

Platform Backlog and Report

Living document for the platform (UI, UX, software architecture, data models and interfaces)

> Version 1 Deliverable 3.4.

| SimpliCITY – Marketplace for user-centered sustainability services |
|--|
| SimpliCITY |
| 10/2018–03/2021 |
| 870739 |
| WP3 / T3.4 |
| www.simplicity-project.eu |
| |

Authors:

Thomas Layer-Wagner, Polycular OG Irina Paraschivoiu, Polycular OG Christoph Wögerbauer, Polycular OG Michael Kager, Polycular OG Birgit Schönauer, Polycular OG



This project has received funding in the framework of the Joint Programming Initiative Urban Europe.

Document versions:

| Version | Date | Changes | Author/s |
|---------|------------|--|--|
| v0.1 | 20.03.2019 | Platform design process, initial list of features, system architecture | Thomas Layer- Wagner, Christoph Wörgerbauer, Irina Paraschivoiu |
| v0.2 | 30.05.2019 | Update feature list, update system architecture | Thomas Layer- Wagner |
| v0.3. | 25.06.2019 | Feature prioritization, initial UI and UX, update system architecture | Irina Paraschivoiu, Thomas Layer- Wagner |
| v0.4. | 13.09.2019 | User journeys | Thomas Layer- Wagner |
| v0.5 | 16.09.2019 | Document editing, formatting | Irina Paraschivoiu |
| v0.6 | 30.09.2019 | Release Plan for Pilot 1 | Christoph Wögerbauer |
| v1.0 | 28.10.2019 | Update and Revision | Christoph Wögerbauer, Thomas Layer-Wagner |

List of abbreviations

UX User experience

UI User interaction

Table of contents

| 1. | Executive Summary | 4 |
|-----|--------------------------------------|------|
| 2. | Administrative Information | 5 |
| 3. | Platform design process | 6 |
| 4. | Feature selection and prioritisation | . 11 |
| 5. | Gamification and User journey | . 15 |
| 6. | UI and UX | . 23 |
| 7. | System architecture | . 25 |
| 8. | Development Roadmap | . 31 |
| 9. | Lessons learned | . 32 |
| Арр | endix I: Design Documents | . 32 |
| Ref | erences | . 33 |

1. Executive Summary

This deliverable is part of Work Package 3 within SimpliCITY, namely, Platform Architecture and Concept of Service Aggregation. This deliverable provides an overview of the system architecture, user interaction design and user experience, as developed iteratively throughout the project. Therefore, this document is constantly being updated following a Human-Centered Design process conducted together with project consortium partners, the platform target groups and feedback received in qualitative and quantitative testing phases. More specifically, this deliverable provides information on:

- The platform design process and the iterative stages in its development following HCD principles;
- The process for finding user requirements for the SimpliCITY platform and a prioritization of system features, based on these;
- An overview of the gamification approach within the project and of the user journey on the platform as experienced by the user;
- An overview of UI elements used in the platform;
- An overview of data collected for analytics purposes;
- An overview of the system architecture.

The deliverable closely follows the aim of the project as described in the project application:

"Creation of a platform that bundles the sustainability offers of a city and increases the commitment of the users with the participating services through incentives and challenges."

The purpose of this deliverable is to have a great concept before starting development of the platform itself. The current version of this document represents work in progress as a continuous release.



2. Administrative Information

Basic information on the SimpliCITY project and the present deliverable:

| Project title | SimpliCITY - Marketplace for user-centered sustainability services |
|---------------------|---|
| Project coordinator | Salzburg Research Forschungsgesellschaft mbH (SRFG), Salzburg, Austria; project manager: Petra Stabauer BSc MSc |
| Project partners | Polycular OG, Hallein, Austria |
| | Stadt Salzburg (City of Salzburg), Austria |
| | Salzburger Institut für Raumordnung und Wohnen – SIR (Salzburg Institute for Regional Planning & Housing), Salzburg, Austria |
| | Uppsala Kommun (City of Uppsala), Sweden |
| | University of Uppsala, Sweden |
| Funding | JPI Urban Europe, Innovation Actions (Call: Making Cities Work) |
| | Funding is being provided by Vinnova (Sweden) for the Swedish project partners, and the Austrian Research Promotion Agency (FFG) for the Austrian project partners. |
| Project nr. | 870739 |
| Deliverable number | D3.4 |
| Deliverable title | Platform Backlog and Report – Living document for the platform (UI, UX, software architecture, data models and interfaces) |
| Authors | Thomas Layer-Wagner (Polycular OG), Irina Paraschivoiu (Polycular OG), Christoph Wögerbauer (Polycular OG), Michael Kager (Polycular OG), Birgit Schönauer (Polycular OG) |
| Version & status | Version 1 |
| Date | 28 October 2019 |

