Requirements Elicitation for a Holistic Mobile Wallet Ecosystem

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Abstract: The digitization of physical wallets into mobile applications is a promising trend, namely for payments, personal identification, and for grouping marketing items or digital tickets. Mobile digital services emerge on these areas promising to bring ease and convenience for wallet owners and, for place owners, lower costs on payment processing fees, increased service efficiency and a closer relation with customers. However, there are several challenges, like the users' acceptance, security concerns and lack of interoperability between wallet services, that delay a significant impact on persons' lives. On this paper, we present the requirements elicitation for a holistic mobile wallet ecosystem.

1 INTRODUCTION

Mobile devices are reaching a massive level of impact on societies. Their growing capabilities of data acquisition, communication and processing makes them ideal instruments to foster paradigmatic changes on people routines. This is the case of the digitization of physical wallets into mobile applications, which is a promising trend for payments, identification, ticketing and marketing (Forrester Research, 2015). Mobile digital services grow in these areas promising improved usability, convenience, security, control over items and novel disruptive experiences to wallet owners. To place owners, these services have the potential to offer lower costs on payments processing, control over targeted marketing campaigns, improved proximity to costumers and knowledge about their interests and needs (Forrester Research, 2015, TechNavio, 2015, M. Evans, 2015).

However, there are several challenges associated with these systems. Research shows that "digital mobile wallets do not fulfil consumer's needs" (Williams and Yu, 2015). Only 13% of the people who own smartphones have mobile wallets installed, and 76% of these rarely or never use it due to safety concerns, unclear convenience and poor functional characteristics (Williams and Yu, 2015). Other studies identify issues on the: (i) User Experience (lack of acceptability, usability, trust, privacy, perceived value for wallet owners, place owners and others); (ii) coexistence of mobile payments with other services; (iii) coexistence of multiple mobile wallets in one device; (iv) connection between wallets of consumers and merchants; (v) interoperability between mobile wallets; (vi) proximity payments; information security; (vii) lack of collaboration between the stakeholders (European Payments Council, 2014, Shaw, 2014, Gannamaneni, Ondrus and Lyytinen, 2015).

For this purpose, on weWallet project we aim to face the mentioned challenges by researching and developing a universal solution that dematerializes the main items present on nowadays physical wallets, namely the currency, personal identification, tickets and marketing items (like coupons or discounts), all integrated into one mobile solution available for the main mobile operating systems (OS). Our approach is based on three axels: (*i*) the fragmentation reduction of mobile wallet services, currently separated in several independent mobile applications. We propose one single digital mobile wallet for converting every physical wallet experience as a way of reducing interoperability issues, improving the User Experience for wallet owners and optimizing/increasing the services provided to place owners; (*ii*) the abstraction regarding mobile OS to optimize the number of potential users and, therefore, increase the adoption from place owners; (*iii*) the abstraction regarding communication technologies between wallet owners and place owners in order to reduce their investment in hardware infrastructures and to increase its acceptance across the smartphone owners, regardless

of their devices communication technologies (NFC, QR Code, Wi-Fi, BLE).

On this paper, which is part an on-going industrial R&D project, we present a study that combined applied research with user-centered techniques for the elicitation of the requirements for the envisioned system. These are consolidated on a functional architecture that illustrates an overview of the solution.

2 RELATED WORK

This section surveys the most relevant related work about mobile wallets and the solutions available on the market, from their functionalities and communication technologies used, to the identified limitations.

