduce citizen’s acceptance and support of behaviour change policies. • It can also be unfair if in common good initiatives some can prevent being nudged and avoid costs but benefit from the gains.

6.2 Strengths

A particularly strong factor of nudging is its compatibility with the ideals of the free market and customers’ freedom of choice. When faced with human, societal and environmental issues, governments instead of introducing regulations, taxes and other “hard” measures can resort to nudging to steer citizens, businesses and consumers towards preferable behaviours. Nudges based on behavioural insights thus help policy-makers to relate complex issues to individuals’ decision-making and behaviours in everyday life. Representative surveys for many countries around the world have shown that a large majority of citizens approve of nudges if they are used appropriately (Sunstein et al., 2018a/b).

Another strength which drives the use of nudges is that they usually cost little but can have a high impact on economic and other goals such as public health or energy consumption. The impact can even be higher than with more coercive tools (e.g. regulations) and costly methods (e.g. monetary incentives) (Sunstein, 2014). Use of simple means can produce noticeable effects, for instance regarding compliance with citizens' duties such as tax paying. For example, reminders with the mere indication that most citizens already paid can increase tax revenues significantly (Kettle et al., 2016).

While nudging provides a practical and acceptable tool for policy makers to address societal issues, it also offers some advantages for citizens. Nudges can offer guidance in decision-making regarding difficult choices in areas such as food consumption or health, for instance. At the same time, citizens can reject choices proposed as preferable if they do not match with their values and preferences.

6.3 Weaknesses

With using nudges to steer citizens and consumers in certain directions governmental agencies use the same methods as commercial actors who do it to increase sales and profits. In many cases the interventions by governments actually are “counter-nudges” to negative effects which result from commercial strategies (e.g. consumption of unhealthy food, production of waste, mounting credit debt, etc.). Instead of tackling the deeper socio-economic reasons of social and environmental problems, governments seek to reduce them with nudging (Leggett 2014, 15-16). Experts doubt that nudging alone will be sufficient to achieve broad and persistent effects regarding critical health and environmental issues such as obesity and climate change (e.g. Bhargava & Loewenstein 2015; Marteau et al., 2011; Selinger & White 2012).

An increasing use of nudges instead of taking decisive actions weakens governments' position regarding both businesses and consumers. Businesses promoting behaviours unfavourable to people's well-being and sustainable development can do so without being curtailed by regulators, while citizens expecting their government to step in with regulations will lose their trust in reliable governance, which is already rather low in Europe and worldwide (Edelman Trust Barometer, 2018). An increasing cacophony of commercial and policy counter-nudges would add to this trend.

Although many field experiments have already been conducted, there is little evidence available on long-term effects of nudges (Sanders et al., 2018). Few studies report effects of interventions over time and, if they do, typically only for a rather limited timeframe of one to two years. Lasting effects are mainly known for cases of “once and done” interventions such as enrolment in a pension plan (Cronqvist et al., 2018) or as a potential organ donor (Rithalia et al., 2009). Persistent effects require adopting a different habit which is difficult to realise with one nudge (on requirements for habituation see Hollingworth & Barker, 2017). Therefore, continued nudging will often be necessary to achieve significant results, and it is likely that repeated exposure will yield diminishing returns or become ineffective (Sanders et al., 2018).

6.4 Opportunities

Governmental agencies can use nudges as a policy tool while maintaining trust if they involve citizens and are open to their concerns and objections (John, 2018). Engagement of concerned

citizens, consumer organizations and other NGOs allows extending the knowledge base of public bodies regarding social, health and environmental issues and appropriate ways to address them in nudging initiatives. Transparent processes, involvement of citizens and public scrutiny will strengthen people's trust that their government applies the right nudges. These could also include democratically controlled nudging of businesses towards changes in unfavourable practices (Oliver, 2013; Schmidt, 2017). However, some businesses have already recognized the opportunity to build trust and brand equity by promoting sustainable consumption, e.g. the "Nudging For Good" initiative of the European Brands Association supported by the BVA Nudge Unit, France (www.nudgingforgood.com).

Information and communication technologies greatly expand the number of people that can be reached and involved cost-effectively as well as enable novel forms of nudging. For example, "smart meters" and other "smart home" solutions allow households more resource-efficient behaviours. Mobile apps that can be customised and provide information and feedback on self-defined goals support individuals in living a healthier lifestyle for instance regarding nutrition or physical fitness (Braun, 2019). Social communities can be involved with challenges, competitions and other game-like methods to develop and adopt solutions in areas such as sustainable mobility or local production and consumption.

6.5 Threats

In the context of public policies threats mainly concern the issue that non-transparent nudging by governmental agencies might erode freedom of choice and values of a democratic society

Proponents of nudging do not strictly exclude non-transparent nudging from the toolbox of public "choice architects". They argue that such interventions are acceptable if it can be shown that they support the well-being of citizens and society (Thaler & Sunstein, 2009; Sunstein, 2015a, 2015b). Their opponents maintain that public policy should avoid nudges that are questionable in ethical and democratic terms by using only transparent methods or regulatory measures to steer people to behave in a manner that ensures their own and society's good (e.g. Hansen & Jespersen, 2013; Lin et al., 2017; Rebonato, 2013; Yeung 2016).

Requests only to use transparent nudges make "choice architects" face a dilemma: not being transparent may be seen as having something to hide, but making nudges transparent may decrease their effectiveness. There is ample evidence that non-transparent nudges which exploit cognitive biases and shortcomings in people's decision-making are more efficient and effective than transparent methods such as information, education and rational argumentation.

But even if transparency does make nudges less effective, public agencies might happily pay this price for greater accountability, democratic control and trust in their work. Mont et al. (2014, 32-33) note that use of non-transparent methods by public agencies in behaviour change activities might lead to a backlash in citizens' acceptance and support of such policies. Furthermore, they caution that non-transparent nudging to achieve common goods can be unfair if uniformed people change their behaviour and accrue costs while others are able to identify and prevent being nudged but benefit from the gains.

6.6 Implications for SimpliCITY

The aim of a SWOT analysis is to identify strategies that allow for matching strengths with opportunities, ward off threats, and seek to overcome weaknesses. In this vein, implications for SimpliCITY of the SWOT analysis can be summarised as follows:

- In smart sustainable city initiatives city governments instead of legal regulation of citizen's behaviour can use "soft" measures of nudging to promote desired behaviours (e.g. biking instead of using the car).
- Active involvement of citizens in initiatives can strengthen their trust in reliable city governance and allow public bodies extend their knowledge base regarding perceived social or environmental issues.
- Non-transparent forms of nudging should be avoided in general as these can have very negative effects, including that citizens do not accept and support behaviour change policies.
- Web and mobile applications greatly expand the number of people that can be reached and involved as well as enable novel forms of nudging such as competitions and other game-like methods.
- There is little evidence for long-term effects of typical nudging methods, and such effects may also not be expected from gamification. Repeated application may be necessary to achieve significant results.

7 Best Practice case studies

7.1 Overview of best practice cases

In the first step of the literature research, scientific papers, study reports, web pages of initiatives, political institutions, NGOs and other organizations, as well as magazine articles were screened to identify best practices from research projects as well as “real life” (practical) initiatives. A large number of cases was identified and pre-selected based on the following criteria:

- Relevance for the project
- Field of application
- BE methods and tools used
- Digital or analogue
- (Smart) City context
- Degree of innovation

First of all, the identified initiatives were screened whether they are relevant for the SimpliCITY project. At this stage, for example case studies dealing with employee incentivisation were sorted out.

Furthermore, the field of application, which is strongly linked to the first point, was considered. The aim of this study was to present at least two best practice case studies for each of the focus areas of the SimpliCITY project, bike mobility, local consumption and social inclusion. Further case studies from other fields of application, preferably related to sustainability, are selected if there are similar basic situations or conditions, or relevant lessons learned for SimpliCITY.

The next selection criterion was the behavioural economics methods and tools used for reaching the specific target. We aimed to have representative case studies for a variety of the methods and tools identified above.

Another criterion was whether the incentivisation or context was analogue or digital. As the focus in SimpliCITY is on digital methods and tools for incentivisation, the majority of the selected best practices are at least to some extent digital.

Two further criteria for selecting the case studies were if there is a (smart) city context and if a case can be considered as innovative in some respects.

Table 11: Overview of best practice cases

No	Title	Type	Country	Field of application	BE tools/ methods	Digital	Link
I	STREETLIFE	Research application	Italy, Germany	(Bike) Mobility	Information, gamification, challenges	Yes	https://cordis.europa.eu/project/rcn/110044/factsheet/en
II	Cycling Kilometric Allowance	Practical application	France	Bike mobility	Monetary incentives	No	http://www.eltis.org/discover/case-studies/cycling-kilometric-allowance-france
III	Sustainable transportation behaviour	Research application	Canada	Mobility	Descriptive social norm, information	Partly	http://web.uvic.ca/~esplab/sites/default/files/Kormos%2C%20Gifford%20%26%20Brown%202015.pdf
IV	Frequent Biking Challenge	Research application	Canada	Bike mobility	Triggering, social comparison, awareness	Yes	https://www.researchgate.net/publication/291351902_Challenged_to_Bike_Assessing_the_Potential_Impact_of_Gamified_Cycling_Initiatives
V	Bike Citizens	Practical application	> 450 cities	Bike mobility	Information, monetary and non-monetary incentives, gamification	Yes	https://www.bikecitizens.net/
VI	Biklio	Practical application	Portugal, Italy, Sweden, Luxembourg, Bulgaria, UK, Netherlands	Bike mobility	Information, monetary incentive, social norms	Yes	https://www.biklio.com/



VII	10,000 Steps challenge	Practical application	Singapore	Health	Challenge, gamification, monetary and non-monetary incentives, social norms	Yes	https://www.healthhub.sg/programmes/37/nsc
VIII	SmartAPPetite	Practical Research & practical application	Canada	Local consumption	Information	Yes	http://theheal.ca/projects/smart-appetite/?fbclid=IwAR2PPNmP22nsqQisz40-zuZ4QTQUvdsJsk59DRrTxXTIMDDV2tRQxsoj7TE
IX	goodbag	Practical application	Austria, Portugal, UK, Netherlands	Local consumption	Monetary and non-monetary incentives	No (to come)	https://www.goodbag.io/
X	Eco-Friendly Shopping Bags	Research application	Lebanon	Sustainable consumption	Reminders	Yes	https://nudgelebanon.org/2019/02/20/
XI	PIPs	Practical application	USA	Social impact	Monetary and non-monetary incentives	Yes	https://www.pipsrewards.com/login
XII	CitizenLab	Practical application	global	Civil engagement	Information	Yes	https://www.citizenlab.co/
XIII	Engage Barnet	Practical application	UK	Civil engagement	Information	Yes	https://engage.barnet.gov.uk/
XIV	Tribal Planet	Practical application	USA	Social inclusion	Information, challenges, gamification	Yes	https://www.tribalplanet.com/
XV	Reduction of electricity consumption	Practical application	USA	Electricity	Information, social norms, social comparisons	No	http://www.oracle.com/us/industries/utilities/social-norms-energy-conservation-3631977.pdf

7.2 Best practice case I: STREETLIFE

7.2.1 Key facts

- **Initiator:** Fraunhofer Gesellschaft zur Förderung der angewandten Forschung E.V.
- **Incentivisation area/goal:** reduction of CO2 emissions
- **Status:** closed
- **Location/country:** Rovereto, Berlin
- **Link:** <https://cordis.europa.eu/project/rcn/110044/factsheet/en>

7.2.2 Short description of case

STREETLIFE aimed to reduce carbon emissions through a sustainable mobility concept in cities based on ICT. More specifically, the aim of the interventions was to reduce the number of car trips by complying with the following points:

- informing commuters about the existing transport alternatives and their real value (in terms of time, cost, carbon footprint),
- enhancing public transport to meet the needs of the citizens and of the city,
- promoting the usage of sustainable transports through (virtual or real) incentives.

7.2.2.1 Project initiator and objective

STREETLIFE was coordinated by the Fraunhofer Gesellschaft zur Förderung der angewandten Forschung E.V. and delivered a prototype urban mobility system by integrating heterogeneous information sources both directly and indirectly related to traffic and offering safe, personalized, and real time-routing solutions covering all modes of transport. Additionally, the traffic management centres and city administration were offered ICT solutions and a new value-added chain was established. Moreover, STREETLIFE performed an impact assessment of the solution in terms of traffic situation, end-user behaviour, and reduction of carbon emissions.

7.2.2.2 Intervention focus

STREETLIFE focused on the reduction of carbon emissions through a sustainable mobility concept in cities. This concept is based on ICT and targets a reduction of the number of car trips. It deals with offering safe, personalized, and real-time routing solutions to citizens as well as with offering sophisticated ICT solutions to the traffic management centres and city administration.

7.2.3 Intervention design

In the course of the STREETLIFE project, interventions in the three different pilot cities were carried out. Here, the two cases of Rovereto are described.

Rovereto Trial 1

The first intervention in Rovereto lasted for 5 weeks and consisted of three phases:

- Phase 1 (baseline, 1 week): end users had to get confide with the App and record itineraries and normal mobility behaviour;

- Phase 2 (recommendations without gamification, 2 weeks): by switching on an additional ViaggiaRovereto (name of the App) functionality, recommendations for sustainable mobility are offered (see Figure 7);



Figure 7: Overview of a planned journey in the ViaggiaRovereto App; Source: Fraunhofer Gesellschaft zur Förderung der angewandten Forschung E.V (2016)

- Phase 3 (gamification, 2 weeks): in addition to both described features above, gamification is added in form of the Green Game with ViaggiaRovereto. The layout of the gamification framework is illustrated in Figure 8.

The target group consisted of 40 users, of which 36 people used the system. In phase 1, 26 users participated actively, in phase 2 were 29 and in phase 3 there were 26 playing the Green Game with ViaggiaRovereto. 20 participants were active in all of the three experiment phases.

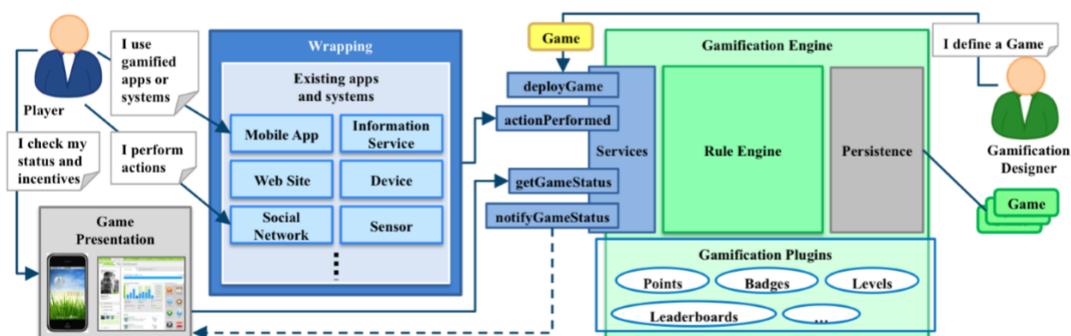


Figure 8: First gamification layer of the ViaggiaRovereto App; Source: Fraunhofer Gesellschaft zur Förderung der angewandten Forschung E.V (2016)

Rovereto Trial 2

The second case study of Rovereto is a long-running mobility game. This means that an open-field experiment was conducted, which measured the impact of different gamification techniques and incentives on the mobility behaviour of citizens of Rovereto and the area surrounding the city. From April 16th to June 18th, the open-field game Rovereto Play&Go addressed all Rovereto citizens to take part in the game. Within these 9 weeks, different game concepts supported by the developed Gamification Framework (see Figure 9) are tested.

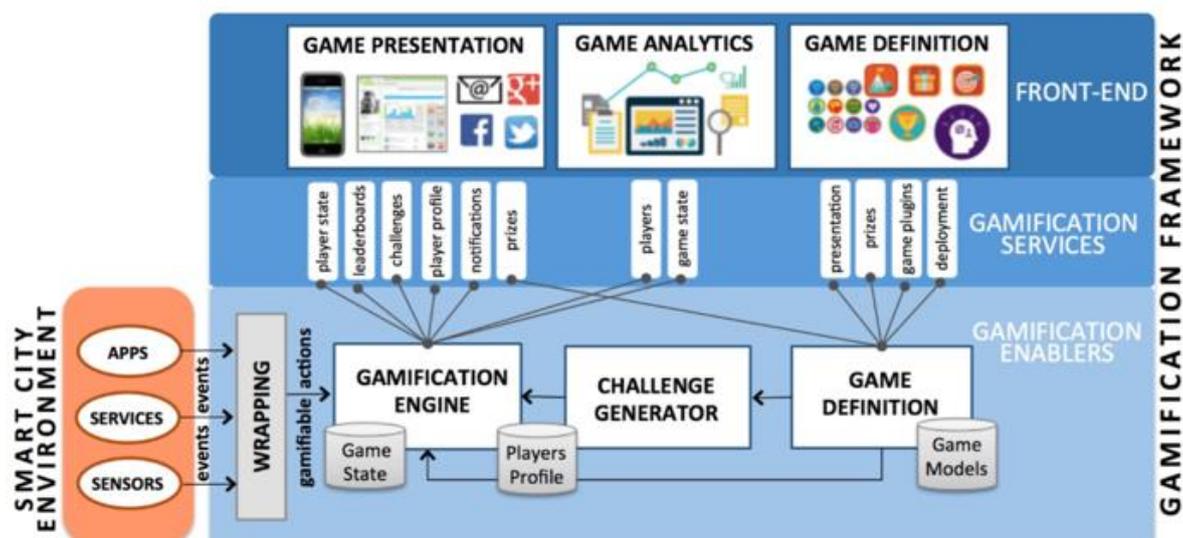


Figure 9: Layout of the second smart city gamification framework for Rovereto; Source: Fraunhofer Gesellschaft zur Förderung der angewandten Forschung E.V (2016)

The game was structured in two phases:

- Phase 1 (Basic Game, 2 weeks): during this phase participants were able to collect Green Leaves points, which could be achieved by travelling with sustainable transportation means. For zero-impact trips (trips with zero CO₂ emissions) bonuses were granted. Additionally, weekly and global leader boards for the collection and comparison of the Green Leaves were offered and badges for certain amounts of Green Leaves, for specific kind of trips and for exploring new mobility alternatives (e.g. using a Park&Ride facility) were assigned.
- Phase 2 (Challenges, 7 weeks): in addition to the Basic Game, weekly themes were introduced. Examples were the bike week, the zero-impact week or the public transport week. Moreover, weekly challenges were implemented, which tailored to the personal mobility behaviour of the participants. This means that a participant who had never used a bike got other challenges than a regular biker. As a reward, participants got Green Leaves bonuses.

Prerequisite for participation in the game was the installation of the ViaggiaRovereto Play&Go App, which was available for both Apple and Android users. After complete registration, the players had to use the App for journey planning and tracking the sustainable itinerary choices. Furthermore, the status in the game (e.g. number of Green Leaves, open challenges, rank, etc.) could be checked and the results could be shared on social networks. Figure 10 shows some of the functionalities offered by the App.

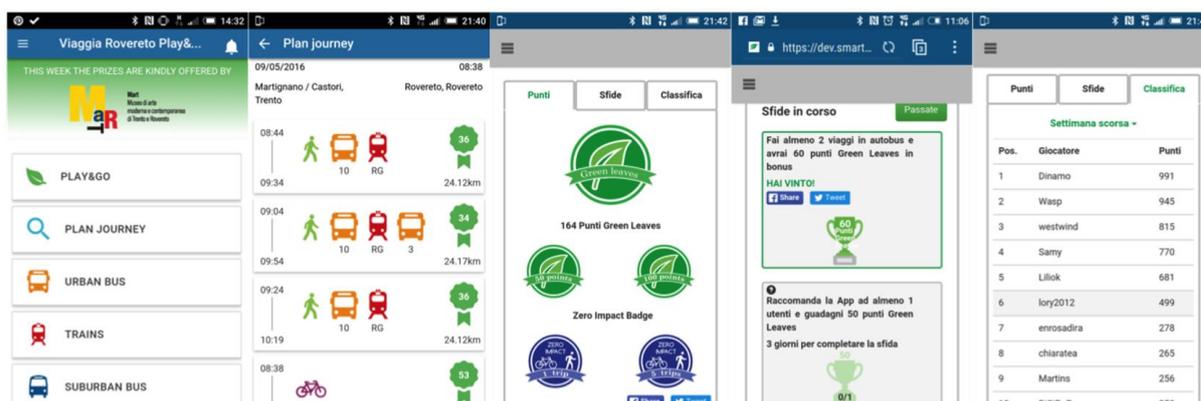


Figure 10: Overview Gamification Approach Streetlife project; Source: Fraunhofer Gesellschaft zur Förderung der angewandten Forschung E.V (2016)

7.2.3.1 Used intervention methods

The project explores the potential of information, gamification mechanisms and different kind of challenges. In more detail, it targets the incentivisation of voluntary behavioural changes towards sustainable mobility solutions.

7.2.3.2 Used digital technologies

STREETLIFE used a navigation app that is additionally equipped with game functions. Therefore, users of the apps can not only find their ways with help of the offered maps, but also take party in different games, riddles and challenges.

7.2.3.3 Description of process of intervention method

As already described above, the interventions (trials) in Rovereto are divided into phases. In the first trial, the first phase was characterized as baseline, where the users got familiar with the app and had to record their mileage. No further intervention or action was taken at this time. In the second phase, additional information in form of recommendations were activated. These recommendations suggested different options for sustainable mobility offers that could be used by the participants and which contribute to cleaner trips. In the last phase, a gamification scheme was tested, including different kind of challenges, riddles and quizzes.

Similar to this approach, the interventions were planned in the other trials, following a step-by-step implementation of the intervention methods.

7.2.4 Intervention evaluation and impact

7.2.4.1 Evaluation methods (interval)

In the course of the project, 'a wealth of data on the mobility behaviour of participants' was collected and evaluated (Kazhamiakin et al., 2015: 4). Due to space and time reasons, the evaluation is limited to the effect of the gamification. This means, the changes between the game phase (3 and 1, respectively) and the other phases (e.g. information or baseline, challenges) are analysed. To evaluate these changes, research questions were formulated. To address them, different metrics of sustainable mobility behaviour were compared (before

and after intervention). Examples for this are the distribution of the number of trips per user, proportion of the routes chosen by user that were recommended or changes in mode choice. With the help of the app, these items were recorded and statistically analysed. So, the driven kilometres per transport mode could be displayed and user changes from one mode to another could be revealed.

7.2.4.2 Results in mobility behaviour

Rovereto Trial 1

Figure 11 shows the distribution of saved trip per user during the five weeks of the experiment. This provides information about how often the participants used the App and the journey planning service. The underlying hypothesis is that users consult the App more frequently during the game weeks (weeks 4 and 5). As the figure shows, this holds, because the boxplots of GameW1 and GameW2 are further up (= more saved trip per user). According to the performers of the experiment, the distributions of GameW1 and GameW2 are significantly different from the distribution of the other weeks, whereas the distributions of weeks 1 to 3 are not statistically different.