3. Platform design process

This section describes the design process of the SimpliCITY platform, as planned by task and work package leader Polycular OG, based on international standards in human-centered design of interactive systems, usability (Bevan, 2001) and ergonomics of human-centered design.

The design process of the SimpliCITY platform follows the HCD principles as highlighted by ISO 9241-210 (ISO STANDARDS, 2019), respectively:

- The design is based upon an explicit understanding of users, tasks and environments.
- Users are involved throughout design and development.
- The design is driven and refined by user-centred evaluation.
- The process is iterative.
- The design addresses the whole user experience.
- The design team includes multidisciplinary skills and perspectives.

Specifically, the HCD process is reflected in the distribution of activities throughout the work packages involving the understanding of user requirements, the design and development of the platform, its testing and evaluation.



3.1. User requirements

Understanding user requirements is an integral part of systems design and is critical to the success of interactive systems. The complexity of the SimpliCITY platform requires the understanding of three type of users, namely: (1) end users (citizens interested in sustainability and the services presented on the platform), (2) service providers (either publicly or privately owned) who are interested in presenting their services on the platform and (3) local administration staff, involved in smart city and sustainability initiatives.



Figure 1: SimpliCITY requirements

The following tools have been implemented in the project for the requirements gathering phase with respect to the three target groups in SimpliCITY:

- **Consortium meetings**: during these, group discussions were focused on requirements for the platform as perceived by project staff, including and especially with a focus on municipalities and their needs.
- **Personas:** were drafted during the second consortium meeting in Uppsala, with respect to the three target groups identified in the project (citizens, service providers and city administration staff). Personas were drafted based on comments from relevant stakeholders, including municipality staff not involved in the project and also based on statistical data available with reference to potential target groups in the two cities.
- End user surveys: 2 initial surveys, targeting the behaviour and needs of users in the areas of mobility and local consumption were drafted. The first survey (mobility) was implemented in Salzburg in Uppsala in spring 2019 while the second is underway in both cities.
- Focus groups and workshops: 3 workshops with different categories of service providers were already conducted in the two cities (one in Uppsala, two in Salzburg). Focus groups are an excellent technique for facilitating communication between designers and different user types (Bruseberg & Mcdonagh-Philp, 2001). During focus groups, interest and requirements from service providers were drafted. Additional workshops are potentially planned for autumn of 2019.
- Individual meetings and discussions: took place depending on need and identified resource individuals, located within the local administration in the two cities, including ICT departments, smart city managers and others. Discussions were focused on needs of the individual departments involved thematically in the project (i.e. Bike Coordinator Salzburg) or requirements for the digital integration of more complex digital city services (i.e. availability of open data layers, ownership and programming of existing applications, etc.)

3.2. Design

The design process is based on the user requirements. User requirements will get prioritized first. Then prioritization of system features is performed.

Initial tools envisaged in the specification and design phase include:

- User journeys and storyboards
- Wireframes
- UML and technical specifications
- Mock-ups (high fidelity)
- Interactive prototypes



3.3. Development

Figure 2: Agile management & design process

The development process is based on continuous software development principles (Theunissen & Van Heesch, 2017), (Clarke, O'Connor, & Yilmaz, 2018), namely:

3.3.1. Efficiency, effectiveness

Involves striving for the optimal balance between efficiency (quality) and effectiveness (resources invested). The ambition is to achieve as much as possible for both efficiency and effectiveness without losing the balance. Regarding efficiency, the primary means in lean is eliminating waste. Effectiveness refers to delivering working software, achieving customer satisfaction, and simplicity. Additionally, measurements are required for checking if development and operations are on the right track. Both, efficiency and effectiveness should strive for a sustainable pace

3.3.2. Learning and improvement

The objective is the improvement of the development process as well as the learning outcome. Regular feedback sessions both internal as well as with different categories of users. Focus on short feedback loops, sharing ideas, uncertainties and mistakes.