On (Ma and Wei, 2014) is proposed a mobile payments system using the NFC technology. Users can charge the mobile service balance through their their bank account, and then use it on a NFC-enabled Point of Sale (POS). The transaction is forwarded to a banking management system for validation and money transfer. The planned system used identity authentication, information encryption, data integrity verification and digital signature as security measures. Beside the conceptual prototype, the solution was just developed for Android OS and presented a limited number of functionalities. Rehman and Coughlan presented another NFC-enabled mobile payments system for Android devices, where consumers and merchants need to be registered on the same Financial Service (Rehman and Coughlan, 2013). Using a different communication protocol, on (Ugwu and Mesigo, 2015) is proposed an Android application that uses QR codes as links to process transactions. This work identifies the two main actors as receiver and the payer. The receiver launches the mobile application, selects the amount to receive, and a QR code for the transaction is generated. The payer application scans the QR code on the receiver's smartphone, selects the payment method, authenticates on the system and on the financial institution, and the transaction is processed. PayPal and credit card accounts can be used to make the payments. This system is just for Android devices, communicates just by QR codes and both the actors have to be online for performing the transaction.

The dematerialization of identification cards into mobile applications is also a current research trend. In (Zhang *et al.*, 2015) is proposed an identity recognition framework based on NFC and fingerprint technology for Android devices that can be used in many different areas. In (Portnoi and Shen, 2015) is presented an authentication system based on BLE beacons. The system is conceptualized to work on indoor locations, with beacons broadcasting encrypted messages (Ciphertext-Policy Attribute-Based Encryption) containing a session token. Users with BLE devices are able to capture the encrypted messages and, if their devices are capable to decrypt these messages, then the users would be authenticated in the system, at that exact location.

Other elements that are frequently present in physical wallets are tickets and loyalty cards, and there are also studies on mobile solutions for digitizing them. In (Zupanovic, 2015) is described a NFC ferry ticketing system implemented in Croatia that enables users to acquire the tickets at home and present them on a digital format through their smartphones. This procedure aimed to speed up the ferry boarding.

Besides the studies presented, there are considerable solutions already on the market. The Apple Pay (Apple Inc., 2014) allows consumers to store credit/debit cards information, loyalty cards and coupons on their smartphones, enabling online and in-store purchases. The in-store purchase communications are made through NFC, which is only allowed on iPhone since the iPhone 6 model. It supports payments using American Express, MasterCard and Visa, and uses the Secure Element on the smartphone to store personal encrypted transactional data. The Android Pay (Google, 2015) is a mobile wallet system for Android devices developed by Google that dematerializes credit, debit and loyalty cards. It allows payments by MasterCard, Visa or American Express. The in-store payments can be made using NFC technology. Differently from Apple Pay, the Android Pay uses the Host-based Card Emulation (HCE), which allows the emulation of users' cards on the smartphone, avoiding private information from these cards to be directly stored on the smartphone. By using this mechanism, a token, that corresponds to the virtual information of the card, is used to initiate the transaction, being this information forwarded to the cloud, where the real card information is retrieved to finish the purchase. The Samsung Pay (Samsung, 2015) has been developed for Samsung devices (Android) and allows consumers to make payments through NFC or Magnetic Secure Transmission (MST) technologies (allows payments to be made using older POS). On both cases, payments have to be authorized through fingerprinting or PIN codes. The whole payment system is based on a tokenization mechanism, which allows private card information to be replaced by a

token during the whole payment process between the consumer and the merchant.

These wallets are mainly focused on mobile payments and on the loyalty cards usage. However, there are other applications in the market that can be used for identification or ticketing purposes. The MEO CardMobili (MEO, 2014) allows the management of MEO services, and aggregates identity, loyalty, and discount cards. To add those cards, the user has to introduce the card number manually and scan its bar code if it has one. To use the cards, users have to show them on their smartphones to the merchants, without any automatized process. The m.Ticket application (NOS, 2015) is intended to allow people to buy cinema movie tickets for the NOS theatres, with the tickets being forwarded to the users through SMS. To validate their entrance in the theatre, the users have to pass their smartphones with the received SMS and validity code on a terminal on the entrance of the theatre room.

By analysing the state of the art, it is noticeable that no mobile solution provides a holistic wallet experience (with payments, identification, ticketing, marketing items) for the main mobile OS, with more than one communication protocol.