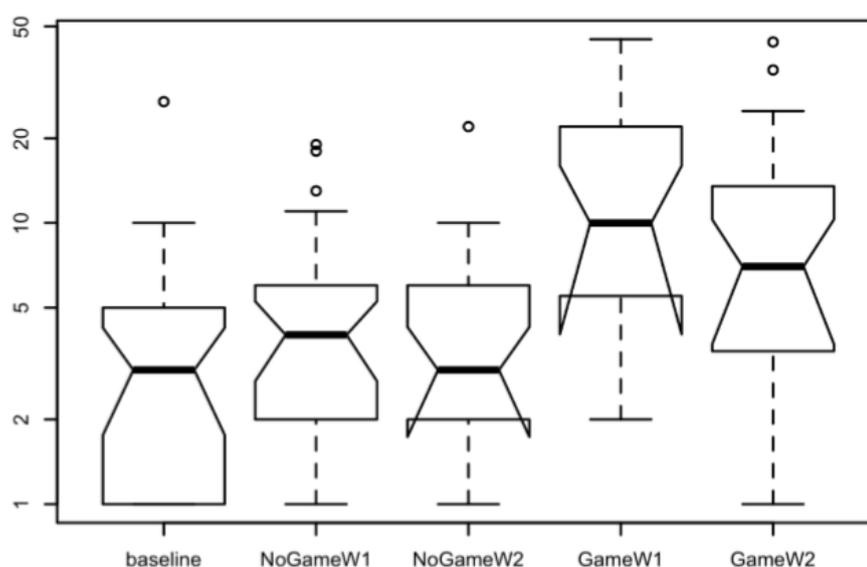


Figure 11: Boxplot of the distribution of saved trip per user; Source: Kazhamiakin, 2015

The next question to be answered was whether gamification can be effective to investigate voluntary travel behaviour change towards more sustainable urban mobility. The results of the assessment of the changes in mode choices is summarized in Figure 11. Initially, 59 % of all trips were made with the private car. The first phase (baseline) did not bring significant changes, while the results shows a clear tendency for phase 2 and phase 3. Recommendations caused mode shifts towards sustainability, mainly from car to train. Gamification improved those mode shifts.

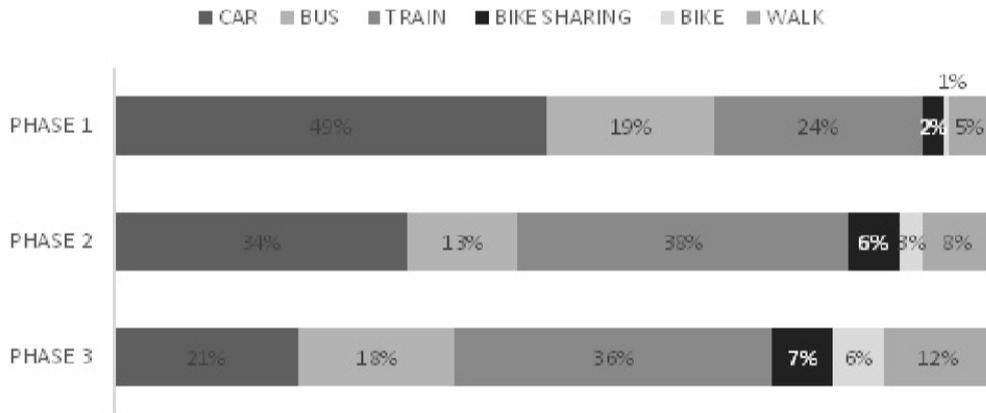


Figure 12: Phase description Streetlife trial; Source: Fraunhofer Gesellschaft zur Förderung der angewandten Forschung E.V (2016)

Rovereto Trial 2

In total, about 300 citizens downloaded and registered for the Play&Go game and of those, 110 actively played the game and collected Green Leaves points. More than 3,700 itineraries were recorded, active players succeeded 212 individual challenges, while 83 challenges were not completed.

The aim of the gamification framework was to investigate whether a long-run change in the mobility behaviour of the players could be observed. In order to proof this, the dynamics of the temporal series of collected data were analysed. Figure 13 shows the distribution of the trips (per player) during the nine weeks of the game in form of boxplot charts. The green boxplot shows that in total, the median number of gamifiable actions played by participants either maintained or increased over time and in comparison over the whole game. Only during weeks 4 and 5 the median values are below average. The reason for this is that the weather in Rovereto inclement with rain and low temperatures.

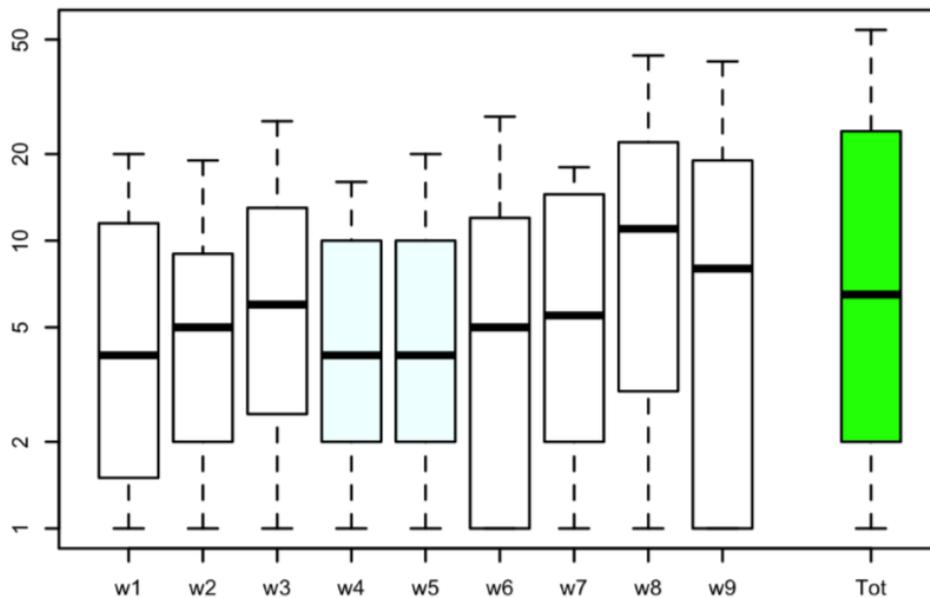


Figure 13: Impact overview Rovereto trial II; Source: Fraunhofer Gesellschaft zur Förderung der angewandten Forschung E.V (2016)

Figure xxx gives an overview of 0-impact trips (0-impact transport modes, i.e. walking, biking and bike sharing) against the number of players throughout the nice weeks. As can be seen, 0-impact trips grew significantly to around 2600 trips in week 9. Also the number of players increase, although not as quickly as the number of 0-impact trips did.

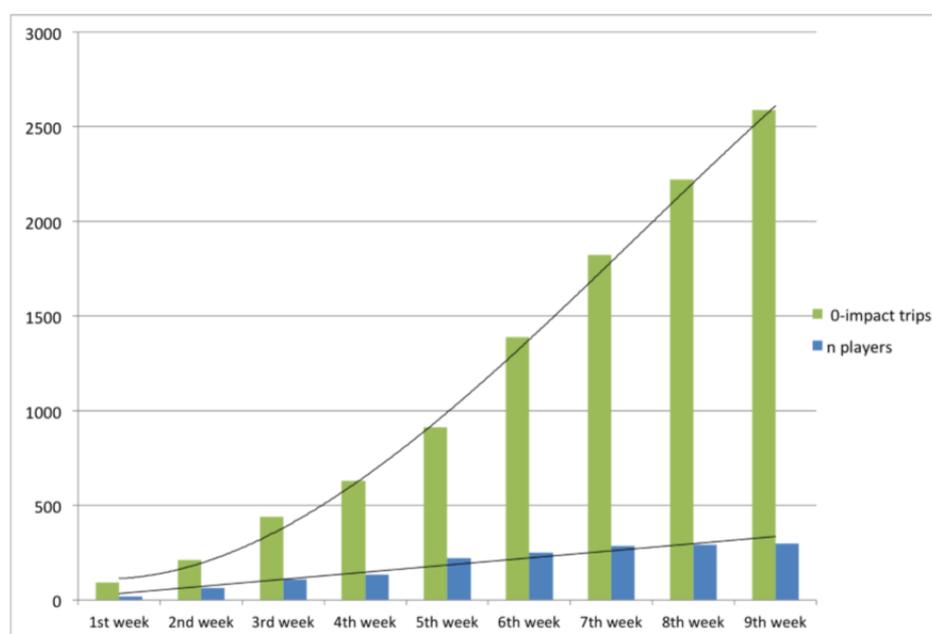


Figure 14: Impact overview Rovereto trial II; Source: Fraunhofer Gesellschaft zur Förderung der angewandten Forschung E.V (2016)

With respect to the impact assessment of user behaviour it can be stated that people provided with an intermodal app are more willing to change mobility behaviour while changing their mode choice, as long as alternative “green” transport means are available. It could be observed independently from the app tested, that also different modes were combined more easily due to the information available. In all cities the modal share could be changed in the envisaged way. With regard to the impact category environment the potential effects on carbon emissions has been assessed. For Rovereto the results concerning carbon friendly trips are also positive. A reduction of almost 6% CO₂ emission compared to the baseline could be achieved. There was a constantly decreasing carbon emission, finally representing a saving of 4,4t a day.

7.2.5 Lessons learned / implications for SimpliCITY

Apps and the provided information can be an essential instrument in changing the behaviour of people. More and more use apps to track daily activities, e.g. sport exercises, nutrition facts. Combining methods of behavioural economics (like gamification) with such apps might be a fruitful way to guide individuals’ behaviour. This study is one of few studies, which shows that this is also possible within the sustainability area to make positive behaviour changes. While this is documented well within the health sector, only a handful studies deal with this effect from a sustainability perspective.

SimpliCITY can use the insights of STREETLIFE to alter people’s behaviour towards more sustainable transportation decisions. With the help of a central app, real-time information can

be shared and different challenges and gamification tools can be played. This holds for all three focus areas.

7.3 Best practice case II: Cycling Kilometric Allowance

7.3.1 Key facts

- **Initiator:** French Ministry of Environment and Club des villes et territoires cyclable
- **Incentivisation area/goal:** promote active travel (walking and cycling)
- **Status:** continued
- **Location/country:** France
- **People involved:** employees of private businesses
- **Link:** <http://www.eltis.org/discover/case-studies/cycling-kilometric-allowance-france>

7.3.2 Short description of case

Some years ago, an ambitious roadmap for sustainable development and growth was adopted by the French Ministry of the Environment. Out of numerous transport initiatives to improve air quality and reduce private car use in cities, active travel choices such as bike rental schemes for businesses, financial incentives for bike purchases and secure bike storage facilities at public transport stations were selected. The Cycling Kilometric Allowance is part of the Plan de Déplacements Entreprise, which is a package of measures encouraging the use of alternative mobility solutions among private businesses. It is a measure with a variety of incentives designed to position bikes as clear alternative to cars and a way to induce a shift towards sustainable transport modes.

7.3.2.1 Project initiator and objective

The project was initiated by the French Ministry of Environment and promoted by the Club des *villes et territoires cyclable*. The focus of this initiative is on the promotion of active travel behaviour, more specifically walking and cycling. The objective is an appraisal scheme for stakeholder and public involvement in this area.

7.3.2.2 Intervention focus

In France, a multitude of transport initiatives were undertaken to both improve air quality and reduce the use of private cars within cities. Examples of these are the promotion of active travel, different bike rental schemes for businesses, monetary incentives for those who intend to buy a new bike as well as bike storage facilities at public transport stations.

The Cycling Kilometric Allowance is the newest scheme that targets the increasing use of alternative mobility solutions among private businesses. It focuses on the incentivisation of bikes and thus, on a shift away from cars and towards sustainable transport modes.

7.3.3 Intervention design

After a year-long pilot phase from 2014 to 2015, implementation began in early 2016 at a rate of € 0.25 per kilometre. The French Environment and Energy Management Agency (ADEME) monitored the first six months of the pilot, in which 18 French private businesses took part in the scheme. From a total of 10,600 employees, 380 benefitted from the allowance. The

scheme is voluntary for the private sector. It entitles employees to an annual allowance of up to €200 (except from taxes and charges). The allowance is calculated by using the most direct route from the recipient's home to its workplace. An integrated part is the intramodality with and support of public transport, as employees get money back for public transport season tickets and single journeys. This holds for journeys that involves a bike ride to a public transport station. With the help of a national observatory (L'Observatoire de l'indemnité kilométrique vélo), data is collected, the implementation of and follow-up activities related to the scheme is supported and good practices are shared with companies involved.

7.3.3.1 Used intervention methods

The scheme is based on **financial incentives**, as people get money for using the bike instead of another mode of transport (especially car). Additionally, money for public transport tickets are refunded, when the journey to the station was done by bike.

7.3.3.2 Used digital technologies

None

7.3.3.3 Description of process of intervention method

After a pilot, which lasted for a year and involved 18 private companies, the French Ministry of Environment extended this scheme in 2016 and included the public sector as well. The implementation of the scheme began at a rate of 0.25 € per kilometre, with a maximum value of 200 € per year (exempt from taxes and charges). The calculation of each recipient's allowance depends on the most direct route from his or her home to the workplace. Moreover, the use (intramodality) of public transport is supported.

7.3.4 Intervention evaluation and impact

7.3.4.1 Evaluation methods (interval)

Two surveys were carried out: a first one prior to the experiment with all employees to obtain a first image of travel habits, as well as the level of receptivity of the approach and the reasons that may lead employees to adhere or not to the experiment. A second survey was conducted for members who received the allowance at least once, and additional quantitative analyses were carried out to compare the results with national data, including those from ENT-D (national transport and travel survey), but also from company internal monitoring data.

The calculation of the environmental impacts of changes in driving behaviour over the different time periods is based on a specific calculation method. It was based on the evaluation of average distances by mode, the mode of travel before survey and the calculation of the carbon impact. Put together, the impact of the change from alternative transport means to the bicycle were assessed.

7.3.4.2 Results in mobility behaviour

The allowance was introduced over the winter period. Companies participating in the scheme could double their cycling rate compared to those companies that were not participating. The modal share of cycling increased by 50 % during the initial months of the scheme's trial phase. Many people increased the bike use to 3–4 times a week. Those who are characterized as 'new cyclists' have for the most part switched from public transport, 20 % switched from car

and 9 % from mopeds or motorcycles. The amount of people using the bike daily has doubled, while the number of those who were inactive halved. More than 80 % stated that they engaged in extra physical activity, which took the form of extra cycling trips (additional to home and work trips).

The environmental impact was measured and it shows a CO₂ emissions reduction of 2.7 tons during the six months monitoring period. That means an average of 0.03 tons per new cyclist per year.

7.3.5 Lessons learned / implications for SimpliCITY

The project shows that financial incentives work quite well for changing the mobility behaviour of employees and employers. Together with a smartphone or another device to track the mileage driven, one can easily calculate the amount a cyclist is entitled to. The system is therefore simple to implement and transferable to other users, e.g. to citizens. What has started in the private business area can easily be transferred to the public sector, which happened in another city in France.

It is also interesting to see that the scheme works during the winter period, because it is usually harder to motivate people to bike in winter. This has direct implications for the SimpliCITY pilot phase, because the first one is planned for the winter period.

7.4 Best practice case III: Sustainable transportation behaviour

7.4.1 Key facts

- **Initiator:** University of Victoria, British Columbia
- **Incentivisation area/goal:** promote sustainable transportation behaviour
- **Status:** completed
- **Location/country:** Canada

- **Link:**
<http://web.uvic.ca/~esplab/sites/default/files/Kormos%2C%20Gifford%20%26%20Brown%202015.pdf>

7.4.2 Short description of case

In the United States, the transportation sectors accounts for 27 % of GHG emissions. Around 65 % of these emissions are from passenger transportation. Approximately the same holds for Canada where GHG from transportation, and in both countries the share is on the rise. One reason for this is the increased energy use for personal transportation. Economic and environmental incentives are in place however, GHG emissions from vehicles still have grown at a faster rate than total domestic emissions.

Therefore, interventions to prevent people driving their car hold the potential to reduce overall GHG emissions. A possibility is to use message campaigns, which are informed by psychological principles. However, there is a lack of knowledge about which types of messages contribute best to a reduction of vehicle use. Therefore, a field research was carried out to evaluate the impact of divergent social norm information on the disposition of individuals not to use their private vehicle.

7.4.2.1 Project initiator and objective

The project initiator was the University of Victoria, located in British Columbia, Canada. The field experiment promoted sustainable transportation behaviour based on social norms to reduce greenhouse gas (GHG) emission.

7.4.2.2 Intervention focus

The intervention focused on the examination of the impact of divergent descriptive social norm information on the willingness of individuals to reduce (self-reported) private car use. The sample included university students, faculty, and staff members. Their aim was to reduce their private vehicle use by 25 %.

7.4.3 Intervention design

The field experiment used divergent descriptive social norms to examine their effect on the individuals' willingness to reduce their (self-reported) use of a private vehicle. A sample consisting of university students, faculty and staff members was asked to reduce their private vehicle use by 25%. The intervention involved both goal setting and normative information. Each participant was assigned either to a control group or to one of two experimental conditions. Participants under the social norm conditions received information that either under- or over-reported others' successful efforts at their university to switch to sustainable transportation. In total, 78 participants were recruited, of which 28 were randomly assigned to the control group, 25 to the low social norm conditions and another 25 to the high social norm conditions. The participants then recorded their daily transportation behaviour for both commuting and non-commuting purposes for four weeks. These records were then compared with their baseline transportation behaviour as a measure of change.

7.4.3.1 Used intervention methods

The first method was the provision of **information** about options for sustainable commuting. This information was the same for all three groups of participants. Additionally, fictitious descriptive **social norm** information was provided for the two experimental conditions. Participants of the high social norm condition got the following information: "Since 1993, 26% of commuters at [our university] have switched to more sustainable modes of transport to campus". People in the low social norm condition were notified that "only 4% of commuters at [our university] have made the switch". No information was provided to the control group. Another intervention method was **goal setting**, because participants were asked to reduce private vehicle use by 25 % and therefore a binding target has been agreed.

7.4.3.2 Used digital technologies

The participants got reminder emails at the beginning of week 2 and at the beginning of weeks 3 and 4.

7.4.3.3 Description of process of intervention method

Regardless of which group the participants belonged to, they received the identical information about options for sustainable commuting. Low social norm and high social norm conditions received additionally fictitious descriptive social norm information. Participants of the high social norm condition got information that "Since 1993, 26 % of commuters at the university have switched to more sustainable modes of transport to campus". Participants of the low

social norm condition were informed that “only 4 % of commuters to the university” have made the switch. According to statistics, the actual value was 7 %, which was communicated to the participants in the debriefing. To assess the mobility behaviour of the participants, daily transportation journals were used. Participants needed to fill in their daily private vehicle use trips and sustainable transport trips (i.e. with bus, bike, carpool, etc.), the time spent with the respective means of transport and whether the trip was for commuting or non-commuting purpose. Furthermore, the descriptive social norm was measured with a four-item measure of descriptive normative beliefs.

7.4.4 Intervention evaluation and impact

7.4.4.1 Evaluation methods (interval)

After the processed data was cleaned, means and standard deviations were used to evaluate the outcome of the intervention. Three analyses of covariance (ANCOVA) were conducted to assess the impact of the social norm manipulation (week 4) on total transportation behaviour, commuting behaviour and non-commuting behaviour. With the help of a trend analysis, every type of transportation behaviour was assessed.

7.4.4.2 Results in mobility behaviour

In general, participants engaged in sustainable transportation more frequently than in private vehicle use. They typically engaged in more sustainable transport use (relative to private vehicle use) for commuting than for non-commuting purposes. Social norm information influenced behaviour change as shown in Figure 15 (for commuting). As stated by Kormos et al. (2015: 490), the mean transportation “index values reflect the number of private vehicles use trips minus the number of sustainable transport trips, averaged across each week”. Thus, negative values are more sustainable transport trips, positive values vice versa less sustainable. The higher descriptive social norm the participants received, the “more sustainable” their transportation behaviour got.

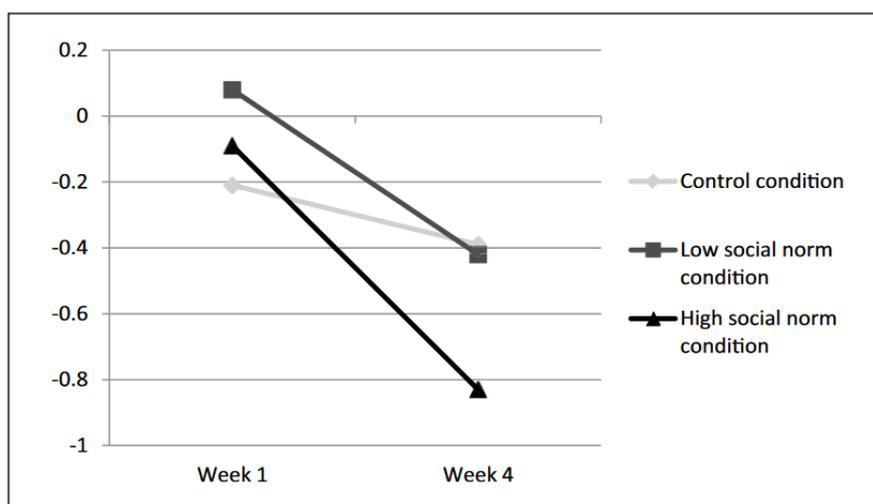


Figure 15: Mean transportation index values; Source: Kormos et al. (2015)

7.4.5 Lessons learned / implications for SimpliCITY

The experiment brings together two tools of behavioural economics: information and social norms. Information can support behaviour changes especially if combined with social norms

description, i.e. information about the behaviour of peers. As shown in the experiment, those participants who received over-reported successful efforts of others to reduce use of their private vehicle reduced their use significantly more than others. Information in combination with social normative belief can lead to a pro-sustainable attitude. This is not always the case, such nudges can also have an opposite effect, e.g. in a study which wanted people to make fewer car trips (Perkins et al., 2005).

7.5 Best practice case IV: Frequent Biking Challenge

7.5.1 Key facts

- **Initiator:** Wunsch et al.
- **Incentivisation area/goal:** promotion of biking
- **Status:** completed
- **Location/country:** Greater Boston, USA
- **Link:**
https://www.researchgate.net/publication/291351902_Challenged_to_Bike_Assessing_the_Potential_Impact_of_Gamified_Cycling_Initiatives

7.5.2 Short description of case

The project developed a web-based application to visualize level names and descriptions, badges and a competition element in the form of a leader board. At the beginning of the study all participants were invited to jointly reach a total number of points. After this collective goal was reached, a social comparison feature was installed, showing the number of individual bike rides in comparison to the average rides of all participants and to the current front-runner's number of rides.