3.3.3. Flexibility

Possibility of learning from new situations. The objectives are to benefit from insights uncovered in the development process or through interaction and testing with potential users.

3.3.4. Time to market

A focus is placed on short delivery cycles and frequent releases. The objective is to deliver features as fast as possible. Improvements will start earlier and there is a better fit between end-user, customer, organization, and development team.

3.3.5. Trust and attitude

Especially with respect to the development team, which requires thinking outside of the box for involvement of other parties and high autonomy for the project team.

3.3.6. Competences

The capable team involved in the development of the SimpliCITY platforms covers game development, web development, interaction design and user research as well as business strategy. The Polycular team has weekly project meetings to ensure shared and coherent view on the software product. JIRA and Mattermost are used for internal communication and task division.

3.3.7. Competitive advantage

The team is focused on delivering added value. The objective is to achieve a competitive advantage by focusing on core competences and outsource commodity services.

3.3.8. Involvement

This includes involvement from consortium partners, end-users, service providers, local administration and other interested parties. We attempt to communicate our vision to interest parties in order to share common goals and share principles and priorities.

The diagram below illustrates our iterative, continuous software development process:





Figure 3: Design & Development

3.4. Testing

The testing of the platform is planned within WP 5 and 6, in partnership with the two municipalities. Feedback will be collected both from the system via data analytics with respect to usage and functionalities, as well as through questionnaires and qualitative inquiry with selected users. Functionalities will be developed iteratively, aiming for a minimum viable product (MVP) for a first release during pilot phase 1 and with an extension of functionalities during pilot phase 2 based on user and partner feedback.

3.5. Evaluation

Evaluation will be performed continuously starting with platform launch, until the end of the project according to indicators established within the consortium. Of particular interest with respect to the design and development of the platform, UX, UI and behaviour change results will be evaluated both for the overall platform as well as for different components and features. A/B testing will be used wherever possible with respect to game mechanic features such as messaging, rewards, referrals and social influence mechanisms, throughout pre-testing and testing. Finally, UX and UI will be evaluated qualitatively and quantitatively at different development stages, iteratively.



Figure 4: Game mechanic

4. Feature selection and prioritisation

4.1. Problem statement

Scenario A: IT developer



Created an app allowing citizens to submit location-based polls and suggestions, but user adoption has been slower than foreseen.

Scenario B: enthusiastic citizen

Refuses to download another "smart city app" for reporting problems with bicycle tracks. She is tired of handling too many applications, right now, she needs two to find the least polluted route through the city.

Scenario C: city manager



Researchers have developed and tested a city navigation app, but the project terminated and users have no support and the information is outdated. The city lacks ICT and innovation management knowledge to keep users engaged and boost the app further.

Figure 5: Problem statement

The initial problem statement was already drafted at the moment of application submission, with a focus on three personas, illustrating the needs or situation of citizens (end users), city managers or municipality technical personnel and service providers. The service provider here illustrates the case of digital services, although throughout project development both digital and analog services have been planned for inclusion. The initial problem statement explains:

"The scenarios above illustrate the problems of smart city management and related stakeholders in designing user-centered solutions and scaling up innovative regional sustainability services (RSUS) in many smart citie (...). The underlying problem however, is, that the initiators of these scientific-based or pre-market solutions are trapped in the middle of the innovation cycle. They have failed to materialize to a sustained practice truly incorporating citizen involvement. As a result, local authorities are running the risk of not reaching their targets of greenhouse emissions reduction by 2050 (...). Solution providers lack an active user base: 83% of consumers consider the sustainability of a product to be important, but only 15% take it into account during a purchase decision(...)."

4.2. Initial feature categories

An initial list of platform features was drafted answering the needs of the three initial target groups / personas.



Figure 6: Initial feature catagories

The initial list can be grouped conceptually into: **information** (service listing, articles), **interactivity** (games, riddles, survey module) and **behaviour change module** (challenges / nudges / rewards). Based on the existing target groups, the features respond to overlapping needs of the three target groups, as follows: **citizens** (interactivity, information), **city manager** (information, behaviour change), **service providers** (service listing, behaviour change).