3 RESEARCH METHODOLOGY

For the purpose of this project we are using an action research methodology, iterative and user-centered. We are planning three iterations of the methodology, related with three releases of prototypes iteratively improved accordingly to research. The first iteration starts with the combination of an applied research with user-centered techniques, having as results the requirements of the system (presented on this paper) and a first functional prototype of weWallet. The second iteration starts with a user-centered evaluation of the former prototype, which will feed the applied research to be done accordingly to its results. The aim is to use users and stakeholders to confirm and adapt the preliminary requirements gathered, now using a hands-on prototype. The result of the applied research of this iteration is a second prototype, more adapted to the user's perspective and to the project objectives. The final iteration starts once more with the evaluation of the preceding prototype, now in a real-world setup. The goal is to use the results of this evaluation to perform a final applied research, which will end with a pilot of the system ready for running on a real setting for a significant period of time. Articulated with the user-centered approach, all the

iterations have the objective of measuring and increasing the security, performance, scalability and abstraction of the system (which is intended to be applied in businesses of several types and dimensions, and inherently with unique needs).

This paper shows the main results of the first iteration of the research methodology, compiled on a functional architecture that provides an overview of the requirements and will guide the forthcoming efforts. In this sense, for the applied research we have performed a profound state of the art research on (*i*) digitization flows of physical wallets for payments, identification, ticketing and items of costumer engagement/marketing; (*ii*) devices and technologies for communication between mobile wallet owners and place owners; (*iii*) current mobile wallets features and interaction mechanisms; (*iv*) current solutions for place owners' in the management of mobile wallets; (*v*) Cloud infrastructures and backend mechanisms for supporting mobile wallet ecosystems (including architecture, security, processing performance and information systems' needs). The applied research included hands-on testing with current solutions and technologies, as well as the testing of preliminary technical possibilities.

In what concerns the techniques applied on the user-centered research, is has been performed a focusgroup and a questionnaire with potential mobile wallet owners, and a set of 6 individual interviews with potential place owners. The focusgroup and the questionnaire were made in one session with 15 participants with distinct levels of experience regarding mobile applications and mobile wallets from different professional and demographic characteristics, 10 males, and 5 females, aged from 25 to 50 years old guarantying a closer analysis to different types of users that might interact with the wallet in a real-world scenario. The session consisted on three main phases: (*i*) the presentation of the project and an introduction of the main mobile wallets currently on the market, combined with an open discussion regarding the good aspects of these systems and of their limitations; (*ii*) a focusgroup oriented for gathering scenarios of use of a holistic mobile wallet in the context of payments, identification, ticketing and marketing; and (*iii*) the questionnaire, filled at the end of the session. The questionnaire comprised 17 multiple-choice questions with an open alternative, and had the goal of gathering the individual perspective of the potential mobile wallet owners. The focusgroup has been recorded (video and audio) and its results transcribed, categorized and measured for allowing its analysis.

The interviews with place owners were held individually, in order to consider their different professional areas. Each session had the duration of 30 minutes, where issues related with payments, ticketing and identification through mobile devices were discussed. The first set of interviews was performed with 4 place owners: (*i*) a responsible from a tourism office that provides information about the city and sells tickets for transports and public attractions; (*ii*) a restaurant owner; (*iii*) a place owner that manages multiple service provisioning; (*iv*) a bar owner. After this first set, another stakeholder approached our company, volunteering to provide context and real world scenarios for the project. This stakeholder owns a renown Portuguese winter sports resort, and feels considerable efficiency problems on payments, identification, ticketing and marketing that fit the scope and goals of the weWallet project. In this sense, were performed 2 more interviews: one with the resort owner, focusing business goals and vision regarding the use of mobile wallets at his place and the second with the administrator of the resort, where he showed operational needs, problems and restrictions. The 6 interviews allowed to understand the place owner's perspective, assuring abstraction regarding business areas and dimensions.

On the next section, we show the key findings, which are summarized by the functional architecture of the system.