7.5.2.1 Project initiator and objective

Matthias Wunsch and colleagues of the AIT together with researchers from the MIT initiated the project. The performed intervention with a small-scale research experiment used self-reported daily transportation trips by mode, pre- and post-intervention questionnaires and qualitative interviews to assess the impact of a cycling initiative.

7.5.2.2 Intervention focus

At the centre of the Frequent Biking Challenge was the promotion of biking with different persuasive strategies as part of various interventions or small-scale experiments within this area. The challenge was designed to encourage participants to collect points for their bike rides. By collecting these points, so-called experience levels could be achieved.

7.5.3 Intervention design

The experiment ran 29 days, of which in the pre-intervention phase of 12 days baseline data was gathered. In the intervention phase of 17 days the defined experimental group participated in the "Frequent Biking Challenge". Participants were awarded points and achieved levels based on how often they biked. A comparison to other participants and encouraging messages

were included to foster motivation. The second group (control group) did not receive any intervention.

7.5.3.1 Used intervention methods

The Frequent Biking Challenge used several intervention methods combined. The first one was **information**, which was shared with the participants via e-mail. In the first week, daily updates were sent out. After that, a reduction of frequency occurred. In order to have a notable influence on the planning of the following day, the e-mails were sent evenings. Such an information update included (positive) weather forecast, general benefits of riding a bike or notifications regarding your current status and level in the game. The second method is the **game approach (gamification)**. It is an integrated part of the Frequent Biking Challenge, because the intervention is designed to encourage users to collect points for riding their bikes. By doing so, different levels with different ranks can be achieved. The web-based application shows different level names with descriptions, badges and a leader board. The leader board visualizes the competition between bikers, which is an important element of the game. After reaching a collective goal with a certain amount of points, another intervention mention is unlocked: the **social comparison** feature. This add-on shows the number of individual rides compared to the average rides of all users as well as in comparison with rides of the front-runner.

7.5.3.2 Used digital technologies

In the course of the project, a web-based application was developed. With the help of this app (see Figure 16), level names, descriptions, badges and a leader board could be visualized.

Additionally, information was communicated via e-mail. During the first week, participants got a daily e-mail update. After that, the frequency was reduced to 3–4 mails per week.

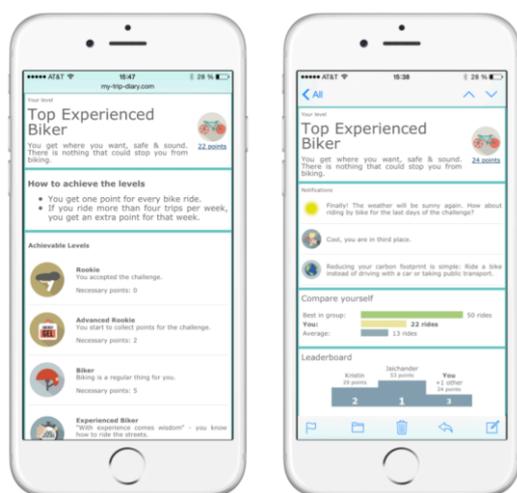


Figure 16: Screenshots from the Frequent Biking Challenge App; Source: Wunsch et al. (2016)

7.5.3.3 Description of process of intervention method

The process of intervention method was described above under 6.5.3.1 *Used intervention methods*.

7.5.4 Intervention evaluation and impact

7.5.4.1 Evaluation methods (interval)

The evaluation was based on the data of the app, with which the participants had to report their daily trips. Participants got instructions on the selection of the transport modes they used (walking, biking, public transport, car and other; single or multi-modal) and what the purpose of the selected trip was. Starting from this data, the share of biking (among all modes) was computed (per person/day) and analysed with the help of statistics. With the help of applied methods, other influencing effects that the introduced intervention (e.g. weather) could be outweighed. The effect of the intervention was assessed by determining the *average controlled share of biking* for the time before the intervention and the same share for the time during the intervention. These values were tested for normality (using a Shapiro-Wilk test) and then compared with a specific t-test. Using again a t-test, per participant changes of bike share were evaluated to compare daily bike share before and during the intervention. In addition to this procedure and to gain qualitative data, a post-intervention online survey and interviews with four participants (two from the control group, two from the experimental group) were conducted. Moreover, an open question e-mail was sent out, which had to be answered by the participants nine months after the initial study.

7.5.4.2 Results in mobility behaviour

The increase of the share in biking was statistically significant for three out of 12 participants (25 %) in the experimental group after the intervention. Thus, three participants presented a substantial increase in bike use during the study. A long-term evaluation showed that nine months after the intervention one of three kept his higher level of biking. The other two returned to their pre-study mobility habits. Comparing the share of the controlled biking during the intervention to the pre-intervention phase showed an increase of 13.5 %. Qualitative post-study data, which was collected immediately after the “Frequent Biking Challenge”, showed an increased awareness of participants of biking as an alternative mode of transportation.

7.5.5 Lessons learned / implications for SimpliCITY

The intervention shows that competitive elements work quite well but have a rather short-term effect. In the long run, most participants who increased their cycling switched back to their previous behaviour. This may be due to the short time frame of the intervention or might be a typical effect. If the latter is the case it has severe implications for planning the SimpliCITY, e.g. the type, time frame and other aspects of the intervention. In addition, the required sample size needs to be considered. An initial small-scale experiment may be used to test the specific approach followed by a large-scale intervention to get representative results.

7.6 Best practice case V: Bike Citizens

7.6.1 Key facts:

- **Initiator:** Bike Citizens
- **Incentivisation area/goal:** Promotion of cycling
- **Status:** ongoing
- **Location/country:** > 450 cities in Europe, Australia and the US
- **Link:** www.bikecitizens.net

7.6.2 Short description of case

Bike Citizens is both the name of the company and the developed app. The app is now available in more than 450 cities in Europe, Australia and the US and offers bikers a set of features: routing profiles, bike type related information, offline map material, information regarding surface, gradient profiles and many more. Registered cyclists can use the app and accumulate so-called Finneros, which is a fictitious currency and can be spent in local stores of cooperating partners. Additionally, achievements for special performances or commitment are awarded. Cyclists benefit by the programme by discovering new companies and shops in their town and by becoming familiar with new products and services. On the other side, companies and shop owners can gain new customers or increase their image and brand awareness.

7.6.2.1 Project initiator and objective

The developer of the eponymous Bike Citizens app is the start-up technology company Bike Citizens. The company was founded by the bike messengers Daniel Kofler and Andreas Stückl and employs more than 25 people in Graz and Berlin. While the company started with a simple bike navigation app and a mount (holder) for the smartphone on the bike, Bike Citizens' focus is nowadays on cycling promotion, app technology and data analysis for cities.

7.6.2.2 Intervention focus

The Bike Citizens app uses different ways to promote more and safer biking. By showing relevant data and information regarding bike use in cities, cyclists and both gather information and provide information for others. Additionally, the app offers challenges, campaigns, personal achievements and other features to activate bikers and non-bikers.

7.6.3 Intervention design

7.6.3.1 Used intervention methods

Bike Citizens uses a variety of intervention methods. **Information** is an important one as the app provides details concerning different (tracked) data, ranging from route details, performed statistics to traffic information. The second group of methods contains different kind of **rewards** and **incentives**. They can be gathered by visiting local shops and companies or by having a certain number of bike trips (e.g. five times as week). Lastly, **gamification** tools like challenges or campaigns (e.g. bike to work) are used to increase the motivation of cyclists in the respective city.

7.6.3.2 Used digital technologies

All interventions are started via the Bike Citizens app. It therefore serves as the central digital tool for the promotion of bikers, but also for companies and shop owners, which provide different kind of rewards, products, etc.

7.6.3.3 Description of process of intervention method

Bike Citizens target governments and cities. The main objective is to increase the bike mobility within cities. The best way to achieve this target is by using the different methods (described above) in the following way. Firstly, through connecting each type of bikers via the Connect

Tool, a local bike community is created. The app helps the community to find bike-friendly routes by offering routing, tracking, newsfeed, etc. in the corporate design of the city. Secondly, cycling in the respective city is promoted. That happens with the help of campaigns, challenges, a specially developed reward system (Bike Benefit) or with a feedback system, where different bike-related problems can be documented and communicated. Thirdly, the information gathered (e.g. through tracking) can be used by urban planners and other officials to improve bicycle traffic planning and set impulses in this way. On the other hand, bikers receive high quality and real time data on their newsfeed and can as a consequence surpass dangerous places on their way.

7.6.4 Intervention evaluation and impact

7.6.4.1 Evaluation methods (interval)

Bike Citizens uses an own GPS data analysis tool to evaluate gathered data. It offers a continuously expanding number of features to analyse, visualise and interpret GPS cycling data. As stated by the founders, some features are self-explanatory, while some work invisibly in the background. Others reveal their true power in combination or in correlation with a complementary feature. For example, the tool is able to create heat maps, showing the number of cyclists on the road or measure parameters as speed, relative speed, delay, and others.

The various campaigns are primarily determined by the following indicators: tracked bike kilometres, number of uploaded tracks, weekly active users (app users, regardless of whether they are registered in the campaign or not).

7.6.4.2 Results in mobility behaviour

Unfortunately, there are no published studies yet that document the results of the different interventions. Bike Citizens have subjective reports from their partners and customers, but they do not have any concrete measurable key figures - such as the proportion of bicycle traffic - due to the great effort that such surveys entail.

7.6.5 Lessons learned / implications for SimpliCITY

Bike Citizens offers a concrete approach for cities or governments to increase bike mobility. As other cases presented here, a mix of different intervention methods is used. Information plays a vital role within Bike Citizens and can be seen as first intervention step. The gathered data out of the app can be useful for both the bikers and urban planners. Bike Citizens already offers ready analysis software, which can be applied for different purposes. Unfortunately, there do not exist case studies describing the results in mobility behaviour or the practical usage of the data by city officials. Such case studies are essential in order to decide whether such a sequence of intervention methods is suitable for SimpliCITY.

7.7 Best practice case VI: Biklio

7.7.1 Key facts:

- **Initiator:** Biklio
- **Incentivisation area/goal:** Promotion of cycling
- **Status:** ongoing
- **Location/country:** Portugal, Italy, Sweden, Luxembourg, Bulgaria, UK, Netherlands
- **Link:** <https://www.biklio.com/>

7.7.2 Short description of case

Biklio is part of the walking and cycling tracking services project TRACE, which aimed to promote cycling and walking to the workplace, to school, for shopping purposes or simply for leisure. The focus was on ICT-based tracking services in order to optimise the planning and implementation of them and to increase their potential impact. Biklio is one example of a mobile application that is focused on bicycle users. In more detail, it creates a network of recognition and benefits by linking cyclists to local shops and to the cycling community.

7.7.2.1 Project initiator and objective

The initiator of the project is Biklio by itself, the whole TRACE project 12 companies, organisation and cities. TRACE pursued the goal of an open knowledge base on cycling and walking tracking possibilities, benefits, challenges and solutions. Different tools address ICT challenges, but keep also an eye on market-orientation. The involvement of business and other types of commercial actors enabled the promotion of cycling and walking, teste in eight pilots with different foci, tools and locations.

7.7.3 Intervention design

With Biklio, a benefit scheme was developed, which rewards people who cycle within certain areas or stop by participating *Biklio spots*. The mobile app helps to detect when the bike is used and when the bike user stops at such Biklio spot. In such situation, a notification pops up and announces a benefit. The biker needs to show the app to the respective Biklio spot keeper in order to prove the eligibility to a benefit. The app map shows where the benefits are and what benefit can be fetched. The maps show additionally the available cycling facilities at the spot (e.g. parking near the shop). Bikers do not have to have the app opened when cycling next to a Biklio spot, but get a benefit notification despite doing so.

7.7.3.1 Used intervention methods

To promote the use of the bike, Biklio uses several methods. Besides providing **information** like optimal routing, covered distances and on location, evaluated data can be used by policymakers to issue improved bicycle polies (e.g. infrastructure measures). The **monetary incentive scheme** aims to connect selected shop owners with bicyclists. This should increase their motivation of cycling through the cities, doing something good for their health and exploring new areas and neighbourhoods. Another essential tool in Biklio is the use of **social norms**, emphasising that other people also contribute to a cleaner and healthier city

surrounding. Besides that, every city participating in the Biklio scheme can develop and launch own **challenges**.

7.7.3.2 Used digital technologies

Biklio is fully integrated in a mobile application with different functions. It creates a so-called network for recognition and different kind of benefits to bike users. The app map shows where and what are the spots, where benefits can be found and which other cycling facilities are offered. Additionally, the app offers an involvement tool for communities of users to cycle for their city and for their own health. Each user gets information about his individual contribution, but also about the contribution for the whole community.

7.7.3.3 Description of process of intervention methods

The Biklio app combines the different intervention methods and therefore they are applied simultaneously. The app shows the different spots that are relevant for getting monetary rewards or start the different challenges. Another tab shows your results and ranks them in comparison to the others. Additionally, information regarding your calorie consumption, CO₂ emissions saved and added space to the city is displayed.

7.7.4 Intervention evaluation and impact

7.7.4.1 Evaluation methods (interval)

The evaluation is done implicitly by the app. This means that key indicators as the biked kilometres or prevented CO₂ emissions are calculated automatically based on specific formulas. These formulas are unfortunately not published publicly and there do not exist (at least up to now) documented cases studies of participating cities.

7.7.4.2 Results in mobility behaviour

At this point in time, no results regarding the changes in mobility behaviour could be observed. Unfortunately, a telephone conference was also unsuccessful.

7.7.5 Lessons learned / implications for SimpliCITY

Biklio can work as a valid proof-of-concept for a bike tracking app, which could be a crucial element of the SimpliCITY platform and app. The project team will keep an eye on Biklio results in the future, as they will be significant especially for the thematic area of bike mobility and the developments and ideas within this area.

7.8 Best practice case VII: 10,000 steps challenge

7.8.1 Key facts:

- **Initiator:** Health Hub
- **Incentivisation area/goal:** health improvement through more walking
- **Status:** closed
- **Location/country:** Singapore
- **Link:** <https://www.healthhub.sg/programmes/37/nsc>

7.8.2 Short description of case

The National Steps Challenge (10,000 steps challenge) is being run in Singapore and aims to change the citizens' behaviour. In the challenge period, Singaporeans can register online and take part using a smartphone application developed for the challenge. With the help of the app, the distances walked are recorded and comparisons with family and friends are enabled. By offering rewards, which are achieved when reaching a certain number of steps, people are motivated to walk more and, ideally, make long-term behaviour changes.

7.8.2.1 Project initiator and objective

The National Steps Challenge (10,000 steps challenge) was introduced by the Health Promotion Board (HPB) and focuses on an active lifestyle of Singaporeans by increasing the steps walked and, thereby, promoting physical activity.

7.8.2.2 Intervention focus

The intervention is a physical activity initiative, implemented to encourage Singapore residents to be more physical active. By focusing on walking, residents can be active anytime and anywhere and do not need equipment or special facilities.

7.8.3 Intervention design

Participants are encouraged to walk at least 10,000 steps a day. The participants get an app or a pedometer to monitor their daily step count. They can redeem rewards such as shopping and grocery vouchers if they hit certain targets. Additional challenges can bring prizes or points. The points can be collected and swapped for different prizes.

7.8.3.1 Used intervention methods

The National Steps Challenge is based on a **gamification** approach with integrated **incentives** for kilometres walked. Participants can compare their performance with those of friends and family members or with other participants in the online community (**social comparison**). With the help of the app, health challenges can be accepted and started. The points earned in the challenges can be used to redeem rewards and casually getting healthier. This should motivate the participating Singaporean to walk more.

7.8.3.2 Used digital technologies

The mobile app (Free Healthy 365) works as daily step counter and calculates also the corresponding calories burned as you move. With the help of a suitable wearable device, the

tracked heart rate is displayed and informs about the duration engaged in higher intensity physical activities. The dashboard provides an overview of fitness parameters, the amount of the so-called Healthpoints and information concerning rewards.

7.8.3.3 Description of process of intervention methods

The sequence and application of the intervention methods depends on the individual user. By choosing the different sections in the app, the user can decide whether he wants to participate in a challenge, compare the performance with others or achieve different rewards based on his performance. Therefore, no unique and linear order of the methods can be identified.

7.8.4 Intervention evaluation and impact

7.8.4.1 Evaluation methods (interval)

The collection of the data is done with the central app. This data is analysed by the initiator Health Hub and overall figures are then published. Further information regarding the evaluation methods are not available.

7.8.4.2 Results in mobility behaviour

The fourth season of the National Steps Challenge is currently running and therefore results are only available for the other seasons. The second season has attracted more than 360,000 Singaporean, while over 690,000 joined the third season.

7.8.5 Lessons learned / implications for SimpliCITY

Compared to other experiments and schemes described in this study, the National Steps Challenge promotes a behaviour change of a large number of people. To do so, the contact with people needed to be easy and as cheap as possible.

Apps are a promising way to engage people and to bind them, especially in combination with behavioural economy tools and methods. Gamification and/or challenges are promising means to motivate people to change their motion behaviour. The competition with family members, friends or others encourage people to walk more or move in another sustainable way (e.g. with public transport or bicycle). In combination with incentives, it is a promising approach to promote behaviour change.

7.9 Best practice case VIII: SmartAPPetite

7.9.1 Key facts:

- **Initiator:** Human Environments Analysis Lab
- **Incentivisation area/goal:** promote healthy and local food
- **Status:** completed
- **Location/country:** Canada
- **Link:** <http://theheal.ca/projects/smart-appetite/>

7.9.2 Short description of case

For public health researchers and practitioners, the access to healthy food is of growing interest. The reasons are inter alia the existing links between the level of accessibility to (un)healthy food and the prevalence of obesity, type 2 diabetes, and other diet-related diseases. As nutrition and health are directly related, it is alarming that less than half of Canadians aged 12 and over eat the recommended daily portions of fruit and vegetables. Adolescence is a critical time for interventions to promote healthy eating behaviour, as lifelong eating habits begin in childhood and nutritional quality tends to decline sharply at the age of 14 and remains low into adulthood. SmartAPPetite was designed to encourage healthy eating by reducing educational, behavioural, and economic barriers for assessing local food.

7.9.2.1 Project initiator and objective

The main objective of SmartAPPetite was to enhance people's nutritional literacy in order to encourage them to adopt smarter purchasing and eating habits and thus improve their overall nutritional quality and health. A second objective was to make it easier for people to find, buy and prepare local food, thus strengthening the local food economy.

7.9.2.2 Intervention focus

The SmartAPPetite research project focuses on the development of an app, “designed to encourage healthy eating by reducing educational, behavioural, and economic barriers to accessing healthy, local food.” (Gilliland, 2015: 1).

7.9.3 Intervention design

For each participant, the intervention period lasted between eight and ten weeks. During this time, the participants (n=208) received daily two to three messages, which included information regarding healthy eating and recipes as well as information regarding local food vendors at the market. This regularly nutrition and health tips (push notifications) tailored to their own nutritional goals, schedules and geographic locations. The tips were carefully researched and approved by a team of registered nutritionists. They provided information about seasonal availability, nutrition, safe food and other healthy habits, as well as related recipes and local grocers. Users could also choose to display location-based messages on their smartphone as they approach a local farmers' market or other pre-approved local providers. Users determined how many tips they received per day and when they appeared.

7.9.3.1 Used intervention methods

The project uses **information** about health consequences, which are transmitted to the participants via app. The use of smartphone technology should share and expand local food knowledge and as a result, promotes the consumption of healthier eating and valorises the local food system in Ontario.

7.9.3.2 Used digital technologies

The SmartAPPetite is run on smartphones and sends push notifications with underlying dietary information to the participants.

7.9.3.3 Description of process of intervention method

Before receiving the intervention, an upfront food survey was conducted. With the help of the survey, dietary habits and health-related goals were assessed. Questions regarding household demographics, allergens/restrictions, diet, food purchasing and consumption habits were asked and analysed. Based on this questionnaire, the intervention period was designed. During this period, messages were sent out to inform the participants in line with their habits, needs and goals. Also, during the intervention period, participants were interviewed about their experiences with SmartAPPetite in order to optimize their experience for the rest of the study. Both questions about the utility of the messages/information and about initial habits, needs and goals were asked. Additionally, a section with improvement suggestions was included. After the intervention period, a follow-up survey with questions combining the upfront and experience sampling survey was conducted. With the help of this survey, the effect of SmartAPPetite on the purchasing and consumption behaviour could be evaluated.

7.9.4 Intervention evaluation and impact

7.9.4.1 Evaluation methods (interval)

After the 8–10 weeks of intervention, the evaluation was carried out in form of a follow-up survey and an in-depth telephone interview. From the total of 208 participants, 123 participated in the follow-up surveys.

7.9.4.2 Results in health behaviour

The results show that participants who used the app often experienced more positive changes in healthy food consumption. 66 % of the participants were female, while the median age was 33 years. More than two thirds reported that they were already customers at farmers` markets, while around one third visited the market only infrequently or for the first time the day they were recruited.

As described above, at the end of the 8–10-week study period, each participant was asked to fill out follow-up surveys and complete a telephone interview. Analysis of the 123 surveys revealed that 80 % of participants somehow benefitted from the study. In total 46 % believed that the messaging scheme has changed their food purchasing, eating habits, food knowledge and/or health. The participants found the messaging especially helpful for learning about seasonal and local foods and lowest for topics like recipes and produce storage/prep.

The findings showed additionally that involvement with SmartAPPetite had a direct effect on consumption of healthy foods. The correlations between the extent of participation in the app

(number of visits, tips, likes, check-ins, links visited) and changes in the consumption of a range of foods. This showed that greater participation with the app was strongly associated with improvements in healthy eating.

7.9.5 Lessons learned / implications for SimpliCITY

SmartAPPetite highlights the possibility of smartphone interventions in order to spread information and to improve the knowledge about healthy and local food. By focusing on the consumer needs, individual dietary recommendations are possible and every person gets customized advice and tips. The question is whether people are really ready for this kind of paternalism. The initiators of SmartAPPetite justify themselves by engaging dietitians, who give reliable recommendations. According to the given feedback by the participants, people are ready for such kind of scheme and adjust their behavior based on the given messages.

The same mechanism could also work for SimpliCITY, especially for promoting local consumption and production places. For example, different local farmer markets in Salzburg or Uppsala can be promoted and the information can be sent to the users.

7.10 Best practice case IX: goodbag

7.10.1 Key facts:

- **Initiator:** bgood GmbH
- **Incentivisation area/goal:** sustainable consumption behaviour
- **Status:** ongoing
- **Location/country:** Austria, Portugal, UK, Netherlands
- **Link:** <https://www.goodbag.io/>

7.10.2 Short description of case

goodbag focuses on the avoidance of plastic bags by offering organic cotton bags. In selected partner stores, shopping with goodbag brings different kind of rewards, discounts and/or goodies. Besides that, shoppers can get vouchers to plant a tree.