4.3. Extended list of features

In a second iteration of the list of features, following internal discussions within the consortium with city managers and input provided by support staff and colleagues from municipalities, an extended list of features was developed. Internally, the list was iterated in two consortium meetings. The list of services was mapped on four categories: information, participation, feedback and other.

| Information | Engagement | Feedback | Other |
|-------------------|--|--|--------------|
| Marketplace | Survey/questionnaire / citizen engagement | Feedback and analysis tool (for city managers) | Location/map |
| Events / workshop | Gamification/challenges | | Calendar |

| Notifications | Social media and links | Self-reporting and self-assessment (for citizens) |
|---------------------------------|------------------------|---|
| Recommendations and suggestions | Share | |
| Key facts | Matchmaking | |
| | Crowdfunding | |
| | Volunteers call | |

4.4. Feature prioritization

Based on the findings from consortium meetings, first survey with end user and workshops with service providers, the needs of the three types of users were mapped on translations of these needs into system features. In the figure below, the left side column contains the most important or frequently named needs of users and the right one the system features which can respond to these needs. For example, citizens highlighted the need for (hyper)local information, easy access to services, giving feedback to the city and loyalty facilities as the most



Figure 7: Feature prioritization

important added value of such a platform, which would determine them to use it. The features are further described below, based on their above categorization:

- (Hyper)local information
 - Content creation: articles, presented in a blog or magazine format, on topics of sustainability
 - Service listing: list of available sustainability services, either in a list or map format

- Guided tours: gamified or non-gamified tours for the discovery of points of interest
- Free discovery: discovery of points of interest without being in a guided tour mode
- Feedback to city
 - Crowdsourced feedback: providing a suggestion to the city with respect to urban design improvements, upvote a suggestion provided by others
- Loyalty facilities
 - Game mechanics: different game or gamification elements providing motivation such as avatars, minigames, dashboard, achievements, riddles, challenges and rewards, lottery
 - o Incentives
- Incentives
 - Game mechanics: see above
 - Challenges and rewards: setting challenges within a specified timeframe for achieving a certain goal, monetary or in-kind rewards such as vouchers or discounts
- Automated aggregation
 - Service listing: see above
 - Widgets and sharing: possibility of sharing of links from the platform on other online platforms or social media, integration into other platforms such as the websites of the municipalities
- Information new services and offers
 - Service listing: see above
 - Guided tours: see above
 - Free discovery: see above
- Collection of data and suggestions
 - Crowdsourced feedback: see above

Based on the above mapping of features on target group needs, an internal prioritization was made, based on a two-dimension matrix of effort and impact. The prioritization took place during two internal workshops at Polycular with the team involving two game developers, one web developer, one strategist and one designer. The dimension "effort" refers to development (programming time) or need to adapt existing tools. The dimension "impact" is based on user perception of desired features in the platform and the team experience in the field of interactivity, UX and UI. Features were mapped on the three main categories (engagement, feedback and information). The low-effort and high-impact features are prioritized in the development process over the high-effort low-impact ones such as achievements and avatars. The faded text boxes in the diagram represent the features that are not being prioritized for implementation.

Priority matrix





5. Gamification and User journey

This section describes principles of game and play, gamification and the way these have been translated into a gamification approach (McGonigal, 2011) in SimpliCITY. We additionally provide user journey to illustrate the typical interaction of a user with the SimpliCITY platform / app.

5.1. Game and play

The terms 'play' and 'game' refer to two intertwined, but still different things. Some scholars on videogames, including Frasca, use the terms 'paidia' and 'ludus' to define the difference between play and game. Frasca has adapted these two terms from the seminal work by Caillois (Caillois & Barash, 2001) whose original idea was to distinguish between "free play" and "formal play", but he uses them differently. Paidia and ludus can be seen as the opposite ends of a huge range of activities. Ludus is a form of play with rules that define winners and losers, while paidia is a form of play that does not do this.

Johan Huizinga ((Huizinga & Huizinga, 2016) highlights the role of play in culture and society, addressing play as:

- play as a free action, outside of the ordinary life
- just acting "as if"
- has its own timeframe and space
- fixed rules
- Formation of social groupings
- The magic circle of play.