4 RESULTS

As introduction to this section, which will have the form of explanation of the requirements for a holistic mobile wallet per area (payments, identification, ticketing and marketing), our user-centered studies confirmed that despite the recognized advantages of mobile wallets, the current solutions do not fulfil the users' needs. All the participants (Wallet Owners and Place Owners) see advantages on these systems, but only one Wallet Owner (6,7%) mentioned to have a mobile wallet application installed on his smartphone, which just works for one restaurant brand, for gathering points to get discounts in future meals. The remaining participants (93.3%) mentioned that they didn't have a mobile wallet installed because they never needed it. Place Owners demonstrated that the friction on the adoption of these kind of services comes from the low adaptation on the current solutions to their needs, the small number of users of this kind of systems and the current safety concerns users have. These findings confirmed the

challenges in hands. On the next subsections, we will describe the requirements gathered, which are summarized and depicted on Figure 1.

4.1 Personas and Key System Concepts

Our studies revealed that to assure the abstraction and the scalability of the mobile wallet ecosystem in different areas of application (restaurants, resorts, stores, public transports, corporate facilities, summer festivals and others) and for different business sizes, it has to consider the following personas: (*i*) *Wallet Owner*: the persona that has the mobile wallet application installed on the smartphone, and is able to use it for payments and management of receipts, personal identification, buying and managing tickets of several types, receiving and managing items of customer engagement, such as loyalty programs or coupons. The demography of this persona is very broad, basically anyone with a smartphone; (*ii*) *Place Owner*: the persona responsible for the business with which the mobile wallet owner interacts, being interested on the system business metrics (data visualization, business performance notifications and other management features), on managing the system modules and on managing the employees' performance and permissions on the system. This persona has permissions to do everything that the *Place Manager* and *Place Controller* do. The businesses scope (places that a *Place Owner* may own) is defined by any place that involves payments/money transfer, user's identification, ticketing or marketing; (*iii*) *Place Manager*: the operator responsible for interacting with the wallet owner in payments, identification, ticketing and marketing; (*iv*) *Place Controller*: the operator that confirms/validates wallet owner's ID or the permission for those personas to be on a specific spot.

As key concepts for ensuring the encompassing of different types and dimensions of businesses, we found that the system needs to be prepared to have representation of: (*i*) *Brands*: group of places from the same company (ex: set of restaurants or hotels from a group; set of facilities from a company or public corporation, or other); (*ii*) *Places*: a specific place, like a store, office, restaurant, cinema, mall, football stadium, or other; (*iii*) *Spots*: a specific spot on a place, for example a specific corridor, the entrance, the spot nearby a specific Nike shoes.

On the next subsections, we present the system's requirement findings organized per functional area.

4.2 Mobile ID

On Figure 1 is possible to see that a Wallet Owner will have the possibility of presenting a mobile ID, feature valued by 93.3% users, to be used in scenarios of corporate ID, insurance ID, or others like gym ID, or library ID. The mobile wallet ID will be composed by a fixed and a variable component. The fixed part will be similar to the citizen card and have personal info like the name, fiscal number, email, photo, address, phone number and birth date. This information will be extended with data related with the users' relation with each Brand, like the ID of the person on that Brand.

The Wallet Owner will be able to present the mobile ID in two forms: active or passive. For the active presentation of ID, the Wallet Owner selects that option, inserts the security PIN or fingerprint, and the system generates and presents a QR Code and activates the NFC for transmitting his ID from his mobile wallet to the Place Manager application (which may be just a reader that activates the opening of a physical barrier on clearance, p.e. a door). When no digital communication of information is required, the Wallet Owner can present his ID on the smartphone screen in a format like regular cards (which we call weWallet ID card). When the Wallet Owner leaves the ID screen or the smartphone enters in standby mode, the ID stops being transmitted. The personal mobile ID info is securely stored on the persons' devices to allow offline presentation of ID, and at the Cloud, to allow the recovery of a lost/stolen wallet (feature valued by 73.3% of the potential Wallet Owners). The passive presentation of ID is when the user authorizes his mobile wallet to send automatically his ID after receiving specific BLE signals. Using BLE beacons broadcasting a signal on specific spots, the mobile wallet will send the users' ID to the Cloud infrastructure. This data that may be used for marketing matters, for corporate ID and others.