7.10.2.1 Project initiator and objective

The goodbag project was initiated by the bgood GmbH. The objective of goodbag is to protect the environment firstly by offering reusable bags and secondly by planting more trees.

7.10.2.2 Intervention focus

goodbag is characterized as the first reusable bag that grants rewards for pro-sustainable behaviour. The intervention focuses among other things on the planting of trees for each shopping in the partner stores done with the goodbag. In return, shoppers receive discounts and goodies.

7.10.3 Intervention design

7.10.3.1 Used intervention methods

goodbag uses primarily **monetary** and **non-monetary incentives** for people who own this type of bag and who purchase goods in participating stores. The purchase of goods induces both the planting of trees and exclusive discounts and goodies.

7.10.3.2 Used digital technologies

goodbag is equipped with an NFC chip so that shop operators can recognize buyers and submit the special offers to them.

According to the provider, a goodbag app will be on the market soon.

7.10.3.3 Description of process of intervention method

The intervention is not time-limited, however implemented only in some European countries. The NFC chip that connects with the partner stores builds the centrepiece of the intervention and works automatically and without further measures.

7.10.4 Intervention evaluation and impact

7.10.4.1 Evaluation methods (interval)

There are so far no evaluation methods in use, because they will be implemented only after the app is launched and data is gathered.

7.10.4.2 Results in consumption behaviour

Same as for the evaluation methods, the results of the intervention will be published when data from the app exist.

7.10.5 Lessons learned / implications for SimpliCITY

goodbag is a form of intervention that targets the reduction of one-way plastic bags by implementing a NFC chip into a cotton bag that delivers a benefit to the consumer. Each time the chip is recognised in a partner store, various kinds of discounts are offered. While responsible persons from bgood GmbH pointed out that the scheme is one with great success, currently no data concerning results or intervention evaluation methods exist in order to build an objective opinion.

7.11 Best practice case X: Eco-Friendly Shopping Bags

Key facts:

- **Initiator:** Nudge Lebanon
- **Incentivisation area/goal:** sustainable consumption behaviour
- **Status:** closed
- **Location/country:** Lebanon
- **Link:** <https://nudgelebanon.org/2019/02/20/>

7.11.1 Short description of case

Nudge Lebanon together with a group of students from the American University of Beirut planned an intervention to reduce the use of plastic bags. The idea was to increase the use of

eco-friendly shopping bags among customers by sending out weekly SMS reminders. The group of customers all shopped on a regular basis at a large chain supermarket and were in possession of a reusable shopping bag. The problem is that, mainly due to cognitive overload, Lebanese forget to bring their shopping bag and use disposable alternatives instead, which exacerbates the problem of plastic waste in the country.

7.11.1.1 Project initiator and objective

The project was initiated by Nudge Lebanon, a nongovernmental and non-profit initiative that applies behavioural insights to Lebanese policy challenges, and by a group of students enrolled in a course of Behavioural Economics (offered by Nudge Lebanon with the American University of Beirut). The aim of the project is to encourage the regular use of eco-friendly shopping bags in order to reduce the use of one-way plastic bags.

7.11.1.2 Intervention focus

While different reasons for not using eco-friendly bags are described (e.g. inconvenience, social norms, habit, etc.), the focus of this intervention is the daily forgetfulness due to cognitive overload. By designing an intervention based on reminders, the use rate of already existing eco-friendly bags should be increased.

7.11.2 Intervention design

7.11.2.1 Used intervention methods

In order to overcome the cognitive overload challenge, two different text messages were designed. This method falls into the category of **reminders** and can come into effect in situations, where people tend to miss something in their daily life (e.g. pay bills, take medication) and where small memories can stimulate an action. Bringing the own bag is exactly such situation.

7.11.2.2 Used digital technologies

Nudge Lebanon uses SMS messages to remind shoppers of their eco-friendly shopping bags. No other digital technologies are used.

7.11.2.3 Description of process of intervention method

The intervention was organised in a Randomized Controlled Trial (RCT) in three branches of the supermarket chain and conducted between April and May 2018. The target sample consisted of around 1,400 customers who are already in possession of an eco-bag. Based on a stratified randomization as well as on branch and frequency of visits, two groups were built: a treatment and a control group. The actual trial was divided into four phases and lasted for seven weeks. In the first phase (baseline period, 2 weeks), the focus lied on the tracking of the reuse of eco-bags across the three selected branches in order to highlight baseline differences between the two groups before the intervention started. The second phase (intervention I, 2 weeks) compromised weekly SMS messages for the treatment group. These messages reminded only this group to bring their eco-bags when visiting the supermarket, while the control group received nothing. The post-intervention I period (2 weeks) tracked the reuse of eco-friendly bags to see the impact of the intervention (i.e. if eco-bag users created a habit to reuse the bags). In the last phase (intervention II, 1 week), members of the treatment group

received an additional reminder and a tip (place eco-bag in car), so that the likelihood of misplacing the bag is reduced. Figure 17 summarizes the intervention graphically.

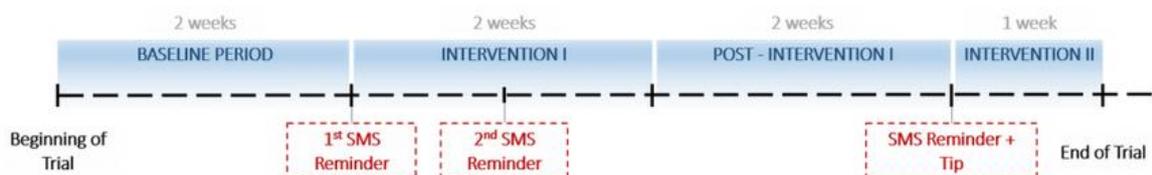


Figure 17: Timeline of intervention; Source: Nudge Lebanon (2018)

7.11.3 Intervention evaluation and impact

7.11.3.1 Evaluation methods (interval)

The evaluation was done by tracking the reuse of the bags by cashiers. They inserted a line code into the system, this means that every time they observed a customer reusing their eco-bags, they recorded it on site. It was important for Nudge Lebanon to clarify whether customers reused their bags at least once per week. Additionally, the number of new purchased eco-bags during the intervention period was collected.

7.11.3.2 Results in shopping behaviour

In order to point out the impact of the intervention, the customers were ordered based on their frequencies of visiting the supermarket (frequent, regular and occasional). Focused on the regular customers of the treatment group, the overall likelihood of reusing their eco-bags increased by 8 % compared to the control group (after intervention I). After the post intervention, the likelihood of the treatment group reusing the eco-bags was 7 % higher than those of the control group. The same holds for intervention II (also 7 %). These effects also persisted in the long term, i.e. several weeks after receiving the reminders. Additionally, to the reuse of the bags, the impact of the reminders on the purchase behaviour/likelihood of eco-bags was assessed. According to the evaluation of intervention I, customers of the intervention group receiving the simple reminder were 3.9 % more likely to buy an eco-friendly bag compared to the control group.

7.11.4 Lessons learned / implications for SimpliCITY

Compared to other best practices, this case study offers a complete description of the intervention process, information on how the evaluation was done and a result section. Although it is a rather small intervention that is based on reminders, the periods are selected systematically and cautiously. This process is thoroughly applicable for interventions planned in SimpliCITY.

What comes a little short is the use of digital technologies to intensify the intervention. For SimpliCITY, the use of a mobile application or other software-based solutions would be of interest.

7.12 Best practice case XI: CitizenLab

7.12.1 Key facts:

- **Initiator:** CitizenLab
- **Incentivisation area/goal:** foster citizen engagement
- **Status:** ongoing
- **Location/country:** global
- **Link:** <https://www.citizenlab.co/>

7.12.2 Short description of case

CitizenLab describes a citizen participation toolbox that was developed for (local) governments. The platform enables policy makers to start different actions online, e.g. votes, surveys or participatory budgeting. Citizens can also post their ideas concerning current topics or share their opinions regarding planned policies. They can leave comments directly on the platform and express their wishes and desires. The advantage for governments consists of gathering all information centrally and of having the direct input by the citizens. Moreover, the use of an engagement platform enables policymakers to communicate with a great share of people and with groups that are hard to reach (offline). Consequently, better-informed decision-making and the communication of these decisions are the central advantage of CitizenLab.

7.12.2.1 Project initiator and objective

The platform CitizenLab was founded in 2015 by the company of the same name in Brussels. CitizenLab aims to give cities and governments a digital participation. Consequently, citizens are consulted on local topics and they are included in decision-making. That can help policymakers in the decision-making process, improve trust and strengthen democracy.

7.12.2.2 Intervention focus

The focus of CitizenLab is on the active participation of citizens through an online platform and the resultant exchange of needs, ideas and suggestions between decision-making bodies and the people concerned.

7.12.3 Intervention design

7.12.3.1 Used intervention methods

CitizenLab provides the infrastructure for individual citizen engagement schemes. City authorities and other responsible persons can share relevant information with their citizens through online available entries. **Information** is the key intervention method, however the exact compilation of methods depends on the respective city or government. The platform is flexible enough to offer a variety of functionalities like polls and prognoses, idea collection and idea clustering, maps, etc.

7.12.3.2 Used digital technologies

The core of CitizenLab is its online platform. This digital infrastructure allows the interaction between policymakers and citizens. More specifically, the platform is offered as a cloud-software service in combination with more informative data analysis and a special focus on mobile devices.

7.12.3.3 Description of process of intervention method

The application and sequence of the intervention methods depends highly on the decisions made by the city authorities. CitizenLab offers a modular system that can be assembled according to the individual needs of municipalities, districts or countries. Therefore, a universally valid process is not available.

7.12.4 Intervention evaluation and impact

7.12.4.1 Evaluation methods (interval)

CitizenLab does not offer any insights about the evaluation methods and the interval of evaluation.

7.12.4.2 Results in engagement behaviour

Unfortunately, also the documentation of the results is not offered.

7.12.5 Lessons learned / implications for SimpliCITY

The modular system of CitizenLab offers a flexible tool for online citizen engagement. Authorities can determine on their own how deep they want to dip in and use the offered services. It is not clear whether information as intervention method is efficient enough to engage many people. To underpin that, studies describing evaluation methods and results are necessary.

7.13 Best practice case XII: Engage Barnet

7.13.1 Key facts:

- **Initiator:** District administration of London Borough of Barnet
- **Incentivisation area/goal:** foster citizen engagement
- **Status:** ongoing
- **Location/country:** London Borough of Barnet
- **Link:** <https://engage.barnet.gov.uk/>

7.13.2 Short description of case

Engage Barnet is the name of the consultation hub developed for the London Borough of Barnet. Residents of this municipality have the opportunity to find and participate in relevant consultations and to get the data resulting from forerunning consultations. Engage Barnet helps people to stay in touch with local developments by participating in discussion that are of interest. It serves as a platform, where feedback, ideas and inputs for decisions are welcomed and where information concerning upcoming community events and ways to get involved are published.

7.13.2.1 Project initiator and objective

The project was initiated by the district administration of London Borough of Barnet. The main objective is to offer an easily accessible online platform, on which the residents of London

Borough of Barnet can get in touch with policymakers and share common knowledge, needs and problems.

7.13.2.2 Intervention focus

The main focus of Engage Barnet lies on the participation in discussions and consultations, on the provision of feedback, on the sharing of ideas, on the influence on decisions and on the information on and opportunity to involve in local community events.

7.13.3 Intervention design

7.13.3.1 Used intervention methods

Engage Barnet is primarily a source of **information** for those who are interested in neighbourhood policy of London Borough of Barnet. The platform offers different consultations as well as information on upcoming community events in order to engage with citizens.

7.13.3.2 Used digital technologies

The platform is digital, online and can be processed via phone, tablet or computer. Citizens do not necessarily need to register, but can join the various discussions anyway. A registration brings personalised and targeted information regarding events and consultations next to citizens' place of residence.

7.13.3.3 Description of process of intervention method

By engaging on the website, citizens get active information about current projects, problems and events. This should encourage people to bring in their ideas and knowledge. With the help of them, decisions are made together and social optimal outcomes should be guaranteed.

7.13.4 Intervention evaluation and impact

7.13.4.1 Evaluation methods (interval)

The operators of the Engage Barnet homepage can evaluate the attendance rate of the citizens of Barnet by assessing their posted consultations and ideas. This gives an overview of the efficacy of the intervention.

7.13.4.2 Results in engagement behaviour

Up to now, there are no publications of results about how many people engage in the platform or how successful the engagement in selected consultations are.

7.13.5 Lessons learned / implications for SimpliCITY

Engage Barnet offers a good opportunity for citizens to join the public discussion and to find common ground on current topics and problems. It connects a whole city district and offers an online mouthpiece. Without handing over a great deal of data due to noncommittal registration, the hurdles to take part are limited to an existing device with internet access. The missing information regarding evaluation and results makes it impossible to predict the real impact and efficacy of the platform.

7.14 Best practice case XIII: Tribal Planet

7.14.1 Key facts:

- **Initiator:** Tribal Planet Inc.
- **Incentivisation area/goal:** social inclusion
- **Status:** ongoing
- **Location/country:** USA
- **Link:** <https://www.tribalplanet.com/>

7.14.2 Short description of case

Tribal Planet offers a platform for citizen engagement. The technology platform company uses its expertise in innovative product design to global development priorities to develop the so-called Citizen Platform. With the help of this platform, social impact of people should be captured and shared between the different parties. By motivating consumers to engage in social actions in exchange for rewards, issue advocates are transformed to brand advocates.

7.14.2.1 Project initiator and objective

The initiator of Tribal Planet is the Tribal Planet Inc. based in the Silicon Valley. The objective of Tribal Planet is the provision of an online platform that allows the empowerment of citizens and the acceleration of social impact. By incentivising “multi-generational” users, actions should be taken to achieve impact and individual development should be supported.

7.14.2.2 Intervention focus

The focus of Tribal Planet’s intervention is on the creation and acceleration of social impact. Tribal Planet provides the infrastructure and incentivizes citizens to participate.

7.14.3 Intervention design

7.14.3.1 Used intervention methods

Tribal Planet makes use of various intervention elements. The Citizen Platform engages people through **gamified mobile experiences**. Riddles, quizzes and videos provide different sources of **information** about social and environmental problems and solutions. Every completed activity brings the user rewards points that can be traded for digital and physical items (e.g. micro-scholarships, donations to charities). To empower people around the world and take action, **challenges** are assigned to them they care most about.

7.14.3.2 Used digital technologies

The Citizen Platform is deployed in two ways: the Citizen Earth 2.0 app or partner branded solutions. For both applications, a smartphone or tablet is needed. With the help of the engagement application, users are encouraged to participate in activities concerned with sustainability and clean energy generation. There are no further digital technologies included.

7.14.3.3 Description of process of intervention method

Through the Citizen Earth App, users can start the activities and challenges. The above described intervention methods are then applied simultaneously and by selection. The user can decide on whether he wants to watch a video (e.g. on renewable energy sources) and answer questions about what he learned. He can also take part in a riddle or quiz, or seek out and walk on kinetic energy generating tiles and get the produced energy displayed in real time.

7.14.4 Intervention evaluation and impact

7.14.4.1 Evaluation methods (interval)

There is no further information available about how the methods are evaluated within the app.

7.14.4.2 Results in engagement behaviour

To the opinion of the authors, there do not exist studies dealing with results or evaluations of the impact.

7.14.5 Lessons learned / implications for SimpliCITY

There do exist approaches to engage a wide array of people, even on a global scale. Tribal Planet shows how this can be done using a mobile application. With the help of this app, a variety of problems can be attracted and challenged. The high range and the relative marginal cost of an additional user make it very promising to organise it in this way. Same as in other best practices before, also a mix of different intervention methods comes into effect. This should guarantee a higher penetration and efficacy.

Unfortunately, no studies concerning the evaluation or documentations of results (i.e. impact of intervention) exist. That makes it very difficult to make general statements about the engagement platform. Inquiries regarding evaluation and results remained unanswered.

7.15 Best practice case XIV: Reduction of electricity consumption

7.15.1 Key facts:

- **Initiator:** OPOWER
- **Incentivisation area/goal:** Reduce electricity consumption
- **Status:** closed
- **Location/country:** Minnesota, USA
- **Link:** <http://www.oracle.com/us/industries/utilities/social-norms-energy-conservation-3631977.pdf>

7.15.2 Short description of case

The focus of this pilot programme is on the reduction of energy consumption through using information, social norms and comparisons. By informing people about their energy use as well as the uses of surrounding neighbours, a change in behaviour is aimed for.

7.15.2.1 Project initiator and objective

The initiator of this project was the company OPOWER, which aimed to reach a general reduction of the electricity consumption. The method to reach this goal was the use of social norms and consumption comparisons.

7.15.2.2 Intervention focus

In this large-scale pilot programme, residential users receive so-called Home Energy Reports (energy use feedback reports). Such reports include energy conservation information (Action Steps Module), a module which provides specific information on how the household can conserve energy. Furthermore, a report includes social comparisons between the household's energy use and that of its neighbours (Social Comparison Module). This module offers a detailed explanation about the energy use of the household and compares it to that of its one hundred nearest geographical neighbours (houses of comparable size).

7.15.3 Intervention design

To be part of the experiment, households needed to have an electricity bill history of at least one year. Otherwise, the social comparisons would not have been possible. In total, 80,000 households took part, of which the first half was the treatment group and the second half the control group. The treatment group received the Home Energy Reports, which are letters with several pages, including the two above described modules (Social Comparison Module and Action Steps Module). The first module shows the electricity consumption of each household over the past twelve months compared with the mean of its comparison group as well as the 20th percentile. The comparison group consists of approximately 100 houses, which have similar characteristics (e.g. similar square footage and same heating type) and which are geographically close. The second module gives suggestions, based on historical values, for e.g. the household's stock of energy-using durable goods and the use of that capital stock. These values vary between the households, because of varieties in energy use patterns and demographic characteristics.

7.15.3.1 Used intervention methods

The first pillar of OPOWER's intervention is **information/feedback**. By informing the people about both how much electricity they consume and how they can conserve electricity, a change in consumer behaviour should be stimulated. This is done by submitting the Home Energy Reports to the household, which includes firm suggestions.

The second pillar are **social norms**. They inform people that others behave as proposed by the nudge and therefore pose an influence on other people. Social norm information is highly efficient when it is specific and as local as possible, because then it can reduce illegitimate behaviour, undesired behaviour or such behaviour that puts harm on third parties.

The last pillar is formed by **social comparisons**. Households are compared to neighbours with similar characteristics (i.e. household size, surface area). Based on theoretical foundations, people tend to change their behaviour after comparing with others. For this intervention, people are expected to reduce their energy consumption when they were compared to neighbours with lower demand rates.

7.15.3.2 Used digital technologies

OPOWER did not use a digital technology for this intervention.

7.15.3.3 Description of process of intervention method

The process of the intervention is partially described above under the intervention design. The intervention is basically guided through the feedback reports, however it starts the following: once per month, an energy provider's worker is sent to read the electricity meter of every household. In this way, the electricity consumption over a period is recorded and the bill is sent to the consumer once a month. In the meantime, the meter readings are sent to OPOWER in electronic form, so that OPOWER is able to make the social comparison and print the Home Energy Report. This report is then sent to the household.

7.15.4 Intervention evaluation and impact

7.15.4.1 Evaluation methods (interval)

The intervention is evaluated by applying a statistical method. More specifically, the Population Average Treatment Effect of the Home Energy Reports is calculated, focusing on the households who participated in the experiment. As described in Alcott (2010: 9), "the preferred specification will be a difference-in-differences estimator that models energy consumption as a function of whether the observation is of a treated household and is in a post-treatment period, conditional on other controls, after removing household fixed effects". The mathematical derivation can also be found in the paper.

7.15.4.2 Results in consumption behaviour

The treatment effect for the households which received a monthly report is on average approximately 2.3 to 2.4 % below the energy consumption baseline. The intervention's effects are strongest for households with high energy consumption.

7.15.5 Lessons learned / implications for SimpliCITY

As shown here, information can be a very powerful tool when trying to change behaviours. When people know the consequences of their behaviour, they are often willing to adapt it according to some norms. For example, the comparison with neighbours has a stimulating effect, like an increased motivation to act better and save more money/energy.

Information in combination with social normative beliefs, as used here, indeed can contribute to a behaviour change and lead to a pro-sustainable attitude. However, this is not always the case as described in the literature (see e.g. Perkins et al., 2005). It has been observed that a “boomerang effect” can occur so that induced changes have unintentional outcomes, e.g. an intervention which wanted car drivers to drive less leading to more car trips

8 Business models for smart cities

Involving a responsible handling of natural resources and participative governance, investments in human and social resources as well as the traditional transportation and the modern communication infrastructure lead to an economically sustainable growth and a higher quality of life within a smart city. This field of action of a city together with the increasing permeation of technology in the society presents the starting point for establishing a smart city platform and a corresponding ecosystem. New networking patterns between citizens and the infrastructure of cities become possible and innovative business models arise, pushing the development in the direction of smart cities (Jaekel, 2017, S. 51).

8.1 Business models inducing behaviour change

Convincing consumers to change their behaviour is a significant component of the sustainability agenda. Business models designed to stimulate behaviour change for sustainability are a relatively new concept, but demonstrate that profitable models can coincide with decoupling from resource use. These models aim to reduce consumption, change purchasing patterns or modify daily habits. Often, they empower consumers with knowledge about their consumption, help them track product or service use, and use games to exploit competitive behaviour of customers.

In a business model for sustainable behaviour, the nature of the transaction between consumers and a company becomes nuanced: it is less about selling more goods or services and more about building brand trust and engagement. Companies employing this model aim to increase “stickiness” with the customer, making him or her less likely to buy from another good/service provider.

The fundamental challenge for behaviour change business models is to find a way to drive revenue growth while continuing to encourage a decrease in consumption. The apparel brand Patagonia has experimented with behaviour change marketing in recent years, by encouraging consumers to buy less and repair more. However, because Patagonia is a private company, it's hard to know if the company's bet has resulted in greater revenues or greater loyalty (Clinton & Whisnant, 2014, p.44).

8.2 Platform-based business models

Platform economy

A multi-sided platform (MSP) is set up to sell products, provide services or generate content. However, the platform owner does not produce the goods, offer the services or create the content. A platform business model connects independent groups of participants, the supply side and the demand side, with each other (Uenlue, 2017). A platform can be seen as a link between digital data and innovative business models (Gassmann, 2019, p. 100). The scalable, highly networked platforms together with their ecosystems present the backbone of a digital business model (Jaekel, 2017, p. 50). In combination with innovative business models, platforms are able to connect up to hundreds of millions of people and enable the exchange of information and commercial goods and services producing a large quantity of data (Gassmann, 2019, p. 100-103). Digital data is the driving force enabling growth of the platform and establishing a dynamic ecosystem (Jaekel, 2017, p. 24). The collected data can in turn be used to refine and improve the platform, thus attracting more users (Gassmann, 2019, p. 100-103). This effect leads to technological innovations resulting in the recombination of digital data on

digital platforms generating virtually no marginal costs, once a digital network infrastructure is established (Jaekel, 2017, p. 25). Having their origin in the digital world, platforms are finding their way into the traditional economy like the manufacturing industries as well as into political fields (Gassmann, 2019, p. 100-103).