Bernard Suits (Suits, 2005) coins the term "lusory attitude" as a commitment to play a game, following rules even if they present "unnecessary obstacles" to achieve a goal, pleasure in inefficiency.

Tekinbas and Zimmerman (Tekinbaş & Zimmerman, 2003) suggest that "A game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome.":

| System | Players | Artificial |
|--|--|---|
| A group of interating, interrelated, or independet elements forming a complex whole. (Objects, Attributes, Internal Relationships, Environment | A game is something that one or more participants actively play. Players interact with the system of a game in order to experience the play of the game. | Games maintain a boundary from so- called "real life" in both time and space. Although games obviously occur within the real world, artificiality is one of their defining features. |
| Conflict | Rules | Quantifiable outcome |
| • All games embody a contest of powers. The contest can take many forms, from cooperation to competition, from solo conflict with a game system to multiplayer social | • Provide the structure out of which play emerges, by delimiting what the player can and cannot do. (and how the system reacts to it.) | Games have a quantifiable goal or outcome. At the conclusion of a game, a player has either won or lost or received some kind of numerical score. A quantifiable outcome is what usually. |

With respect to motivation and emotions, Weinshenk (Weinschenk, 2011) notes that:

- The closer one gets to a destination, the more motivated one is;
- Constant progress, skill and control increase motivation;

- People are programmed to enjoy something surprising;
- People are happier when they are busy;
- Thinking of people means having control, too;
- Objects become more desirable when they are scarce or hard to come by.

This is especially true for games and core of gamification approaches.

5.2. Gamification

Gamification is *"The practice of designing game-like experiences for non-game applications."* Gamification is often employed as a strategy to make user interfaces more engaging to achieve goals or improving productivity.

Korhonen, H., Montola, M., and Arrasvuori defined the Playful Experience Framework, bringing together work of previous researchers and defined 20 categories that capture the scope of digital gaming:

| Category | Description |
|-------------|--|
| Captivation | Experience of forgetting one's surroundings |
| Challenge | Experience of having to develop and exercise skills in a challenging situation |
| Competition | Experience of victory-oriented competition against oneself, opponent or system |
| Completion | Experience of completion, finishing and closure, in relation to an earlier task or tension |
| Control | Experience power, mastery, control or virtuosity |
| Discovery | Experience of discovering a new solution, place or property |
| Eroticism | Experience of sexual pleasure or arousal |
| Exploration | Experience of exploring or investigating a world, affordance, puzzle or situation |
| Expression | Experience of creating something or expressing oneself in a creative fashion |
| Fantasy | Experience of make-believe involving fantastical narratives, worlds or characters |
| Fellowship | Experience of friendship, fellowship, communality or intimacy |
| Nurture | Experience of nurturing, grooming or caretaking |
| Relaxation | Experience of unwinding, relaxation or stress relief. Calmness during play |
| Sadism | Experience of destruction and exerting power over others |
| Sensation | Meaningful sensory experience |

| Simulation | Experience of perceiving a representation of everyday life |
|------------|---|
| Subversion | Experience of breaking social roles, rules and norms |
| Suffering | Experience of frustration, anger, boredom and disappointment typical to playing |
| Sympathy | Experience of sharing emotional feelings |
| Thrill | Experience of thrill derived from an actual or perceived danger or risk |

Typical gamification elements are:

- Points/XP, Levels, Progress Bar
- Achievements & Badges
- Collectables/Collecting/ Currency
- Story, Plot & Setting
- Goals, Quests, Missions
- Mini Games
- Rules
- Gambling & Fortune
- Cooperation/Competition
- Characters
- Games Aesthetics

5.3. Game mechanics and game design in SimpliCITY

We introduce a simple and shared game objective of collecting heartbeats through sustainable actions. To have a shared goal creates a community of players that are engaged in playful context, which changes the attitude to try new services and offers.