Place Managers and Place Controllers, will be able to read wallet owners' ID on their mobile devices, using an NFC tap or reading the QR Code. Both users will need to check-in on a specific spot when logging in, in order to record the location of the action performed. Place Managers will also be able to do access management, namely granting access to specific places to Wallet Owners.

Place Owners will be able to see, on a web application, dashboards characterizing the Wallet Owner's patterns of behaviour, namely entrances, exits, passing on a specific spot, and others, per wallet owner or segment of wallet owners. This actor will also be able to manage the places and spots, meaning, creating and managing new places/spots by identifying the related location and sensors.
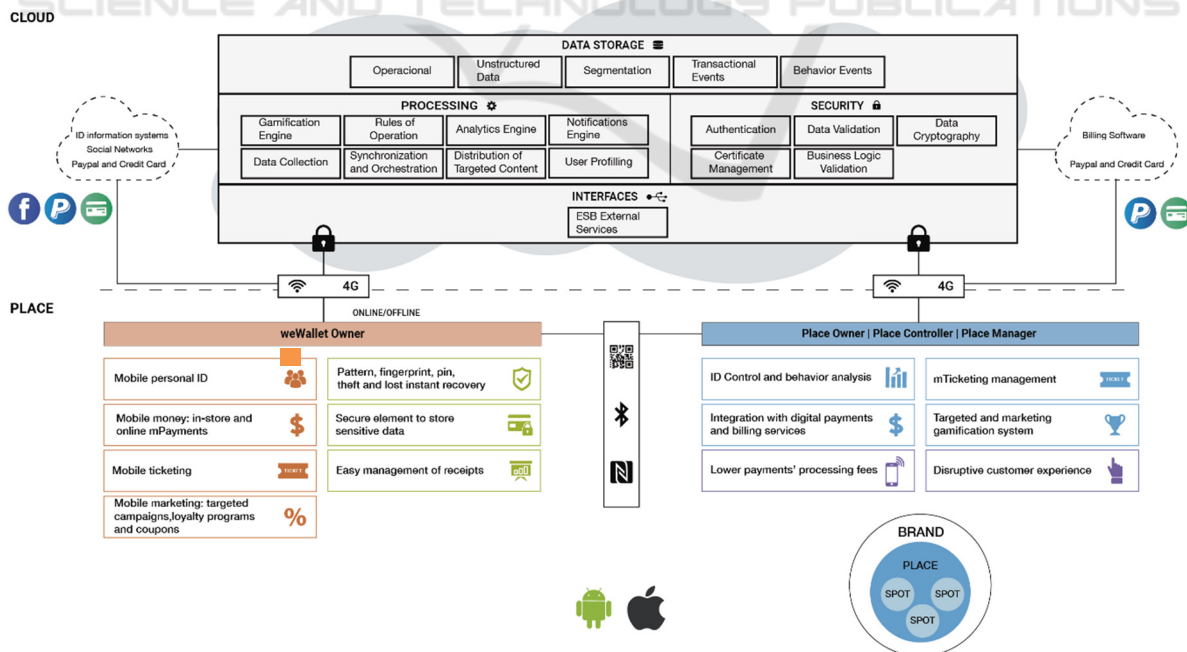

Figure 1: weWallet Functional Architecture.

4.3 Mobile Payments

Mobile payments are the most common features of current mobile wallets. On our studies, 73.3% of the potential Wallet Owners recognize advantages on mobile payments of low value (<20€), and 60% on higher values, mainly related to the convenience. However, the majority still finds issues related to the security and to the lack of vendors that allow payments through mobile wallets, which harms the added value of current solutions.