Network effects (direct/indirect)

In order to successfully run a platform, despite the asymmetric distribution of resources, a suitable business model is essential. A common challenge in two-sided-market business models is to bring providers of products or services together with the respective users and customers. If one of the two groups is absent on the platform, the stimulus for the other group to join the platform disappears. The two independent user groups need to be addressed and incentivised in order to connect them within the platform. This strategy triggers indirect network effects. The more users of one group engage with the platform, the more attractive it becomes for the other group of users (Gassmann, 2019, p. 104-105). Such network effects generate an exponential growth of the platform, which acts self-reinforcing. Direct network effects occur when a rising number of users attract more users of the same side of the platform (Jaekel, 2017, p. 64). Those effects are represented in the figure below.

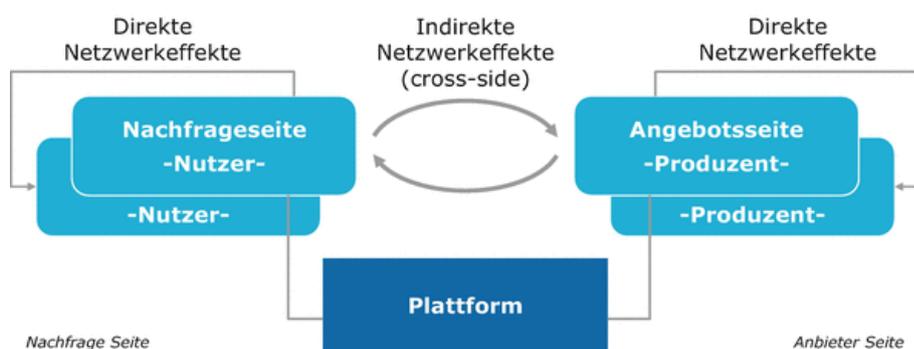


Figure 18: Direct and indirect network effects on a digital platform (Jaekel, 2017, p. 65).

Platform technology

After finding the suitable business model, including the distribution of tasks between the platform provider and the complementors with respect to the available resources, the platform per se needs to be optimised and maintained. This includes user management, interface management as well as defining application mechanisms to secure platform quality and security. An intuitively designed interface assures the required usability of the platform an easy access for users. In order to enable the integration of external developers into the platform, interfaces need to be defined and created where the problem-solving task is assigned to the external innovator. Such Application Programming Interfaces (APIs) define which tasks can be performed within the platform, which hardware components can be controlled and which data can be obtained from the platform (Gassmann, 2019, p. 107-108).

Platform security

Security is a very important issue when it comes to digital platforms. The quality and the underlying security of a platform are substantially dependent on the reliability of such API. In

many cases highly sensitive data is transferred and evaluated, thus leaks in these domains are to be strictly avoided. Guaranteeing high security and quality standards for users is inevitable, whether the application is programmed in-house or by external providers. If a platform counts with many users, crowd-based solutions are possible where the evaluations and recommendations of the community define the quality rating. When the ecosystem of the platform is smaller or the application treats with high security data, the platform provider should take care of the security issues (Gassmann, 2019, p. 108-109).

8.2.1 Smart city app platforms

The responsibility and challenge of a smart city platform provider lies in the governance of such a digital platform. This comprises the access control to the platform, the distribution of the produced values between the different parties as well as conflict solution and management of partly divergent goals of the involved parties. In order to permit a high participation and large number of interactions within the platform, regulations have to be found and standards and incentives inducing a 'good' behaviour within the platform have to be created (Jaekel, 2017, p. 71).

Due to the diverse ecosystem, it might be challenging to bring together the extensive features of a whole city on one single digital platform. A city's infrastructure is complex and there exists a broad offer of services. Therefore, it can be advantageous for a city to create a public-private partnership, where the government agrees with private sector organisations on cooperating in offering public goods or services. Such private firms may be e.g. private transportation companies, electricity or gas providers, bike sharing companies, e-charging stations as well as smart service providers, holding innovation capacity and thus facilitating the development of a smart city (Timeus, 2017, p. 54).

A schematic representation of the structure and the essential functions of a smart city app platform is given below (Figure 19). The anatomy of a smart city app platform is divided into a closed and an open area. Within the closed sector of the platform a huge amount of data is generated, which can be used, applying Big Data Management, to develop new context-based apps. Through the so-called 'Context-Brokering' user data is saved and processed resulting in apps or bundled apps, which in turn can be brought to the market. On the other hand, the generated data can be used to improve the app and optimise e.g. the traffic flow of a city. Within this aspect of dealing with sensible user data, privacy legislations and data security have to be respected (Jaekel, 2017, p. 69).

Given the number of parties and the magnitude of the project, establishing a smart city platform and ecosystem for a whole city is a challenging project. For the planning, financing and implementation of a smart city initiative it is essential to establish a network between cities, economics, science and citizens. When it comes to financing the project, not all the costs have to be covered by the city itself. Implementing elaborate refunding models, initial costs of establishing the digital platform including the installation of cloud computing can be re-compensated. As shown in Figure 19 on the left, possible sources of re-financing are rental models (e.g. eBike, Car2go), the value creation through apps, app sales and app clicks, advertising revenues, subscription models as well as the resale of data and data packages (Jaekel, 2017, p. 74).

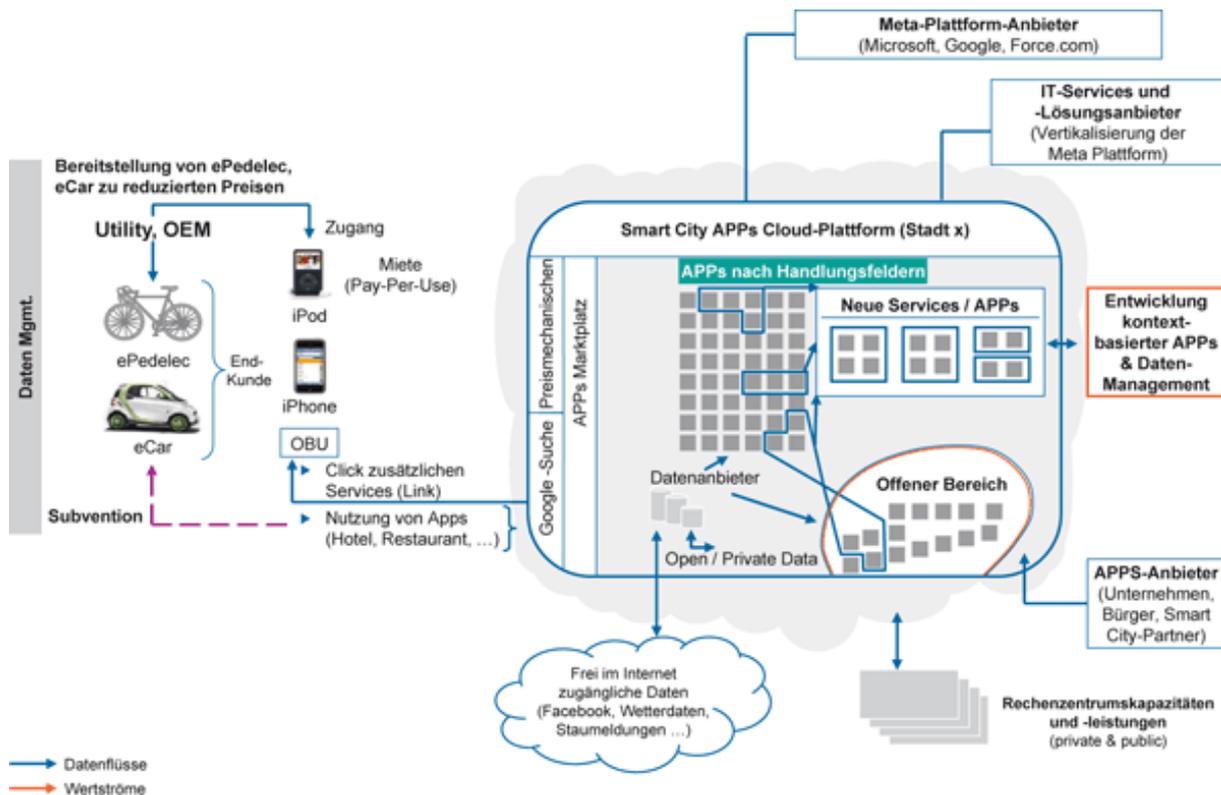


Figure 19: Schematic representation of a smart city app platform (Jaekel, 2017, p. 70).

An essential aspect of launching a smart city app and at the same time one of the biggest challenges in successfully running the platform is to convince users and producers to join the platform. Most digital platform experiments fail in generating the critical mass of users and producers, which is reached when a sufficient number of users and producers' network, interact and thus create value within the platform. Thus, digital platforms need to develop creative ways of how to get around the chicken-egg dilemma of attracting enough users and producers, when you need users to attract producers and vice versa. If a starting point for the initialisation of the interaction-loop is generated, the system will be accelerated via a positive feedback loop. So, if one side of the platform is growing, also the other side of the platform will grow. This performance needs to be continued until the critical mass of users is exceeded and exponential network effects start to act. This problem can be solved taking into account the following five design principles:

1. a 'lure' needs to be found to start the interaction loop attracting one side of the platform without the other side being present
2. a smoothly running feedback loop needs to be secured by avoiding entrance barriers for the other side of the platform
3. the time reaching the critical mass needs to be minimised
4. incentives need to be created for the side, which is harder to attract
5. establishing a two-sided market within a digital platform usually results from attracting first one side of the platform, already generating value for the other side

(Jaekel, 2017, p. 81-82).

8.3 Overview of business models cases

Table 12: Overview of the examples of sustainable business model platforms

No	Title	Business Model	Focus	Characteristics	Link
I	Smart City App Munich	Smart city app platform based on public-private-academic partnership	Promoting e-mobility & public transport Information on events and administrative services	Comprehensive and consistent city app Advertising revenues	https://www.muenchen.de/meta/iphone-android-app.html
II	Smart City App Verona	Smart city app platform based on public-private partnership	Promoting sustainable transport Providing free wifi access points Information on events and tourist attractions	Integration of third-party apps Incentivisation and gamification parts	http://www.veronasmartcity.com/
III	JouleBug	Private app platform focussing on behavioural change	Providing information & tutorials on sustainability issues	Challenges Freemium approach for company users Social media character	https://joulebug.com/
IV	Treeday	Private app platform focusing on producer transparency generating user compliance	Providing transparency by sustainability index of businesses Tracking of users sustainability behaviour	Incentives and challenges Freemium approach for business providers Social media character	https://www.treeday.net/?locale=de

8.3.1 Smart City App Munich

8.3.1.1 Short description

The city of Munich, together with Vienna and Lyon present the three lighthouse cities within the European Union's Horizon 2020 project "SMARTER TOGETHER". The project started in 2016 and aims at finding a balance between smart technologies, citizen engagement and institutional governance in order to deliver smart and inclusive solutions and to improve citizen's quality of life (Smarter Together, 2019).

Within this project, the city of Munich launched the Smart City Munich app, which brings together the above-mentioned points on one single platform.

8.3.1.2 Focus

The Smart City App Munich creates intelligent links between services of the city of Munich on the one hand side and private operators on the other hand side. The focus of this initiative lies on promoting e-mobility as well as the use of public transport, while making the way of transport more efficient for citizens and visitors. The app emphasises on real time information on transport, events and activities in the close vicinity of the user. Further, the city of Munich is concerned to inform the user about administrative services in the city, in order to facilitate people's everyday life. In the area of Neuaubing-Westkreuz/Freiham, the city of Munich aims at cutting CO2 emissions by more than 20%, raising the use of renewable energy to above 20% and increasing energy efficiency by more than 20%. Munich's goal is to be carbon-neutral in Neuaubing-Westkreuz/Freiham by 2050. Besides further measures within the Smart Together project, the Smart City App Munich (with 500 000 downloads) is seen as an important measure to reach this goal. Further information can be found on <https://www.smarter-together.eu/cities/munich#/> and <https://www.muenchen.de/media/mediadaten/werben-auf-muenchen-de.html#users>.

8.3.1.3 Initiator / Organisation

The city of Munich together with Stadtwerke München (SMW) commissioned münchen.de (the official city portal of Munich provided by Portal München Betriebs-GmbH & Co. KG) with the development of the application Smart City App Munich. Within the development of the project, the city of Munich was cooperating with the following experts from research and the private sector:



Figure 20: Project partners of the city of Munich within the smarter together project.

The shareholders of the Portal München Betriebs-GmbH & Co. KG are the City of Munich and the SMW, a municipal enterprise. Further official partners and experts for mobility within the platform is the Münchner Verkehrsgesellschaft (MVG), a subsidiary company of the SMV and the Münchner Verkehrs- und Tarifverbund (MVV), a profit-centre to support transportation organisations. The shareholders of MVV are again the city of Munich, the province of Bavaria and eight districts of the province of Bavaria. For further information see: <https://www.mvv-muenchen.de/ueber-den-mvv/die-mvv-gmbh/organisation/index.html>, <https://www.mvv-muenchen.de/ueber-den-mvv/der-verbund/gesellschafter/index.html>, and <https://www.muenchen.de/presse-mediadaten/presse/wirueberuns/gesellschafter.html>.

8.3.1.4 Elements and components of Smart City Munich

When downloading the free of charge SmartCity App Munich (iOS and android), available in German and English, the user is provided with some general information about the weather as well as sights to see and events in their close proximity. The news category provides users with the latest incidents in the region and an event calendar with integrated ticket service and route planner makes the planning of free time easier. Further, an interactive map is available which shows detailed information about transport options including local public transport, e-car sharing, pedelecs, utility e-trikes and the location of e-car charging stations. Another feature of the application gives insight into city services like health care, safety, education, administrative offices and other authorities. Besides the search function, another interactive feature is provided, as users can report pollution or contamination in public places to the municipality. The categories cinema, eating and drinking, shopping and useful information like near ATMs, taxi stands and wifi hotspots motivate users to enjoy the diverse recreational offers of the city. Within the category MyMunich, users can save their favourites and order them either by distance or alphabetically (muenchen.de, 2019; Smarter Together, 2019).

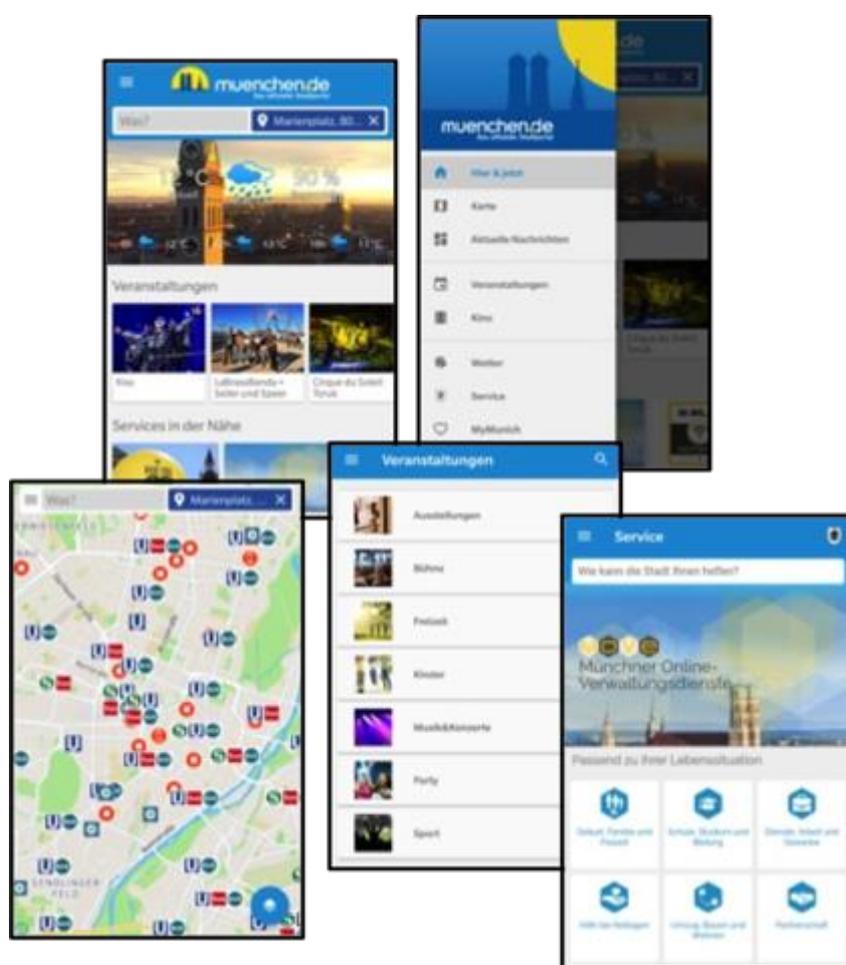


Figure 21: Screenshots of the user interface and features contained in the smart city app Munich; Source: muenchen.de (2019)

8.3.1.5 Business model analysis

The Smart City app was developed to create intelligent links between services provided in the city of Munich. It aims at making the daily life of local residents, visitors and tourists more comfortable and their way of transport more efficient and eco-friendlier. The Private businesses

pay money to the platform provider (münchen.de) for publishing their information, thus augmenting the visibility of their offers. The platform may also contain advertisements from third parties.

Users can also rate the different services or suggest some corrections regarding the availability or the position. Here, the user agrees to the platform's rights to publicly use the information within the scope of the platform. If a certified mail contact is available, the service provider can comment on the user ratings or resign from the rating forum. In this case, the existing comments will be deleted from the platform. The platform may also contain contents of third parties, which are marked by either the logo of the third party or the note 'powered by'. Generally, a user registration is not necessary to use the services of the application. Whereas, the user may register to receive some personalised or non-free content. Data is only collected, saved (on a secured server in Germany) and processed for the use within the purpose of the platform.

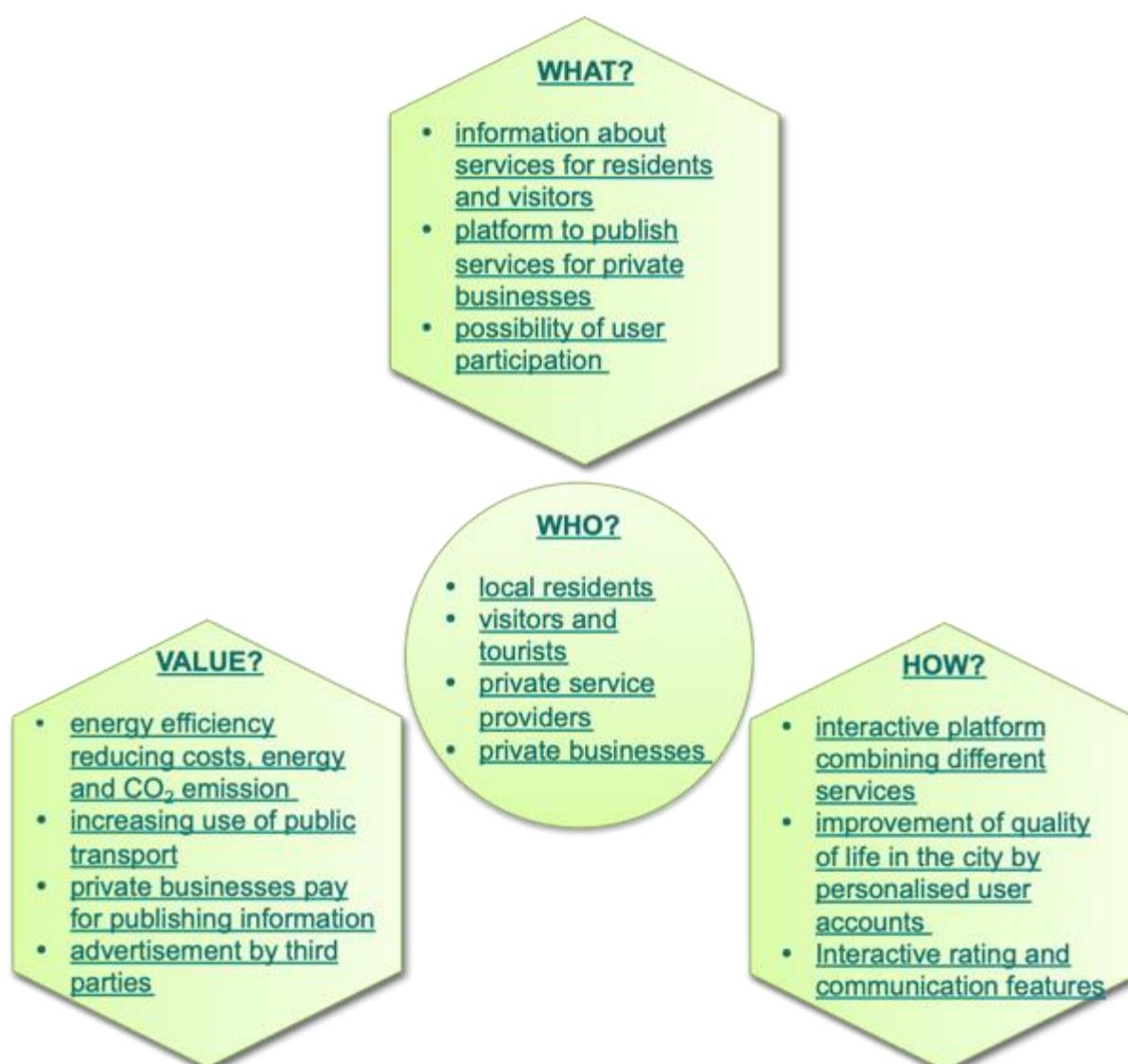


Figure 22: Analysis of the Smart City App Munich using the business model navigator (Gassmann).

8.3.2 Smart City App Verona

8.3.2.1 Short description

The initiative Smart City is part of a 'Sustainable Energy Action Plan', which started in 2012 and aims at reducing CO2 emissions in public lighting, as well as in the residential, production and transport sector. Verona wants to build a new City model, which meets the needs of our modern time. It aims to create an inclusive city involving the actors of the city and chooses knowledge as the basis of economic activity and development. Economic development, shared knowledge, enhancement of the artistic and cultural heritage, social innovation, technology and attention to the environment are among the perspective of the initiative. The project is implemented with the consent of all partners and with the specific contribution of all the active forces of the city. By launching the Smart City App, Verona wants to improve the quality of the life of its citizens through solutions concerning safety, transport and tourism (Verona Smart City, 2019).