The basic game loop is centred around collecting and spending heartbeats. This can be achieved through several means and expanded in the future. There are 3 basic means to gain heartbeats, as seen in the user journeys below:

- Collect heartbeats
 - Track biking (x heartbeats per km)
 - Discover POI in free discovery mode
 - Uncover riddle location (POI) in playful guided tour
 - Solve Quiz at a location
- Spent heartbeats
 - Make a report or suggestion
 - Upvote a report or suggestion
 - Participate in lottery (incentives)

5.4. User journeys in SimpliCITY

This sub-section describes the journey of a user on the SimpliCITY platform, by taking into account the interaction with the different game and non-game elements, as described above with respect to the features and gamification approach.

User Journey Draft | Register and Start



Figure 9: User Journey Draft (Register and Start)

Onboarding and the first start of the app is a crucial step in the user journey of every digital product. After signing up, there will be a short series of screen to introduce the features of the app and present the shared overall goal. The users continue with a small self-assessment about their biking, consumption and engagement habits, so the app can suggest appropriate goals and activities. In a survey, which will be for research purpose only. This reduces the necessity for the users to fill in too many details in their user profile. Therefore, they can easily remove that data later to be conformant with GDPR regulations. With referrals and a challenge to reach a certain threshold of users in each city we create a first intangible incentive to invite more users. Both actions reward the user with their first heartbeats.

User Journey Draft | Daily Tracking



Figure 10: User Journey Draft (Daily Traking)

In a typical scenario a push notification invites the user to keep up their daily biking. Tracking is at the very centre of the bike challenges and activities, therefore plays a significant role. Tracking must be activated manually in the app. Though we conceive tracking very important, we do not implement it as a continuous background service because of three reasons (1) the users should have control and a choice over the tracking to create trust and transparency, (2) save battery. Activating the tracking will be easy and fast. Reaching a destination, the app rewards the user with heartbeats. Giving instant feedback is part of our gamification strategy. Users will always be able to check their progress in challenges and personal statistics in the dashboard. The users can participate in the lottery of a challenge when they have reached the respective threshold. Reaching a threshold also reward the users with achievements.



User Journey Draft | Tours and Free Discovery

To create a link between the service listings and activities we introduce digitally guided tour and a free discovery activity. Both serve as a playful way to inform and engage people with services to test and use. It takes into consideration different player types (6-player types/models). The guided tour is for those that want a ready-made and curated experience, while the free discovery invites for exploration. The guided tours contain location-based riddles and puzzles. Giving clear and encouraging feedback upon reaching a destination and finishing an activity is part of the gamification mechanisms at place. These additional activities also reward the users with heartbeats. Next we will describe how to spend heartbeats beyond lottery and gaining achievements.

User Journey Draft | Feedback 1/2



Figure 11: User Journey Draft (Feedback 1/2)

The users can choose form a given set of urban design improvements to make suggestions and report issues. To prevent spam, you temporarily spend heartbeats for each suggestion or report. Those are placed on a city map layer. The process below describes how these are converted into reports sent to the city.

User Journey Draft | Feedback 2/2



Figure 12: User Journey Draft (Feedback 2/2)

Citizen A reports an improvement as seen above. Citizen B gets the latest/highest ranked suggestion reported in can support an improvement/report through an upvote with heartbeats. When a threshold is met the city, manager gets a report through the cities reporting tools, which we will integrate to reduce clutter and channels. The city manager can be sure, that there is peer support for the improvement and reply and give feedback. Either the city directly responds to report or improvement or use the data to pinpoint the demand. The citizens involved in the improvement get their heartbeats refunded.

6. UI and UX

Preliminary concept and Mock-ups were created to discuss in the project consortium and within the service provider workshops. In this process the following preliminary Information Architecture for the client app was created.



Figure 13: SimpliCITY Module Architecture

Figure 13 Information Architecture gives an overview of the data and information architecture in the app client as planned in the design and development process. It shows the grouping and connection between the SimpliCITY modules. Main categories are the Activities, Dashboard/Profile and Service Listing. Activities contain all the actions citizens are engaged through the SimpliCITY app client and will be available as information on the SimpliCITY website. It also contains the challenge entries, which are closely related to the activities in the app. Dashboard/Profile will be available to all signed up users to overlook challenges, track their progress and get an overall perspective on the progress of city and district challenges. It will be available on both the SimpliCITY app client and SimpliCITY website. The Service Listing is an overview of the available service providers but offers the opportunity to filter and provides a map view of the available services.