Our approach will differ from the current systems by the possibility of payments using several channels of communication between wallet owner and place owner, by the seamless integration of all the elements on the wallet, by the abstraction regarding the mobile OS, and by the possibility for the Wallet Owner to perform payments being offline.

In general terms, we have found that the flow of dematerialization of payments in mobile wallets has 3 main stages: (*i*) The charge of the wallet balance; (*ii*) The payment/money transfer from the Wallet Owner to a Brand; (*iii*) The transfer of the weWallet balance of the Place Owner to his bank account.

For the first stage, on our study, 85,7% of the potential mobile wallet owners assumed that the integration of the mobile wallet with PayPal would be the best solution for charging the balance (as well as for redeem it). As reasons for this choice, the participants mentioned that PayPal is a well-accepted and secure system that users already know and trust. An alternative suggested by 46,67% of the participants is to aggregate a credit card to the mobile wallet account, solution mentioned to be interesting, especially after the weWallet system gains the trust of the users. In this sense, as can be seen on Figure 1, the system will integrate PayPal as a solution to the safety concerns that exists on other wallets (as mentioned above users already trust this platform) and credit card services for the charging of the mobile wallet. It is also shown that the wallet owner solution connects directly with these systems, which happens to assure the security of the solution (we will not store any confidential bank information from the wallet owners on our systems). The personal bank information will be stored locally using the Secure Element of the mobile device. At our Cloud infrastructure, we only store information about the balance and money transfers, for allowing offline payments and for the locking of balance when needed.

The balance transfer (payment) between a Wallet Owner and a Place Owner (or its Brand) can be done using NFC or QR Code, or directly (online) when purchasing a mobile ticket. On in-store payments,

articulated with the billing system (with which we integrate case by case), the Place Owner application generates a QR Code and an NFC signal for the wallet owner to read accordingly to the communication protocol available on his device, and transfer the related balance. This operation has to be authorized using the mobile device security pattern, fingerprint or PIN. After the balance transfer, the place owner is notified and launches the related receipt, which is stored in the Wallet Owner account (at the Cloud) and is possible to be retrieved by this persona anytime anywhere.

The Place Owner has available one dashboard showing the patterns of income using mobile wallets per place or spots and per product or service (including mobile tickets). This persona has also the possibility of transferring the money from the system, which can be made by the transfer of the balance to his PayPal account (and then to his bank account).

4.4 Mobile Ticketing

On the questionnaire filled by potential wallet owners, 93.3% mentioned the management of tickets on mobile wallets to be a valuable feature.

From the analysis of the interviews with Place Owners we identified three types of mobile tickets: (*i*) Entrance (with time constrains and possible multiple uses): tickets for entering on shows, summer festivals, cinemas, football stadiums, thematic parks or others. These tickets validity can be associated with a time frame or with the first presentation of the ticket. (*ii*) Exchange for product or service (without time constrains but with a validity date): tickets that can be exchanged by a meal or a drink (p.e. in events that do not want to have money circulation), or by services, like a car wash, a training class or a night at a hotel. (*iii*) Renting equipment (with time constrains and possible weWallet balance lock): this type of tickets allows the Wallet Owner to rent an equipment made available by a Place Owner. Examples of equipment to be rented are bikes in city centers or ski material in winter resorts. The rent of an equipment may obligate to a value lock on weWallet balance to assure the return in good conditions.

From the scenarios obtained on the studies, the Place Owners should be able to manage the ticketing system, creating and submitting tickets (including the number available), see the list of tickets of type (*iii*) pending (with equipment not returned in the due period) and act regarding that (p.e. notify wallet owner). This user is also able to see a dashboard that shows the patterns of the selling and of the use of the

tickets with historic data and forecasts based on prior data.

The Wallet Owner is able to see the list of tickets available, apply filters accordingly to preferences, buy tickets with weWallet balance, and present the tickets using QR Code or NFC to a Place Manager or a Place Controller (online or offline). In the case of the need of a balance lock (rental of equipment), the Wallet Owner is notified at the moment of purchase and of the use of the ticket, and the acceptance of that lock is asked and confirmed by the submission of the security PIN or fingerprint.