8.3.2.2 Focus

The ultimate goal of the initiative is to improve the citizen's life by taking a series of actions, which include the implementation of technology, innovation and environmental sustainability. The application not only aims at facilitating the everyday life for the citizens of Verona, but also for the administrative area, which is provided with real time information and can thus prevent inconvenience and rapidly inform the public (Verona Smart City, 2019).

One of the measures is to boost the digital transformation of the city of Verona towards a "smart city" model, thanks to the development of innovative services and solutions suitable to meet the increasingly specific needs of all public and private subjects (TIM, 2019).

Another focus of the project is to test the fifth-generation mobile network and to experiment with Internet of Things (IoT). The city introduces IoT into areas like public transport, parking and trolleybuses, but will also take into account the topics of environment, tourism and safety in the city.

Bus as a sensor, is a service which integrates sensors in city buses and bus stops and helps to evaluate data like the route of the bus and the number of users in real time. Further, it gives information about the quality of the air in controlled areas, useful information not only for the municipality, but also for citizens.

Smart parking is the solution for the intelligent management of the city's parking areas. The app guides you to the closest accessible parking lot, thus improving the traffic situation in the city and avoiding useless rounds searching for parking spaces. The function is also coupled to a parking meter.

Filobus Impact is a service, which can control the impact of construction work of the trolleybus on the local traffic. This service was specially designed for the duration of construction work in Verona and aims at finding smart solutions in order to improve the traffic situation during construction work (Verona-In, 2019).

Another topic of the Smart City Verona project is to improve the free of charge wifi network of the city. The city already installed 2600 hotspots which are used by 50 000 people (VeronaSera, 2019).

Further innovative services will be subsequently discussed and developed on the subject of public safety, control of tourist flows, remote control of industrial plants, remote monitoring,

management services of public transport, video services of virtual or augmented reality to support tourism, culture and education (TIM, 2019).

8.3.2.3 Initiator / Organisation

The project Smart City Verona was initiated by the City of Verona together with Agsm, which is the main power supplier in Verona. The agreement for implementing the 5G network was further signed by Mayor Federico Sboarina, Agsm general manager Daniela Ambrosi and TIM North Head Sales Manager Roberto Collavizza. TIM group is a telecommunication company operating in Italy and Brazil and responsible for the implementation of the 5G network (Verona-In, 2019).

The initiative MuoVERsi was presented by the councillors for environment and transport.

8.3.2.4 Elements and components of Smart City Verona

Throughout the city of Verona, public light poles are installed, which indicate free wifi hotspots. All the wifi access points can be found on a map within the application. Further, the city's charging points for electrical cars can be found and information about current events taking place in the city is provided within the application. In the function mobility and traffic, the app contains information about public transport (linked to the ATV app), traffic reports (tweets by Verona mobile), availability of parking areas and a map with electric vehicle parking lots. For tourists, the app provides information on how to get to the city, what to do and see, where to stay and eat as well as suggested itineraries and further tourist information like contacts, tourist guides and a map with toilets. The app also contains a list of all defibrillators situated in the city.



Figure 23: Screenshot of the App guide provided by the Smart City App Verona.

Further, the application includes a questioner for people to make their own suggestions. The bike sharing service provided by ATV gives real time information about available bikes in the specific neighbourhood.



With the function MuoVERsi, the city of Verona launched a project comprising a gamification part to increase sustainable mobility. The participants can track their activities by bike, by foot or by public transport. Within this competition the winners are rewarded with e-bikes, annual tickets for the local bus service or the bike sharing service. With this measure the city of Verona aims on motivating their citizens to increasing sustainable mobility.

After registration the function tracks a person's activity and sums a person's points taking into account the number, type and distance of the respective activity. Everybody participating for at least five days performing at least five activities during the time the competition is running will take part in the tombola. The winners will be rewarded on the 12th of May, where a bike event for children takes place, on the 5th of June, the World Environment Day and the 22nd of September, the day of sustainable mobility. The data collected within this period will be used to analyse people's behaviour and inform the citizens in order to make conscious decisions and motivate them to use their car less often (VeronaSera, 2019).

8.4.4.4 Business model analysis

With the Smart City App, the City of Verona is not only providing information about the possibilities of bike sharing and public transport. With the MuoVERsi feature it actively motivates the users to change their transportation behaviour. People can take part in a challenge regarding the sustainability of transportation and are rewarded for their effort.

The municipality wants to promote innovation, measures of environmental sustainability, energy efficiency and the use of renewables. Further, Verona can progress to become a pioneer city regarding technology and the implementation of IoT by cooperating with a local technology provider and transport enterprise.

The attractiveness of the city for tourists is increased by the accessibility of information about services in the city as well as accommodation and transportation. The quality of life is increased by providing information about nearby events, modes of transport and accessibility of car parking and the supply of free wifi hotspots throughout the city.

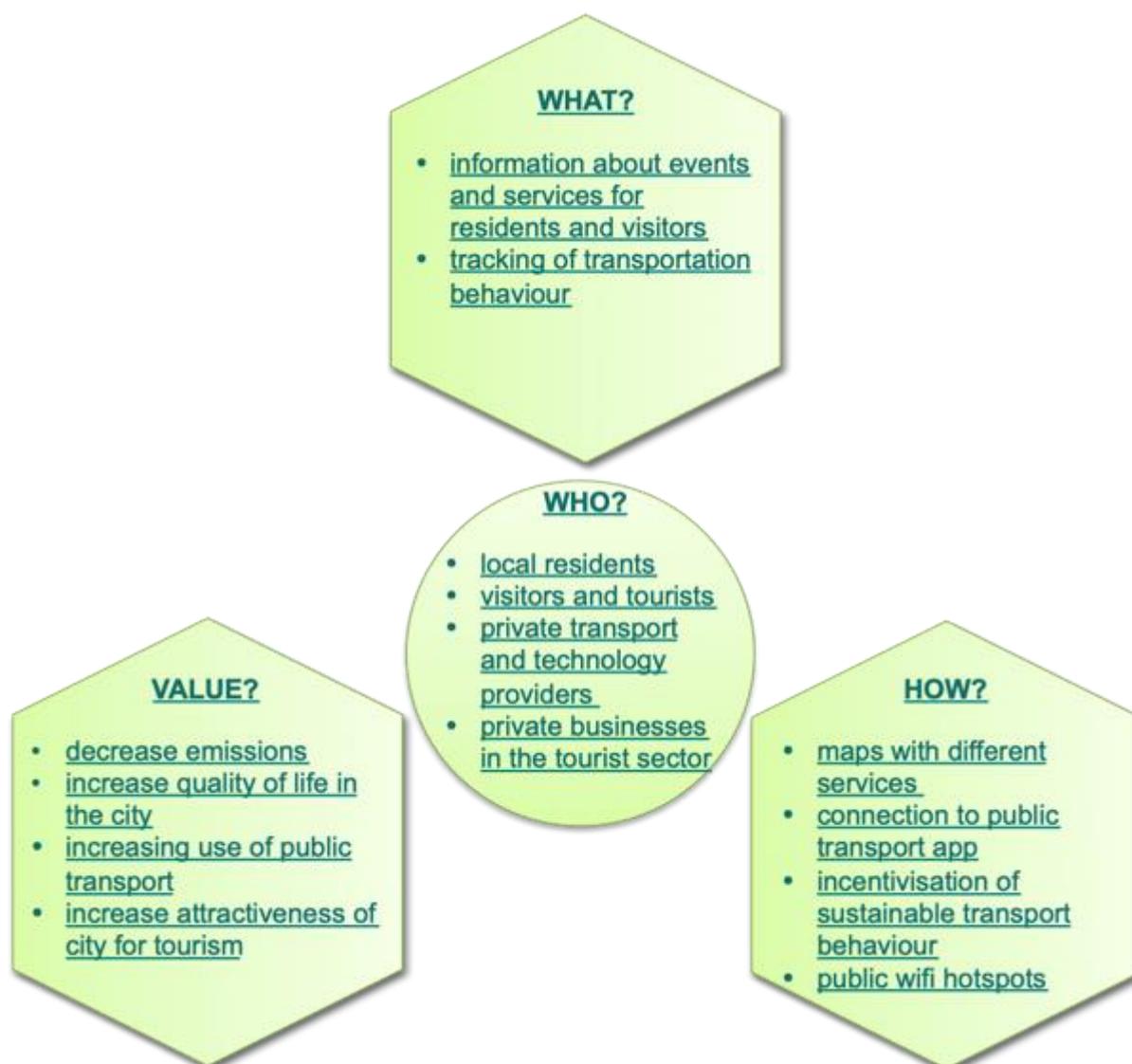


Figure 24: Analysis of the Smart City App Verona using the business model navigator (Gassmann).

8.3.3 JouleBug

8.3.3.1 Short description

The company was established in 2007 in San Francisco and has two main product lines, the App JouleBug and another one called Shine. Both applications aim to encourage people to act more sustainably in terms of social as well as environmental sustainability. JouleBug started as an experiment in the early phase of mobile, social and gamified software. The software and app are designed to engage and educate people on possible solutions to environmental problems, and on how their small daily actions can have a positive impact on the environment.

8.3.3.2 Focus

The focus of the application lies in motivating people to change their habits towards a more sustainable lifestyle. The goal of the initiators is to make sustainable living social, simple and fun. Therefore, they picked the best out of mobile gaming, social media and educational tools. By competing with their friends or colleagues, people can further lower their energy bills,

reduce waist and together save the planet. With the app Shine, JouleBug encourages communities and company's sustainability leaders, bringing their members closer together and enabling interaction between different areas. The application is also being used by companies like IKEA, Siemens or KPIT Technologies for implementing challenges with their closed (employee) community. Reportedly they favoured ecological results as well as strengthened their community (JouleBug, 2019). When setting a challenge, the user can choose his/her own objective, create teams and set prices and rewards.

8.3.3.3 Initiator / Organisation

The vision of the company Cleanbit Systems, Inc. the provider of Joulebug, is to “use technology (mobile, social and gamification) to persuade/encourage users to take small actions that improve their lives, their community and the planet”.

8.3.3.4 Elements and components of JouleBug

JouleBug uses multiple game design elements and reward mechanisms for people taking steps towards environmental behaviour. After login with your e-mail or via a social media network, every user has access to a so-called trophy case, where all the rewards and achievements are stored. The app makes it possible to easily connect with social media like Facebook or Twitter for sharing the personal achievements. Furthermore, the app is designed to set challenges including features like a countdown clock. Besides challenges, the App provides distinct feedback to its users and offers a structured system to measure and present the results of the users' actions. JouleBug uses notifications for offering suggestions (“green information”) reminders, and triggers. The application provides information and tips as well as video tutorials for pro-environmental behaviour within different topics like e.g. transportation,



Figure 25:
Screenshot JouleBug;
Source (JouleBug 2019)

waste, habits and shopping. It also has a feedback system that serves as a positive reinforcement for users. Just like on common social platforms, people may post, share and like photos of their sustainable activities ranging from walking, using public transport to bringing a reusable lunch box to work or skipping the lid and the straw when buying a drink. In the personal profile the user can have a look on their statistics regarding saved CO₂, diverted waste and water saved. The app does not contain any third-party advertisement user's data will not be given to such. With the application Shine the same principle is applied for closed communities like for example companies. To sign in people, need the access code for their community's project. Further, Yammer, Slack or Google can be used for the login. With the free basic version for unlimited users, communities can get started with choosing their action pack and profit from on-going motivational challenges. The charged standard version, suitable for small to medium sized companies includes all basic features plus customised challenges and localised actions. A pro-version is available for large companies providing social inclusion, personal support as well as a customised application.

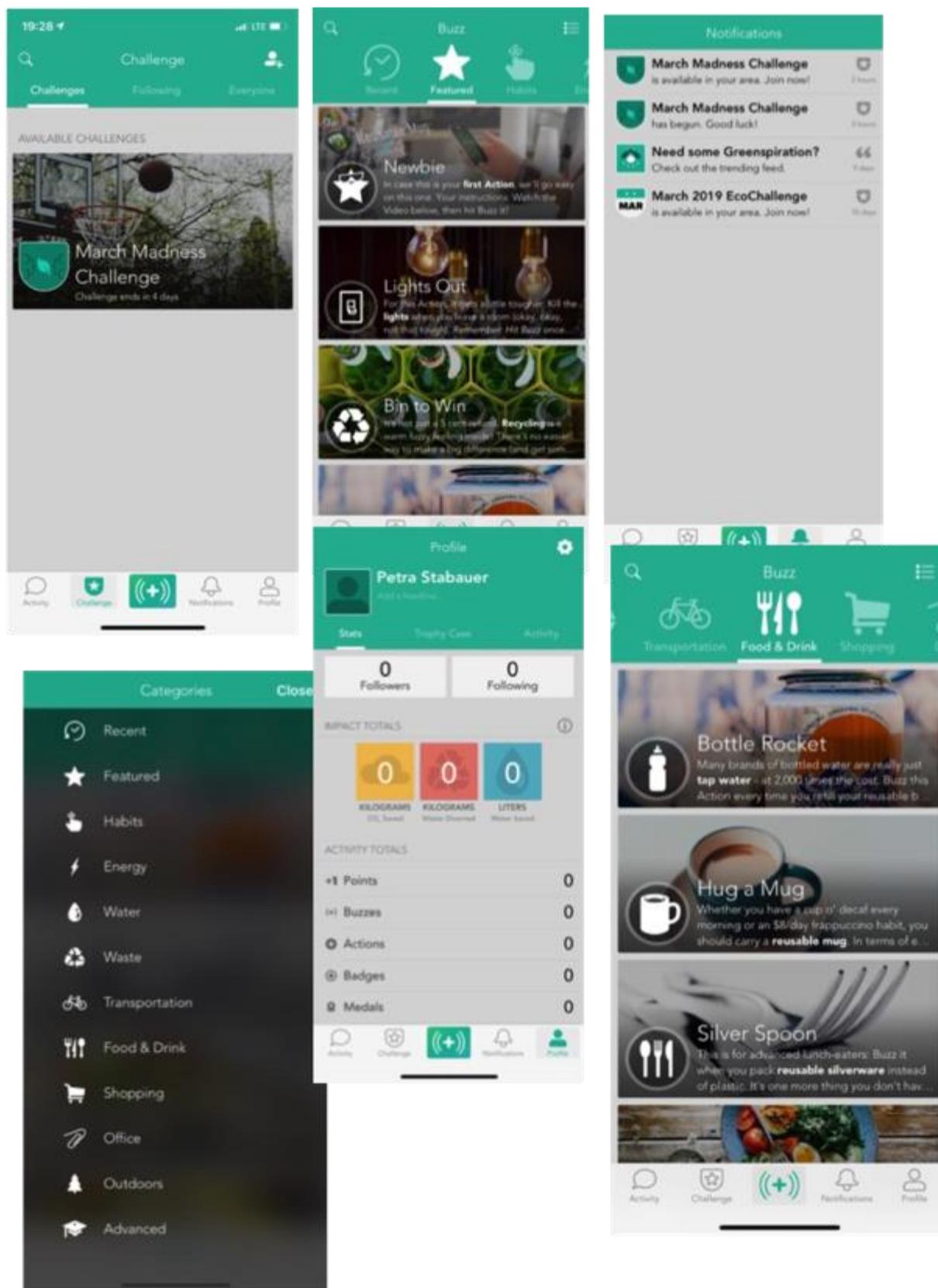


Figure 26: Screenshot of the different tools available within the JouleBug app.

8.3.3.5 Business model analysis

The JouleBug app is aimed at making the daily lives of people, communities and whole companies more sustainable. Summing up the small changes in people’s habits, leads to an

important improvement on the environmental impact of the community. Demonstrative examples and tutorials provide lots of information for the users, which may be applied in challenges or communicated via social networks. Joulebug aims to change people's behaviour towards pro-environmental behaviour and sustainability by using methods and tools from behavioural economics. Incentives are provided in terms of points for taking actions and achievements demonstrate the change of behaviour and a scoreboard gives feedback to the user and makes it possible to compare him/herself with other users. According to the provider, these challenges represent a proven tool to promote sustainable actions in schools, companies or cities. In the challenges, points, badges and trophies are being used as rewards for boosting both intrinsic and extrinsic motivation of the users. Communities and companies are able to buy a personalised application in order to specify the needs of their users and reach for their predefined goals.

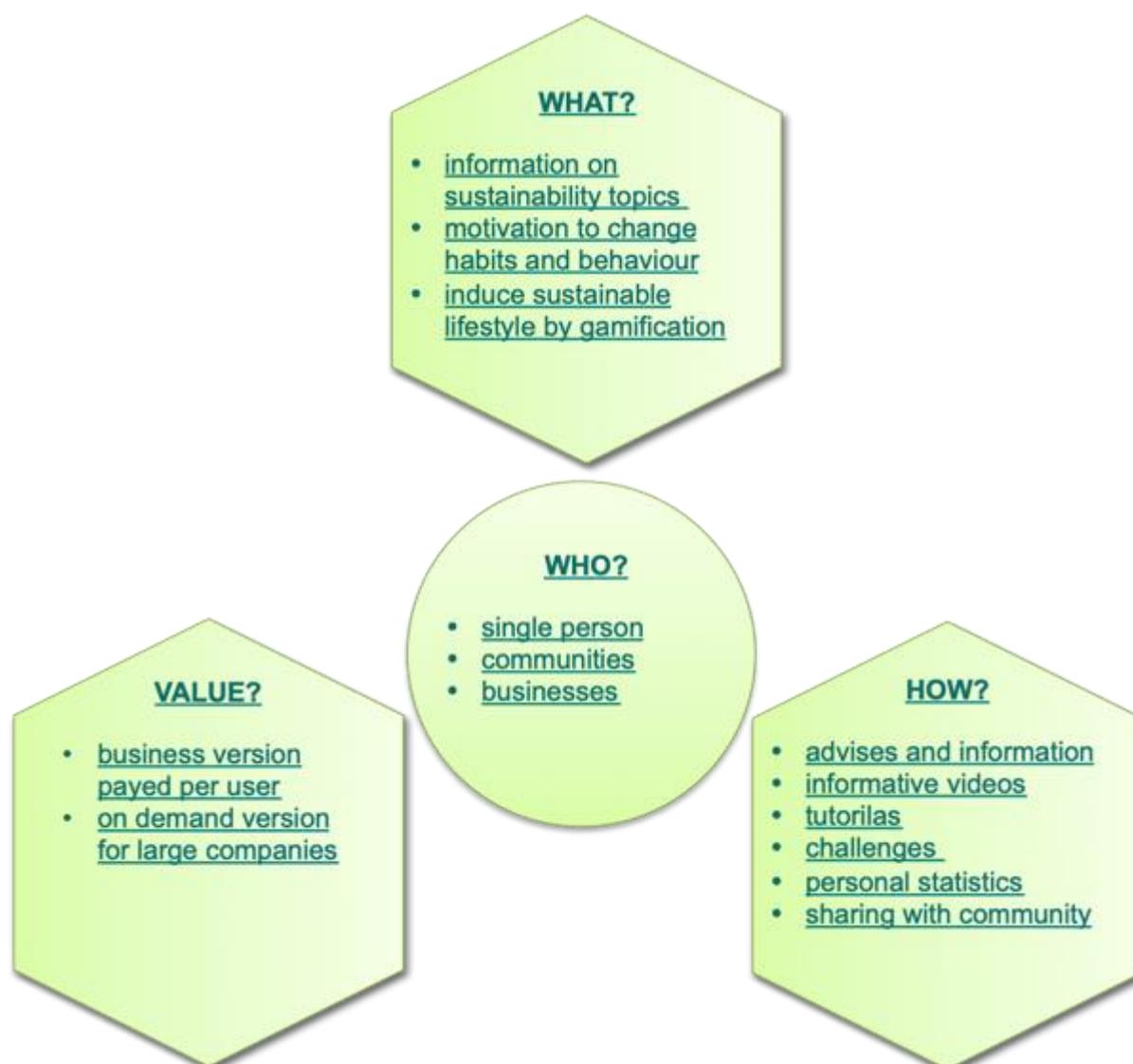


Figure 27: Analysis of the JoulBug app using the business model navigator (Gassmann).

8.3.4 Treeday

8.3.4.1 Short description

The Austrian Start-up named Treeday wants to give orientation when it comes to choosing a sustainable restaurant or shop and make sustainable lifestyle easier for their customers. Treeday offers the first green lifestyle guide, which makes it possible to select the most sustainable businesses within the user's close proximity (Treeday, 2019).

'We generate benefit on both sides: As a 'Green Business Provider' we provide information and make such accessible, for both, entrepreneurs as well as for users and thereby we generate transparency. The central question, we are answering is not only, if a business is sustainable, but how sustainable it is,' comments Andreas Miedaner, founder and director of Treeday (Crowdcircus, 2019).

8.3.4.2 Focus



Figure 28: Interactive map within the Treeday app. More sustainable businesses appear larger; Source: Treeday (2019)

Treeday shows sustainable businesses like restaurants, hotels, supermarkets as well as wine and cloths shops on an interactive map. People can track their own lifestyle and see how much impact their behaviour and their actions have on our planet. Together with the University for Natural Resources and Life Science Vienna, Treeday created the so-called sustainability index. The index scales a business from 0 to 100. This number sums up all different measures a company takes in order to act more sustainably. Therefore, sector relevant indicators are investigated and existing quality or environmental labels are taken into account (Treeday, 2019).

Thanks to an interactive map, users are not only able to find sustainable business within their close proximity, they are also aware of the grade of sustainability of the respective company. Users can on the one hand side select the preferred sustainable company, on the other hand side companies can directly communicate their effort regarding their sustainability measures to their customers.

8.3.4.3 Initiator / Organisation

In 2014 Andreas Miedaner founded the start-up Treeday to encourage green economy and make a step towards a more sustainable behaviour of consumers as well as enterprises (Trending Topics, 2016).

Since then, the project has been subvention with more than half a million euros by crowd funding and has gained several partners in media and seal of quality like the Vienna business agency (Wirtschaftsagentur Wien), the Austrian Research Promotion Agency (FFG) and the University for Natural Resources and Life Science Vienna (BOKU) (Green Rocket, 2019).

Within a business account, companies can publish their sustainability report, inform their customers about promotions and post logos, photos, widgets and stories. Using the digital offline marketplace, registered businesses are able to publish their entire supply chain as well as sales facilities. In the future it will also be possible for registered companies to post banner ads (derBrutkasten, 2018).

8.3.4.4 Elements and components of Treeday

After personal registration, or registration via social networks, the user can profit from the services provided by the Treeday app. The Treeday Index takes into account data received

from the respective company itself as well as information from existing seals of quality. The platform sums up the sustainability of a business in one single number ranging from 0 to 100, easy to be interpreted by the customers. The index rates the used resources and processes by the company as well as the promotion of equality within the enterprise. Further, the results of all the Treeday community are daily shown within the app to encourage people to continue. Through the description of the common success, every single action gains in importance. More than 10 000 businesses can be found at the moment on the Treeday platform with 50 000 users, which can compete to be within the top 10 Treeday users (Crowdcircus, 2019).