Figure 14 Exemplary screens from the wireframe process to pin size and location of interface elements.



Figure 15 Exemplary screens from the preliminary mockups to introduce and discuss the idea of heartbeats as overall objective.

Later in the process the final design and a clickable prototype to evaluate the design will be created.

7. System architecture

Software systems are often getting very complex in its system design. Therefore, a description of the system architecture is mandatory to have a clear picture how the different system components connects.



Figure 16: SimpliCITY System Architecture

SimpliCITY System Architecture diagram (figure 16) shows that the platform and backend are the basis for SimpliCITY. All data is imported, stored and managed in the backend with a dedicated frontend/CMS for editing and maintenance. The platform clients are a webview primarily for the service listing and an app client for most of the interactions and activities.



Figure 17: SimpliCITY grouped System Parts

SimpliCITY System Parts diagram (figure 17) show the roadmap for development. While pilot 1 will focus on the core functionalities, pilot 2 will cover the 3rd party service integration.

On the technical integration we distinguish between two scenarios. They should guarantee minimal effort and a maximum of automation for the service providers involved.

- (1) The information regarding the service (e.g. contact data, locations). Here we investigate with the service provider the availability of APIs to directly access this information and provide self-authoring templates for the data that cannot be extracted or imported.
- (2) The second scenario is the communication of user actions regarding challenges and incentivisation. Primarily, SimpliCITY will provide means of tracking user activity on the SimpliCITY platform and the related app with e.g. a bike tracker in place, but also provides integration through 3 variants.

We cover the integration in more depth in D5.3 Acquisition Plan, as part of the Integration Strategy.

7.1. Backend and API Development

The Backend is the API provider to Frontend, App & Portal. It will include API interfaces as REST endpoints and additionally a GraphQL Schema.

7.2. C4 Model

For creating a more coherent software architecture we adopted the C4 Model (https://c4model.com/) by Simon Brown.

"The C4 model was created as a way to help software development teams describe and communicate software architecture, both during up-front design sessions and when retrospectively documenting an existing codebase. It's a way to create maps of your code, at various levels of detail ... The C4 model is an "abstraction-first" approach to diagramming software architecture, based upon abstractions that reflect how software architects and developers think about and build software."

The C4 Model divides software into 4 views namely: System Context, Container, Component and Code. In the following diagrams you can see the first three views in a current work in progress version.



Figure 18: System Context Draft



Figure 20: Backend Container Draft

7.2.1. Backend Development Stack

The Backend is the part of the system running solely on a web server. It interacts with the web & app client via a predefined defined interface and protocol.

The SimpliCITY backend will consist of the following technologies:

- Elixir
- Elixir: Ecto (ecto_sql + postgrex)
- Elixir: Plug
- Elixir: Jason
- Database: PostgreSQL

The reason for the Elixir programming language is that it compiles into Erlang, which has proven out of the telecom business to be perfectly suited for handling a lot of web requests in a very performant and stable way.

A documentation of the backend will be automatically generated out of the backend code repository.

It consists of:

- Database Schema
- Entity Relationship Diagram (ERD)
- SQL Schema Dump
- API Endpoints Generated out of actual tests - makes sure documented API is always well tested and valid.
- Elixir ExDoc module and functions documentation

The backend development will be done with the following priorities:

- Documentation
- Testing
- Telemetry
- CI & CD

Testing

The project must have a proper testing foundation. Tests ordered by their prioritiy:

- Build
- System Integration
- Endpoints Integration
- Units
- Docs
- Ecto Schemas
- Ecto Contexts
- API -> Plug Routes

7.3. App Client Development Stack

The following client frameworks were investigated:

Native

- Android (Kotlin)
- iOS (Swift)

Cross Platform Frameworks

- React Native (web React JSX)
- Xamarin (C# .NET)
- NativeScript (web Vue.js / Angular)
- Ionic (web AngularJS, Cordova)
- Flutter (web Dart)

Hybrids

Native + web

- Android: WebView / Chrome Custom Tab (CCT) / Trusted Web Activity (TWA)
- iOS: WKWebView

Progressive Web Apps

- Android: Can be brought to the store with TWA (Chrome 72 for Android). Can be added to the home screen though the browser.
- iOS: Not clear when there will be support for adding to the store.