The Place Manager validates the tickets of types (*ii*) and (*iii*) and registers its use. This user also registers the return of the equipment (ticket of type (*iii*)) and the system unlocks the Wallet Owner balance regarding the delivery of the equipment. Regarding the Mobile Ticketing group of features, the Place Controller is responsible for the validation of tickets of type (*i*), entrance in events or transports.

4.5 Mobile Marketing and Gamification

The ubiquity of mobile technologies on people lives gives place owners the opportunity to get closer to their target customers.

Our findings show that place owners are aware and value considerably mobile marketing and gamification features to promote costumers' engagement in a mobile wallet context. All referred that they would use frequently the weWallet system to perform targeted marketing (campaigns directed to segments of consumers) and that they would try to change their current costumer engagement system, of loyalty cards or discount coupons to equivalent mobile wallet items.

In this sense, for what concerns an integrated Mobile Marketing and Gamification system, Place Owners shall be able to: (*i*) Manage targeted mobile marketing campaigns, for specific in-situ delivery of content (using the spots' sensors) or for delivery anywhere accordingly to rules established; (*ii*) Define the Gamification system: as type of gamification system we make available loyalty cards, ranks and coupons, for which the Place Owners can define the rules of application. These rules consist on mechanisms that will be automatically applied integrated with the remaining system (identification, payments or ticketing) accordingly to the Wallet Owners' actions on the interaction with the Brand, Place or Spot. (*iii*) Analyse the efficacy of the marketing campaigns through dashboards with the following KPI's: Number of deliveries; Number of

content visualizations; Number of conversions or purchases. All the KPI's may analysed per costumer segment and per period with different granularities, and may be analysed using a customer funnel of engagement representation to understand where the campaigns are less effective.

The Place Owner can grant permissions to perform these actions to the Place Manager.

The participants on the Wallet Owner user-centered studies referred to be very interested on the digitization of the items of brand engagement. 93.3% referred to prefer digital loyalty cards and coupons on a mobile wallet to the physical current alternatives, and some mentioned the ease of use and the possible decision support for remembering when to use these items as reasons. However, 73.3% of the participants had privacy concerns regarding the user profiling needed for the targeted marketing campaigns, namely the use of their personal data on digital sources like social networks. Specifically, the results of our research regarding marketing and gamification issues suggest that Wallet Owners shall have the following features on weWallet: (*i*) Manage the relation with different Brands or Places, for the purpose of costumer engagement items (loyalty cards, ranks and coupons), having the option of being open to campaigns of Brands with which they are not related but are related with their preferences; (*ii*) Manage the preferences for targeted marketing campaigns; (*iii*) Manage the decision support system regarding marketing items, defining if and when they want to be remembered of using them, or if they want to receive recommendations of Brands / Places regarding their preferences and location. (*iv*) Receive targeted marketing campaigns.

5 CONCLUSION AND FUTURE WORK

Our studies confirmed that despite the interest and the recognition of advantages of digital mobile wallets from the part of Wallet Owners and Place Owners, the current solutions still do not fulfil their needs. On this paper, we described the elicitation of requirements for a holistic digital mobile wallet, based on the combination of applied research with user-centered techniques. Our approach to face the current challenges is based on the reduction of fragmentation of mobile wallet services and on the abstraction regarding mobile OS and communication interfaces. This approach aims to provide a closer digital substitute to nowadays physical wallets, increasing

the perceived added value for Wallet Owners, and to optimize the number of potential users of the system, increasing the perceived added value for Place Owners.

For future work, we will build the first prototype based on the requirements defined, and will invite end-users to evaluate it. We plan to do 3 iterations of the action research methodology, with the phases of research, development of prototype and evaluation (which feeds the next iteration). On the last iteration, the final prototype will be deployed in a resort of winter sports for an operational pilot with the duration of one month.

ACKNOWLEDGEMENTS

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