Another concept of the app is to measure the CO₂, which is not generated by a user and reward this saving of emissions with TreeCoins. Such can be interchanged with partners of the Treeday app into sustainable products and services. The platform sees itself as a sustainable social network where users can communicate, network, exchange opinions and recommendations. Treeday provides data privacy and personalised privacy settings. The data provided within the application will not be passed to third parties without previous confirmation by the user or when explicitly declared in the terms of use of the application.

For companies a free basic version of the app is available where functions like availability of opening hours, Treeday index for the company as well as the Treeday report are included. According to the respective paid membership, functions like a photo gallery, sales points, displaying the company's suppliers, a business pin wall or a social media representation are contained within the contract additionally to the basic functions (Treeday, 2019).



Figure 29: Screenshots of the user interface and different functions of the Treeday app; Source: Treeday (2019)

8.3.4.5 Business model analysis

The platform is financed not only by a crowd funding initiative, but also by the membership fees paid by the registered companies. A third revenue stream will be added, where only registered businesses may place advertisements within the app (derBrutkasten, 2018; Crowdcircus, 2019).

The company does not work together with typical venture capital investors. Their business model idea is businesses paying for additional services and thus propagating the expansion of the start-up (Start-us Magazine, 2016).

A challenge is offered by the possibility to compete with other people for the top 10 users of Treeday. People are rewarded for the saved CO₂ with TreeCoins, which can be changed for sustainable goods and services within the app.

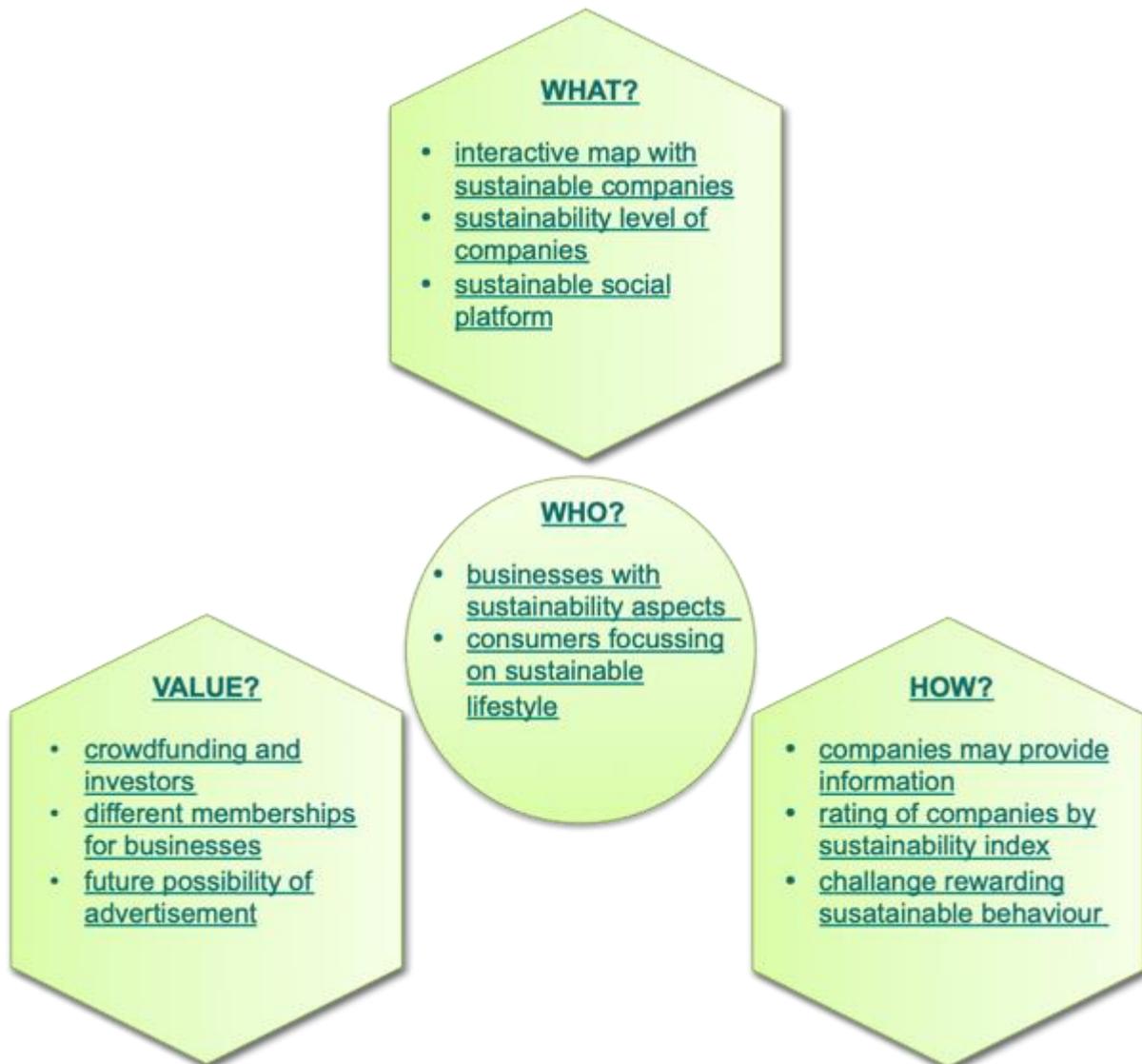


Figure 30: Analysis of the Treeday app using the business model navigator (Gassmann).

8.4 Implications for SimpliCITY: Lessons learned for business models of smart city applications

- Ensure a language consistency in application design (if available in English, all features should be in English), fully functional (no frequent breakdown of server), clear and intuitive representation
- Financing: the operator needs to be able to maintain and expand infrastructure
- Revenue mechanism needs to be financially attractive for business or service providers
- operator needs to assure freedom and technological possibility for innovators to implement their ideas
- Contents: the operator has to make sure that contents are accessible for users
- Need for intensive and high cooperation effort in public/private partnerships
- Place right incentives to build up a platform ecosystem
- Solve the hen-egg dilemma: How can we promote a platform to users and how can we attract producers?
- Reaching a critical mass is essential for generating an exponential feedback loop within the platform
- Competitor analysis needed: are there existing apps we can integrate into the platform or is a fusion of existing platforms possible?

9 Glossary

Term	Definition
Behaviour change technique (BCT)	“A BCT is defined as an observable and replicable component designed to change behaviour.” (Michie et al., 2015)
Behavioural economics	“Behavioural Economics is the combination of psychology and economics that investigates what happens in markets in which some of the agents display human limitations and complications.” (Mullainathan and Thaler, 2000)
Behavioural insight	An inductive approach to policy making that combines insights from psychology, cognitive science, and social science with empirically-tested results to discover how humans actually make choices. (OECD)
Business model	“A business model articulates the logic and provides data and other evidence that demonstrates how a business creates and delivers value to customers.” (Teece, 2010, p. 173)
Critical mass	“The point where the value of the network exceeds the cost of joining for most users. Once a network reaches sufficient size, its network effects start to pull in new users and growth takes off.” (Modern Monopolies)
Demand side	“Buyer, service seeker, guest, consumer, etc.” (Murat Uenlue)
Digital nudging	“The subtle way of using design, information and interaction elements to influence user behaviour in digital environments without restricting the individual's freedom of choice.” (Meske & Potthoff, 2017, p. 2589)
Gamification	“The use of game design elements in non-gaming contexts to improve user experience and user engagement.” (Deterding et al., 2011)
Incentive	“A thing that motivates or encourages someone to do something.” (Lu et al., 2018)

Multi sided platform (MSP)	“Technologies, products or services that create value primarily by enabling direct interactions between two or more customer or participant groups.” (Andrei Hagiu)
Network effects	“Effects that incremental participants (and participation) have on the value of the network to other participants.” (Murat Uenlue)
Nudging	“Any aspect of the choice architecture that alters people’s behaviour in a predictable way without forbidding any options or significantly changing their economic consequences.” (Thaler & Sunstein 2009: 6)
Persistent treatment effects	“long-term behavioural change” (Frey and Rogers, 2014)
Persuasive technology	“Technology that is designed to change attitudes or behaviours of the users through persuasion and social influence but not through coercion.” (Anagnostopoulou et al., 2018, p.1).
Platform ecosystem	“People and companies interacting with a digital platform build an ecosystem. Through the constant exchange and interaction between the parties, the ecosystem as well as the platform itself develops.” (Gassmann, 2019, p. 100)
Public-private partnership (PPP)	“On-going agreement between government and private sector organisations in which the private organisation participates in the decision- making and production of a public good or service that has traditionally been provided by the public sector and in which the private sector shares the risk of that production.” (Forrer, 2010, p. 976)
Regulation	“Restrictions, bans, compliance rules, and similar forms of regulation impose behavioural limitations that individuals or corporations are expected to comply with.” Ly & Soman (2013: 6)
Reward	A thing (tangible/intangible) given in recognition of service, effort, or achievement. (Schweyer, 2017)
Smart city	“A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental aspects.” (ITU-T FG-SSC 2014, p.1).

Supply side	“Seller, service provider, host, content creator, etc.” (Murat Uenlue)
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11 Annex I: BCT taxonomy: 93 hierarchically-clustered techniques

11.1 Goals and planning

Table 13: Annex I Goals and planning (Source: Michie et al., 2013)

Label	Definition	Example
(1) Goal setting (behaviour)	Definition of a goal in terms of the behaviour to be achieved (goal setting is recommended if there is evidence that goals set as part of the intervention; if the goal is unspecified or is a behavioural outcome use <i>goal setting outcome</i> , or if the goal defines a specific context, frequency or duration of the behaviour, action planning should be used).	Agree on a daily biking goal (e.g. 5 km)
(2) Problem solving	Analysis, or prompt the person to analyse, factors influencing the behaviour and generate or select strategies that include overcoming barriers and/or increasing facilitators.	Prompt the patient to identify barriers preventing them from biking to work e.g., lack of motivation, and discuss ways on how to overcome them e.g., biking to work with a colleague
(3) Goal setting (outcome)	Set or agree on a goal defined in terms of a positive outcome of the behaviour that is strived for.	Set a weight loss goal (e.g. 0.5 kilogram over one week) as an outcome of changed biking routines.
(4) Action planning	Prompt detailed planning of the performance of the behaviour (must include (at least one) either context, frequency, duration of intensity). The context can be environmental (physical or social) or internal (physical, emotional or cognitive => includes <i>implementation intentions</i>); Evidence of action planning does not automatically imply goal setting, only code latter is sufficient evidence	Prompt planning of biking at a particular time (e.g. before work) on certain days of the week
(5) Review behaviour goal(s)	Review behaviour goal(s) jointly with the person and consider modifying goal(s) or behaviour change strategy in terms of the achievement. This may lead to re-setting the same goal, a small change in that goal or setting a new goal instead of (or in addition to) the first, or no change; If the goal is specified in terms of behaviour, code <i>Review behaviour goal(s)</i> , if the goal is unspecified, code <i>Review outcome</i>	Examine how well a person's performance corresponds to the agreed goals e.g. whether they biked at least five km per day and consider modifying future behavioural goals accordingly e.g. by increasing or decreasing km target or

	<i>goal(s)</i> and if discrepancy is created consider <i>Discrepancy</i> between current behaviour and goal.	changing means of transportation.
(6) Discrepancy between current behaviour and goal	Draw attention to discrepancies between a person's current behaviour (in terms of the form, frequency, duration, or intensity) and the person's previously set outcome goals, behavioural goals or action plans (goes beyond self-monitoring of behaviour); If discomfort is created only code <i>Incompatible beliefs</i> and not <i>Discrepancy</i> between current behaviour and goal; if goals are modified, also code <i>Review behaviour goal(s)</i> and/or, <i>Review outcome goal(s)</i> ; if feedback is provided, also code, <i>Feedback on behaviour</i> .	Point out that the recorded exercise/ bike route fell short of the goal set.
(7) Review outcome goal(s)	Review outcome goal(s) jointly with the person and consider modifying goal(s) in light of achievement. This may lead to resetting the same goal, a small change in that goal or setting a new goal instead of, or in addition to the first; If the goal is specified in terms of behaviour, code <i>Review behaviour goal(s)</i> , if goal unspecified, code <i>Review outcome goal(s)</i> ; if discrepancy is. created consider also <i>Discrepancy</i>	Examine how much weight has been lost and consider modifying outcome goal(s) accordingly e.g., by increasing or decreasing subsequent weight loss targets.
(8) Behavioural contract	Create a written specification of the behaviour to be performed, agreed on by the person, and witnessed by another person; also, code <i>Goal setting (behaviour)</i>	Sign a contract with the person e.g. specify that they will go to work by bike
(9) Commitment	Ask a person to affirm or reaffirm statements indicating commitment to change the behaviour; If it is also defined in terms of behaviour to be achieved also code <i>Goal setting (behaviour)</i>	Ask a person to use an "I will" statement to affirm or reaffirm a strong commitment (i.e. using "strongly committed" or "high priority") to start, continue or restart the attempt to take medication as prescribed

11.2 Feedback and monitoring

Table 14: Annex I Feedback and monitoring (Source: Michie et al., 2013)

Label	Definition	Example
(1) Monitoring of behaviour	Observe or record behaviour with the person's knowledge as part of a	Watch hand washing behaviours among health care

by others without feedback	behaviour change strategy; Note: if monitoring is part of a data collection procedure rather than a strategy aimed at changing behaviour, do not code; if feedback given, code only, <i>Feedback on behaviour</i> , and not, <i>monitoring of behaviour by others without feedback</i> ; if monitoring outcome(s) code, <i>Monitoring outcome(s) of behaviour</i> by others without feedback; if self-monitoring behaviour, code, <i>Self-monitoring of behaviour</i>	staff and make notes on context, frequency and technique used
(2) Feedback on behaviour	Monitor and provide informative or evaluative feedback on performance of the behaviour (e.g. form, frequency, duration, intensity) Note: if Biofeedback, code only, <i>Biofeedback</i> and not, <i>Feedback on behaviour</i> ; if feedback is on outcome(s) of behaviour, code, <i>Feedback on outcome(s) of behaviour</i> ; if there is no clear evidence that feedback was given, code, <i>Monitoring of behaviour by others without feedback</i> ; if feedback on behaviour is evaluative e.g. praise, also code, <i>Social reward</i>	Inform the person of how many steps they walked each day (as recorded on a pedometer) or how many calories they ate each day (based on a food consumption questionnaire).
(3) Self-monitoring of behaviour	Establish a method for the person to monitor and record their behaviour(s) as part of a behaviour change strategy Note: if monitoring is part of a data collection procedure rather than a strategy aimed at changing behaviour, do not code; if monitoring of outcome of behaviour, code <i>Self-monitoring of outcome(s) of behaviour</i> ; if monitoring is by someone else (without feedback), code <i>Monitoring of behaviour by others without feedback</i>	Ask the person to record daily, in a diary, whether they have brushed their teeth for at least two minutes before going to bed Give patient a pedometer and a form for recording daily total number of steps
(4) Self-monitoring of outcome(s) of behaviour	Establish a method for the person to monitor and record the outcome(s) of their behaviour as part of a behaviour change strategy Note: if monitoring is part of a data collection procedure rather than a strategy aimed at changing behaviour, do not code; if monitoring behaviour, code, <i>Self-monitoring of behaviour</i> ; if monitoring is by someone else (without feedback), code, <i>Monitoring outcome(s) of behaviour by others without feedback</i>	Ask the person to weigh themselves at the end of each day, over a two-week period, and record their daily weight on a graph to increase exercise behaviours
(5) Monitoring outcome(s) of behaviour by others	Observe or record outcomes of behaviour with the person's knowledge as part of a behaviour change strategy; Note: if monitoring is part of a data collection procedure rather than a strategy aimed at changing behaviour, do not code; if	Record blood pressure, blood glucose, weight loss, or physical fitness

without feedback	feedback given, code only, <i>Feedback on outcome(s) of behaviour</i> ; if monitoring behaviour code, <i>Monitoring of behaviour by others without feedback</i> ; if self-monitoring outcome(s), code, <i>Self-monitoring of outcome(s) of behaviour</i>	
(6) Biofeedback	Provide feedback about the body (e.g. physiological or biochemical state) using an external monitoring device as part of a behaviour change strategy; Note: if Biofeedback, code only, <i>Biofeedback</i> and not, <i>Feedback on behaviour</i> or, <i>Feedback on outcome(s) of behaviour</i>	Inform the person of their blood pressure reading to improve adoption of health behaviours
(7) Feedback on outcome(s) of behaviour	Monitor and provide feedback on the outcome of performance of the behaviour; Note: if Biofeedback, code only, <i>Biofeedback</i> and not <i>Feedback on outcome(s) of behaviour</i> ; if feedback is on behaviour code <i>Feedback on behaviour</i> ; if there is no clear evidence that feedback was given code <i>monitoring outcome(s) of behaviour by others without feedback</i> ; if feedback on behaviour is evaluative e.g. praise, also code <i>Social reward</i>	Inform the person of how much weight they have lost following the implementation of a new exercise regime

11.3 Social support

Table 15: Annex I Social support (Source: Michie et al., 2013)

Label	Definition	Example
(1) Social support (unspecified)	Advise on, arrange or provide social support (e.g. from friends, relatives, colleagues, 'buddies' or staff) or non-contingent praise or reward for performance of the behaviour. It includes encouragement and counselling, but only when it is directed at the behaviour; Note: attending a group class and/or mention of 'follow-up' does not necessarily apply this BCT, support must be explicitly mentioned; if practical, code <i>Social support (practical)</i> ; if emotional, code <i>Social support (emotional)</i> (includes 'Motivational interviewing' and 'Cognitive Behavioural Therapy')	Advise the person to call a 'buddy' when they experience an urge to smoke Arrange for a housemate to encourage continuation with the behaviour change programme Give information about a self-help group that offers support for the behaviour
(2) Social support practical	Advise on, arrange, or provide practical help (e.g. from friends, relatives, colleagues, 'buddies' or staff) for performance of the behaviour; Note: if	Ask the partner of the patient to put their tablet on the breakfast tray so that the patient remembers to take it

	emotional, code <i>Social support (emotional)</i> ; if general or unspecified, code, <i>Social support (unspecified)</i> If only restructuring the physical environment or adding objects to the environment, code <i>Restructuring the physical environment</i> or <i>Adding objects to the environment</i> ; attending a group or class and/or mention of 'follow-up' does not necessarily apply this BCT, support must be explicitly mentioned.	
(3) Social support (emotional)	Advise on, arrange, or provide emotional social support (e.g. from friends, relatives, colleagues, 'buddies' or staff) for performance of the behaviour; Note: if practical, code, <i>Social support (practical)</i> ; if unspecified, code <i>Social support (unspecified)</i>	Ask the patient to take a partner or friend with them to their colonoscopy appointment

11.4 Shaping knowledge

Table 16: Annex I Shaping knowledge (Source: Michie et al., 2013)

Label	Definition	Example
(1) Instruction on how to perform a behaviour	Advise or agree on how to perform the behaviour (includes 'Skills training'); Note: when the person attends classes such as exercise or cookery, code <i>Instruction on how to perform the behaviour</i> , <i>Behavioural practice/rehearsal</i> and <i>Demonstration of the behaviour</i>	Advise the person how to put a condom on a model of a penis correctly
(2) Information about antecedents	Provide information about antecedents (e.g. social and environmental situations and events, emotions, cognitions) that reliably predict performance of the behaviour	Advise to keep a record of snacking and of situations or events occurring prior to snacking
(3) Re-attribution	Elicit perceived causes of behaviour and suggest alternative explanations (e.g. external or internal and stable or unstable)	If the person attributes their over-eating to the frequent presence of delicious food, suggest that the 'real' cause may be the person's inattention to bodily signals of hunger and satiety
(4) Behavioural experiments	Advise on how to identify and test hypotheses about the behaviour, its causes and consequences, by collecting and interpreting data	Ask a family physician to give evidence-based advice rather than prescribe antibiotics and to note whether the patients are grateful or annoyed

11.5 Natural consequences

Table 17: Annex I Natural consequences (Source: Michi et al., 2013)

Label	Definition	Example
(1) Information about health consequences	Provide information (e.g. written, verbal, visual) about health consequences of performing the behaviour; Note: consequences can be for any target, not just the recipient(s) of the intervention; emphasising importance of consequences is not sufficient; if information about emotional consequences, code <i>Information about emotional consequences</i> ; if about social, environmental or unspecific consequences code <i>Information about social and environmental consequences</i>	Explain health consequences of air pollution caused by driving cars
(2) Salience of consequences	Use methods specifically designed to emphasise the consequences of performing the behaviour with the aim of making them more memorable (goes beyond information about consequences); Note: if information about consequences, also code <i>Information about health consequences, Information about emotional consequences or Information about social and environmental consequences</i>	Produce cigarette packets showing pictures of health consequences e.g. diseased lungs, to highlight the dangers of continuing to smoke
(3) Information about social and environmental consequences	Provide information (e.g. written, verbal, visual) about social and environmental consequences of performing the behaviour; Note: consequences can be for any target, not just the recipient(s) of the intervention; if information about health consequences, code <i>Information about health consequences</i> ; if about emotional consequences code <i>Information about emotional consequences</i> ; if unspecific, code <i>Information about social and environmental consequences</i>	Inform people about the environmental and social consequences of consuming products shipped around the world
(4) Monitoring of emotional consequences	Prompt assessment of feelings after attempts at performing the behaviour	Agree that person will record how they feel after riding the bike daily
(5) Anticipated regret	Induce or raise awareness of expectations of future regret about performance of the unwanted behaviour; Note: not including <i>Information about</i>	Ask the person to assess the degree of regret they will feel if they use their car daily

	<i>emotional consequences</i> ; if suggests adoption of a perspective or new perspective in order to change cognitions also code <i>Framing/reframing</i>	
(6) Information about emotional consequences	Provide information (e.g. written, verbal, visual) about emotional consequences of performing the behaviour; Note: consequences can be related to emotional health disorders (e.g. depression, anxiety) and/or states of mind (e.g. low mood, stress); not including <i>Anticipated regret</i> ; consequences can be for any target, not just the recipient(s) of the intervention; if information about health consequences code <i>Information about health consequences</i> ; if about social, environmental or unspecified code <i>Information about social and environmental consequences</i>	Explain that physical activity (e.g. riding bike) can lower depression or anxiety and can help to cope with stress

11.6 Comparison of behaviour

Table 18: Annex I Comparison of behaviour (Source: Michi et al., 2013)