For ease of developing a cross platform app and regarding experience in C# within the development team Xamarin was the preferred choice and was selected for the client development.

7.4. Web Client Development Stack

The web client will depend on the standard web stack of:

- HTML
- CSS
- JavaScript

8. Development Roadmap

Development is aligned in an agile process with a new release approximately every 4 weeks.

8.1. Release Plan

| Release | Features / Purpose / Goals |
|---------------------------------------|--|
| 08 Oct 2019 - v 0.1 (Mimas) | FeaturesDiscover Point of Interest (POI)Bike Tracking |
| 05 Nov 2019 - v0.2 (Enceladus) | Features Quiz Fact Tour Riddle Basic design |
| 03 Dec 2019 - v0.3 (Tethys) | Features Provider Listing Urban Design Improvements (Suggestions, Upvote) |
| 21 Jan 2020 - v0.4 (Dione) | Features Dashboards (Personal & City) Challenges Activities List Push Notifications Purpose Internal quality assurance |
| 18 Feb 2020 - v0.5 (Rhea) | Features Lottery User invitation (Achievements) Enhancements QR feature for POI Purpose Project partner facing (meeting in Uppsala) 27 Feb 2020 - 28 Feb 2020 |

| 10 Mar 2020 - v1.0 RC1-alpha | Feature freeze! Purpose Internal polish |
|---|--|
| 17 Mar 2020 - v1.0 RC2-beta | • External testing |
| 07 Apr 2020 - v1.0 (Titan) | PurposePublic on-boarding |
| 24 Apr 2020 - Launch Event (Salzburger Radfrühling) | |

9. Lessons learned and next steps

The initial design process of bigger software projects is one of the parts which is often underrated. By setting up this groundwork, evaluating architecture and design before starting development we are convinced to gather fast progress during the development phases.

The next steps are the continuous work on the wireframes and then to move on the iterative design and evaluation of the design (UI/UX) for client and web frontend followed by the administrative fronted/CMS. This will be accompanied by the actual development in WP4 SimpliCITY platform and tool development.

The current version of this document represents work in progress as a continuous release.

Appendix I: Design Documents

- Information Architecture: Client-information-architecture.pdf
- Platform and Client Wireframes: Platform-and-client-wireframes.pdf
- Platform and Client Mockups: Platform-and-client-mockups.pdf

References

- Bevan, N. (2001). International standards for HCI and usability. *International Journal of Human-Computer Studies*, *55*(4), 533–552. https://doi.org/10.1006/ijhc.2001.0483
- Bruseberg, A., & Mcdonagh-Philp, D. (2001). New product development by eliciting user experience and aspirations. *International Journal of Human-Computer Studies*, 55(4), 435–452. https://doi.org/10.1006/ijhc.2001.0479
- Caillois, R., & Barash, M. (2001). Man, play, and games. Urbana: University of Illinois Press.
- Clarke, P., O'Connor, R. V., & Yilmaz, M. (2018). In search of the origins and enduring impact of Agile software development. *Proceedings of the 2018 International Conference on Software and System Process - ICSSP '18*, 142–146. https://doi.org/10.1145/3202710.3203162
- Huizinga, J., & Huizinga, J. (2016). *Homo ludens: A study of the play-element in culture*. Kettering, OH: Angelico Press.
- ISO STANDARDS. (2019). ISO 9241-210:2019 Ergonomics of human-system interaction— Part 210: Human-centred design for interactive systems. ISO STANDARDS.
- McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world*. New York: Penguin Press.
- Suits, B. (2005). *The grasshopper: Games, life and utopia*. Peterborough, Ont: Broadview Press.
- Tekinbaş, K. S., & Zimmerman, E. (2003). *Rules of play: Game design fundamentals*. Cambridge, Mass: MIT Press.
- Theunissen, T., & Van Heesch, U. (2017). Specification in Continuous Software Development.
 Proceedings of the 22nd European Conference on Pattern Languages of Programs EuroPLoP '17, 1–19. https://doi.org/10.1145/3147704.3147709
- Weinschenk, S. (2011). *100 things every designer needs to know about people*. Berkeley, CA: New Riders.