Label	Definition	Example
(1) Demonstration of the behaviour	Provide an observable sample of the performance of the behaviour, directly in person or indirectly e.g. via film, pictures, for the person to aspire to or imitate (includes 'Modelling'); Note: if advised to practice, also code <i>Behavioural practice and rehearsal</i> ; If provided with instructions on how to perform, also code <i>Instruction on how to perform the behaviour</i>	Perform a role play with people emphasising the topic of social inclusion
(2) Social comparison	Draw attention to others' performance to allow comparison with the person's own performance; Note: being in a group setting does not necessarily mean that social comparison is actually taking place	Show people the amount of days other colleagues are taking the bike to get to work in order to compare with their own data
(3) Information about others' approval	Provide information about what other people think about the behaviour. The	Provide citizens with percentage of a city's population favouring a

	information clarifies whether others will like, approve or disapprove of what the person is doing or will do	bike friendly and car free city centre
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11.7 Association

Table 19: Annex I Association (Source: Michi et al., 2013)

Label	Definition	Example
(1) Prompts/ cues	Introduce or define environmental or social stimulus with the purpose of prompting or cueing the behaviour. The prompt or cue would normally occur at the time or place of performance; Note: when a stimulus is linked to a specific action in an if-then plan including one or more of frequency, duration or intensity also code <i>Action planning</i>	Put a sticker on the stairs to remind people to walk more.
(2) Cue signalling reward	Identify an environmental stimulus that reliably predicts that reward will follow the behaviour (includes 'Discriminative cue')	Advise that a bonus will be given when volunteering in social projects with children
(3) Reduce prompts/ cues	Withdraw gradually prompts to perform the behaviour (includes 'Fading')	Gradually reduce number of reminders used to remember people for biking regularly
(4) Remove access to the reward	Advise or arrange for the person to be separated from situations in which unwanted behaviour can be rewarded in order to reduce the behaviour (includes 'Time out')	Arrange a car-free day in order to reduce the use of cars
(5) Remove aversive stimulus	Advise or arrange for the removal of an aversive stimulus to facilitate behaviour change (includes 'Escape learning')	Arrange for a colleague to stop nagging the person to ride the bike more often in order to increase the desired biking behaviour
(6) Satiation	Advise or arrange repeated exposure to a stimulus that reduces or extinguishes a drive for the unwanted behaviour	Arrange for the person to eat large quantities of chocolate, in order to reduce the person's appetite for sweet foods
(7) Exposure	Provide systematic confrontation with a feared stimulus to reduce the response to a later encounter	Agree a schedule by which the person who is frightened of surgery will visit the hospital where they are scheduled to have surgery

(8) Associative learning	Present a neutral stimulus jointly with a stimulus that already elicits the behaviour repeatedly until the neutral stimulus elicits that behaviour (includes 'Classical/Pavlovian Conditioning'); Note: when a BCT involves reward or punishment, code one or more of: <i>Material reward (behaviour); Nonspecific reward; Social reward, Self-reward; Reward (outcome)</i>	Present repeatedly fatty foods with a disliked sauce to discourage the consumption of fatty foods
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11.8 Repetition and substitution

Table 20: Annex I Repetition and substitution (Source: Michi et al., 2013)

Label	Definition	Example
(1) Behavioural practice/rehearsal	Prompt practice or rehearsal of the performance of the behaviour one or more times in a context or at a time when the performance may not be necessary, in order to increase habit and skill Note: if aiming to associate performance with the context, also code <i>Habit formation</i>	Prompt people to practice first aid in a test-environment
(2) Behaviour substitution	Prompt substitution of the unwanted behaviour with a wanted or neutral behaviour; Note: if this occurs regularly, also code <i>Habit reversal</i>	Suggest that the person should buy groceries at the local farmers market rather than in the supermarket
(3) Habit formation	Prompt rehearsal and repetition of the behaviour in the same context repeatedly so that the context elicits the behaviour; Note: also code <i>Behavioural practice/rehearsal</i>	Prompt people to take the bike to work every day the sun is shining
(4) Habit reversal	Prompt rehearsal and repetition of an alternative behaviour to replace an unwanted habitual behaviour; Note: also code <i>Behaviour substitution</i>	Ask the person to exchange goods, which they previously bought in shops, with their neighbours
(5) Overcorrection	Ask to repeat the wanted behaviour in an exaggerated way following an unwanted behaviour	Ask people to use the bike as sole means of transport for one week after using the car for one day

(6) Generalisation of target behaviour	Advise to perform the wanted behaviour, which is already performed in a particular situation, in another situation	Advise to also take the bike to go shopping, not only to work
(7) Graded tasks	Set easy-to-perform tasks, making them increasingly difficult, but achievable, until behaviour is performed	Ask people to ride the bike for 1 km a day the first week, then 2 km a day when they have achieved the 1 km, then 3 km a day after they have successfully achieved 2 km

11.9 Comparison of outcomes

Table 21: Annex I Comparison of outcomes (Source: Michi et al., 2013)

Label	Definition	Example
(1) Credible source	Present verbal or visual communication from a credible source in favour of or against the behaviour; Note: code this BCT if source generally agreed on as credible e.g., health professionals, celebrities or words used to indicate expertise or leader in field and if the communication has the aim of persuading; if information about health consequences, also code <i>Information about health consequences</i> , if about emotional consequences, also code <i>Information about emotional consequences</i> ; if about social, environmental or unspecified consequences also code <i>Information about social and environmental consequences</i>	Present speech given by a high status professional to emphasise the importance of social engagement or local consumption
(2) Pros and cons	Advise the person to identify and compare reasons for wanting (pros) and not wanting to (cons) change the behaviour (includes 'Decisional balance'); Note: if providing information about health consequences, also code <i>Information about health consequences</i> ; if providing information about emotional consequences, also code <i>Information about emotional consequences</i> ; if providing information about social, environmental or unspecified consequences also code <i>Information about social and environmental consequences</i>	Advise person to list and compare the advantages and disadvantages of daily riding the bike to work or participating in neighbourly help projects

(3) Comparative imagining of future outcomes	Prompt or advise the imagining and comparing of future outcomes of changed versus unchanged behaviour	Prompt the person to imagine and compare likely or possible outcomes of consuming local goods versus imported products
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11.10 Reward and threat

Table 22: Annex I Reward and threat (Source: Michi et al., 2013)

Label	Definition	Example
(1) Material incentive (behaviour)	Inform that money, vouchers or other valued objects will be delivered if and only if there has been effort and/or progress in performing the behaviour (includes 'Positive reinforcement'); Note: if incentive is social, code <i>Social incentive</i> if unspecified code <i>Non-specific incentive</i> , and not <i>Material incentive (behaviour)</i> ; if incentive is for outcome, code <i>Incentive (outcome)</i> . If reward is delivered also code one of: <i>Material reward (behaviour)</i> ; <i>Non-specific reward</i> ; <i>Social reward</i> , <i>Self-reward</i> ; <i>Reward (outcome)</i>	Inform that a financial payment will be made each month when riding the bike to work instead of using the car
(2) Material reward (behaviour)	Arrange for the delivery of money, vouchers or other valued objects if and only if there has been effort and/or progress in performing the behaviour (includes 'Positive reinforcement'); Note: If reward is social, code <i>Social reward</i> , if unspecified code <i>Nonspecific reward</i> , and not <i>Material reward (behaviour)</i> ; if reward is for outcome, code <i>Reward (outcome)</i> . If informed of reward in advance of rewarded behaviour, also code one of: <i>Material incentive (behaviour)</i> ; <i>Social incentive</i> ; <i>Non-specific incentive</i> ; <i>Self-incentive</i> ; <i>Incentive (outcome)</i>	Arrange for the person to receive money that would have been spent for gasoline if and only if the person does not use the car for one month
(3) Non-specific reward	Arrange delivery of a reward if and only if there has been effort and/or progress in performing the behaviour (includes 'Positive reinforcement'); Note: if reward is material, code <i>Material reward (behaviour)</i> , if social, code <i>Social reward</i> , and not <i>Nonspecific reward</i> ; if reward is for outcome code <i>Reward (outcome)</i> . If informed of reward in advance of rewarded behaviour, also code one of: <i>Material incentive (behaviour)</i> ; <i>Social incentive</i> ; <i>Non-specific incentive</i> ; <i>Self-incentive</i> ; <i>Incentive (outcome)</i>	Identify something (e.g. an activity such as visit to the cinema) that the person values and arrange for this to be delivered if and only if the person participates in a social project

<p>(4) Social reward</p>	<p>Arrange verbal or non-verbal reward if and only if there has been effort and/or progress in performing the behaviour (includes 'Positive reinforcement'); Note: if reward is material, code <i>Material reward (behaviour)</i>, if unspecified code <i>Non-specific reward</i>, and not <i>Social reward</i>; if reward is for outcome code <i>Reward (outcome)</i>. If informed of reward in advance of rewarded behaviour, also code one of: <i>Material incentive (behaviour)</i>; <i>Social incentive</i>; <i>Non-specific incentive</i>; <i>Self-incentive</i>; <i>Incentive (outcome)</i></p>	<p>Congratulate the person for each day they use the bike instead of the car</p>
<p>(5) Social incentive</p>	<p>Inform that a verbal or non-verbal reward will be delivered if and only if there has been effort and/or progress in performing the behaviour (includes 'Positive reinforcement'); Note: if incentive is material, code <i>Material incentive (behaviour)</i>, if unspecified code <i>Non-specific incentive</i>, and not <i>Social incentive</i>; if incentive is for outcome code <i>Incentive (outcome)</i>. If reward is delivered also code one of: <i>Material reward (behaviour)</i>; <i>Non-specific reward</i>; <i>Social reward</i>, <i>Self-reward</i>; <i>Reward (outcome)</i></p>	<p>Inform that they will be congratulated for each day they use the bike instead of the car</p>
<p>(6) Non-specific incentive</p>	<p>Inform that a reward will be delivered if and only if there has been effort and/or progress in performing the behaviour (includes 'Positive reinforcement'); Note: if incentive is material, code <i>Material incentive (behaviour)</i>, if social, code <i>Social incentive</i> and not <i>Non-specific incentive</i>; if incentive is for outcome code <i>Incentive (outcome)</i>. If reward is delivered also code one of: <i>Material reward (behaviour)</i>; <i>Non-specific reward</i>; <i>Social reward</i>, <i>Self-reward</i>; <i>Reward (outcome)</i></p>	<p>Identify an activity that the person values and inform them that this will happen if and only if they participate in a social project</p>
<p>(7) Self-incentive</p>	<p>Plan to reward self in future if and only if there has been effort and/or progress in performing the behaviour; Note: if self-reward is material, also code <i>Material incentive (behaviour)</i>, if social, also code <i>Social incentive</i>, if unspecified, also code <i>Non-specific incentive</i>; if incentive is for outcome code <i>Incentive (outcome)</i>. If reward is delivered also code one of: <i>Material reward (behaviour)</i>; <i>Non-specific reward</i>; <i>Social reward</i>, <i>Self-reward</i>; <i>Reward (outcome)</i></p>	<p>Encourage to provide self with material (e.g. new cloths) or other valued objects if and only if they have adhered to riding the bike to work</p>

(8) Incentive (outcome)	Inform that a reward will be delivered if and only if there has been effort and/or progress in achieving the behavioural outcome (includes 'Positive reinforcement'); Note: this includes social, material, self- and non-specific incentives for outcome; if incentive is for the behaviour code <i>Social incentive, Material incentive (behaviour), Non-specific incentive</i> or <i>Self-incentive</i> and not <i>Incentive (outcome)</i> . If reward is delivered also code one of: <i>Material reward (behaviour); Non-specific reward; Social reward, Self-reward; Reward (outcome)</i>	Inform the person that they will receive money if and only if a certain amount of km riding the bike are accomplished
(9) Self-reward	Prompt self-praise or self-reward if and only if there has been effort and/or progress in performing the behaviour; Note: if self-reward is material, also code <i>Material reward (behaviour)</i> , if social, also code <i>Social reward</i> , if unspecified, also code <i>Non-specific reward</i> ; if reward is for outcome code <i>Reward (outcome)</i> . If informed of reward in advance of rewarded behaviour, also code one of: <i>Material incentive (behaviour); Social incentive; Non-specific incentive; Self-incentive; Incentive (outcome)</i>	Encourage to reward self with material (e.g. new clothes) or other valued objects if and only if they have adhered to riding the bike to work
(10) Reward (outcome)	Arrange for the delivery of a reward if and only if there has been effort and/or progress in achieving the behavioural outcome (includes 'Positive reinforcement'); Note: this includes social, material, self- and non-specific rewards for outcome; if reward is for the behaviour code <i>Social reward, Material reward (behaviour), Non-specific reward</i> or <i>Self-reward</i> and not <i>Reward (outcome)</i> . If informed of reward in advance of rewarded behaviour, also code one of: <i>Material incentive (behaviour); Social incentive; Non-specific incentive; Self-incentive; Incentive (outcome)</i>	Arrange for the person to receive money if and only if a certain amount of km riding the bike are accomplished
(11) Future punishment	Inform that future punishment or removal of reward will be a consequence of performance of an unwanted behaviour (may include fear arousal) (includes 'Threat')	Inform that continuing to consume 30 units of alcohol per day is likely to result in loss of employment if the person continues

11.11 Regulation

Table 23: Annex I Regulation (Source: Michi et al., 2013)

Label	Definition	Example
(1) Pharmacological support	Provide, or encourage the use of or adherence to, drugs to facilitate behaviour change; Note: if pharmacological support to reduce negative emotions (i.e. anxiety) then also code <i>Reduce negative emotions</i>	Suggest that patient asks the family physician for nicotine replacement therapy to facilitate smoking cessation
(2) Reduce negative emotions	Advise on ways of reducing negative emotions to facilitate performance of the behaviour (includes 'Stress Management') Note: if includes analysing the behavioural problem, also code <i>Problem solving</i>	Advise on the use of stress management skills, e.g. to reduce anxiety about joining Alcoholics Anonymous
(3) Conserving mental resources	Advise on ways of minimising demands on mental resources to facilitate behaviour change	Advise to use a device to count km (e.g. a smart watch) to reduce the burden on remembering the daily biked km
(4) Paradoxical instructions	Advise to engage in some form of the unwanted behaviour with the aim of reducing motivation to engage in that behaviour	Advise the person to drive twice as much with the car as they usually do

11.12 Antecedents

Table 24: Annex I Antecedents (Source: Michi et al., 2013)

Label	Definition	Example
(1) Restructuring the physical environment	Change, or advise to change the physical environment in order to facilitate performance of the wanted behaviour or create barriers to the unwanted behaviour (other than prompts/cues, rewards and punishments); Note: this may also involve <i>Avoidance/reducing exposure to cues for the behaviour</i> ; if restructuring of the social environment code <i>Restructuring the social environment</i> ; if only adding objects to the environment, code <i>Adding objects to the environment</i>	Advise to store the bike in an easily accessible place and keep the car in a place which is more inconvenient to get to Arrange to provide infrastructure for riding the bike in the city
(2) Restructuring the social environment	Change, or advise to change the social environment in order to facilitate performance of the wanted behaviour or create barriers to the unwanted behaviour (other than prompts/cues, rewards and punishments); Note: this may also involve	Advise to maximise time spent with friends riding the bike to increase km riding the bike

	<i>Avoidance/reducing exposure to cues for the behaviour</i> , if also restructuring of the physical environment also code <i>Restructuring the physical environment</i>	Join friends who volunteer in social projects
(3) Avoidance/reducing exposure to cues for the behaviour	Advise on how to avoid exposure to specific social and contextual/physical cues for the behaviour, including changing daily or weekly routines; Note: this may also involve <i>Restructuring the physical environment</i> and/or <i>Restructuring the social environment</i> ; if the BCT includes analysing the behavioural problem, only code <i>Problem solving</i>	Suggest to a person who wants to focus on local consumption to avoid big shopping centres
(4) Distraction	Advise or arrange to use an alternative focus for attention to avoid triggers for unwanted behaviour	Suggest to a person who is trying to avoid between-meal snacking to focus on a topic they enjoy (e.g. holiday plans) instead of focusing on food
(5) Adding objects to the environment	Add objects to the environment in order to facilitate performance of the behaviour; Note: Provision of information (e.g. written, verbal, visual) in a booklet or leaflet is insufficient. If this is accompanied by social support, also code <i>Social support (practical)</i> ; if the environment is changed beyond the addition of objects, also code <i>Restructuring the physical environment</i>	Provide free bike-parking or bike-repairing stations Provide free bus rides to the local farmer's market/when engaging in a social project
(6) Body changes	Alter body structure, functioning or support directly to facilitate behaviour change	Prompt bicycle courses for kids or bike driving safety training

11.13 Identity

Table 25: Annex I Identity (Source: Michi et al., 2013)

Label	Definition	Example
(1) Identification of self as role model	Inform that one's own behaviour may be an example to others	Inform the person that if they bike regularly, they may be a good example for their children
(2) Framing/reframing	Suggest the deliberate adoption of a perspective or new perspective on behaviour (e.g. its purpose) in order to change cognitions or emotions about performing the behaviour (includes 'Cognitive structuring'); If information about consequences then code <i>Information about health consequences</i> ,	Suggest that the person might think of the tasks as reducing sedentary behaviour (rather than increasing activity)

	<i>Information about emotional consequences or Information about social and environmental consequences instead of Framing/reframing</i>	
(3) Incompatible beliefs	Draw attention to discrepancies between current or past behaviour and self-image, in order to create discomfort (includes 'Cognitive dissonance')	Draw attention to a person's habit of consumption or use of the car and their self-identification as person wanting to protect the environment
(4) Valued self-identify	Advise the person to write or complete rating scales about a cherished value or personal strength as a means of affirming the person's identity as part of a behaviour change strategy (includes 'Self-affirmation')	Advise the person to write about their personal strengths before they receive a message advocating the behaviour change
(5) Identity associated with change behaviour	Advise the person to construct a new self-identity as someone who 'used to engage with the unwanted behaviour'	Ask the person to articulate their new identity as 'environmentalist'

11.14 Scheduled consequences

Table 26: Annex I Scheduled consequences (Source: Michi et al., 2013)

Label	Definition	Example
(1) Behaviour cost	Arrange for withdrawal of something valued if and only if an unwanted behaviour is performed (includes 'Response cost'); Note if withdrawal of contingent reward code, <i>Remove reward</i>	Subtract money from a prepaid refundable deposit when the car is used to get to work instead of the bike
(2) Punishment	Arrange for aversive consequence contingent on the performance of the unwanted behaviour	Arrange for the person to wear unattractive cloths when taking the car instead of the bike
(3) Remove reward	Arrange for discontinuation of contingent reward following performance of the unwanted behaviour (includes 'Extinction')	Arrange for work colleagues to ignore the person not riding the bike to work (rather than attending them by criticising or persuading)
(4) Reward approximation	Arrange for reward following any approximation to the target behaviour, gradually rewarding only performance closer to the wanted behaviour (includes 'Shaping')	Arrange reward for any km used the bike per day, gradually requiring the daily km count to become closer to the planned amount

(5) Rewarding completion	Build up behaviour by arranging reward following final component of the behaviour; gradually add the components of the behaviour that occur earlier in the behavioural sequence (includes 'Backward chaining'); Note: also code one of <i>Material reward (behaviour)</i> ; <i>Non-specific reward</i> ; <i>Social reward</i> , <i>Self-reward</i> ; <i>Reward (outcome)</i>	Reward buying a bicycle; then reward using the bike sometimes at work; then reward coming to work every day by bike
(6) Situation-specific reward	Arrange for reward following the behaviour in one situation but not in another (includes 'Discrimination training'); Note: also code one of <i>Material reward (behaviour)</i> ; <i>Non-specific reward</i> ; <i>Social reward</i> , <i>Self-reward</i> ; <i>Reward (outcome)</i>	Arrange reward for eating at mealtimes but not between meals
(7) Reward incompatible behaviour	Arrange reward for responding in a manner that is incompatible with a previous response to that situation (includes 'Counter-conditioning'); Note: also code one of <i>Material reward (behaviour)</i> ; <i>Non-specific reward</i> ; <i>Social reward</i> , <i>Self-reward</i> ; <i>Reward (outcome)</i>	Arrange reward for taking the bike to work on a rainy day rather than the car
(8) Reward alternative behaviour	Arrange reward for performance of an alternative to the unwanted behaviour (includes 'Differential reinforcement'); Note: also code one of <i>Material reward (behaviour)</i> ; <i>Non-specific reward</i> ; <i>Social reward</i> , <i>Self-reward</i> ; <i>Reward (outcome)</i> ; consider also coding <i>Problem solving</i>	Arrange reward for buying locally grown seasonal vegetables but not buying imported vegetables
(9) Reduce reward frequency	Arrange for rewards to be made contingent on increasing duration or frequency of the behaviour (includes 'Thinning'); Note: also code one of <i>Material reward (behaviour)</i> ; <i>Non-specific reward</i> ; <i>Social reward</i> , <i>Self-reward</i> ; <i>Reward (outcome)</i>	Arrange reward for each day taking the bike to work, then each week, then each month and so on
(10) Remove punishment	Arrange for removal of an unpleasant consequence contingent on performance of the wanted behaviour (includes 'Negative reinforcement')	Arrange for someone else to do housecleaning only if the person has adhered to riding the bike daily

11.15 Self-belief

Table 27: Annex I Self-belief (Source: Michi et al., 2013)

Label	Definition	Example
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(1) Verbal persuasion about capability	Tell the person that they can successfully perform the wanted behaviour, arguing against self-doubts and asserting that they can and will succeed	Tell the person that they can successfully increase their amount of riding the bike, despite their recent knee injury
(2) Mental rehearsal of successful performance	Advise to practise imagining performing the behaviour successfully in relevant contexts	Advise to imagine helping elderly people with their weekly grocery shopping
(3) Focus on past success	Advise to think about or list previous successes in performing the behaviour (or parts of it)	Advise to describe or list the occasions where a person participated in neighbourly help projects
(4) Self-talk	Prompt positive self-talk (aloud or silently) before and during the behaviour	Prompt the person to tell themselves that a bike-ride will be energising

11.16 Covert learning

Table 28: Annex I Covert learning (Source: Michi et al., 2013)

Label	Definition	Example
(1) Imaginary punishment	Advise to imagine performing the unwanted behaviour in a real-life situation followed by imagining an unpleasant consequence (includes 'Covert sensitisation')	Advise to imagine going by car to work every day and gaining weight due to a lack of physical activity
(2) Imaginary reward	Advise to imagine performing the wanted behaviour in a real-life situation followed by imagining a pleasant consequence (includes 'Covert conditioning')	Advise to imagine buying at local markets and as a result enjoying a better integration in the local society
(3) Vicarious consequences	Prompt observation of the consequences (including rewards and punishments) for others when they perform the behaviour; Note: if observation of health consequences, also code <i>Information about health consequences</i> ; if of emotional consequences, also code <i>Information about emotional consequences</i> , if of social, environmental or unspecified consequences, also code	Draw attention to the positive comments colleagues get when riding the bike to work daily

	<i>Information about social and environmental consequences</i>	
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