6-2013

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26th Bled eConference

eInnovations:
Challenges and Impacts for Individuals, Organizations and Society

June 9, 2013 – June 13, 2013; Bled, Slovenia

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Abstract

Mobile information services, preceded on tablet computers, smartphones or other mobile devices, are a significant source of information for people nowadays. By including context data, a new category of information services has been established. On the application side, a range of innovative services, providing the user with an added-value, could be observed in the previous years, boosted by the wide-spread adoption of smartphones in developed countries. For the application provider, the question how to configure the business model is crucial: several factors such as the service configuration, the revenue model and the configuration of the value creation network, which all can be seen as decisive factors for success or failure of a service. In this paper we present a context-aware service named 'Digital Graffiti' and describe the process of the business model development. As an outcome of this process, a specific business model, based on feasibility and future prospect, was chosen and further described.

Keywords: Mobile Service, Context-aware Service, Business Model, Digital Graffiti, Mobile Marketing

1 Introduction

The exchange of information via digital networks is a common way of communication, whether in people-to-people communication or people-to-machine communication. A large variety of services and applications have been developed in recent years, providing information and enabling interaction via mobile devices[1]. When bringing a new service or application to market, the success for the company and/or product is strongly influenced by

1 When referring to mobile devices, we refer to mobile phones (feature phones, smartphones) and Tablet-PCs.

the configuration of success factors described in various business model frameworks we will address in the following chapter.

'Digital Graffiti' is a prototype of a context-aware Service (CAS), developed by the Johannes-Kepler-University in Linz, Austria. It provides information to the application user via a mobile device, considering context information (e.g. location, time and other context data describing the user's situation)[2]. The information can be centrally provided by the application provider, contributed by the community of users or automatically retrieved from connected external systems via application programming interfaces (APIs). With this prototype, a wide range of services can be conducted, as we have seen from previous user tests and feasibility analysis. But, as Timmers (1998) already observed, „*information and communication technology enables a wide range of business models; [...] technology in itself provides no guidelines for selecting a model in commercial terms*". In this stage of service configuration, the need for a solid business model becomes imminent before bringing a service to market.

With the knowledge of the technical capabilities of the service, we emphasize the following research question: Which business model variations for a mobile, context-aware service can be identified and which of these identified is the single most promising for a service based on the 'Digital Graffiti'-prototype?

In this paper we will describe the process of identification of business model components and fields of application for a context-aware service by integrating users as well as experts. Finally we give and outlook on how the most promising business model was identified and configured.

2 Business Model Framework for Mobile Services

At the latest when technically the service is defined, developed and ready to market, the configuration of the business model is inevitable.

But why should a business model be the leading framework for configuring ones services, resources and other internal and external variables in a competitive environment? Kittl (2009) details the two traditional schools of competitive analysis, namely the market-based view following Porter (1980) and the resource-based view[3], resulting in a consideration that the traditional entities (industry vs. resources) lack the ability to properly describe and analyze the success factors of a digital service company or of a digital service itself. A business model seems to be more promising in this context.

Definitions of business models, focused on the digital economy or following a generic approach, are widespread and numerous. As past research has already shown, some general

2 We follow the definition by Dey/Abowd (1999), where context is defined as *„[…] any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves."*

3 A comprehensive overview for the resource-based view can be found at Foss (1997)

components can be identified from existing business model definitions (de Reuver, Haaker, 2009):

- Service component, describing the value proposition and the market segment
- Technological component, describing the technical functionality
- Organizational component, describing the value network and the own position within it
- Financial component, describing the revenue and cost model

Stähler (2002) describes a model adapted to the digital economy, setting the benefit of customers and other stakeholders, the value architecture and the revenue model in focus. Therefore a business model comprises these core elements.

- Value proposition: Which core benefit of the company provides which added-value to whom?
- Value architecture: How is the value network configured? Which actor adopts which part of the value architecture? Which market is targeted with which product?
- Revenue model: How can revenues be obtained by the company?

We are narrowing the business model framework of Stähler to the CAS itself, therefor replacing the 'company' term within the definition with 'service'.

3 The Digital Graffiti Service

In order to be able to identify appropriate business model components and fields of application for the ‘Digital Graffiti’ service based on the given business model framework, we first have to understand the philosophy and functionality of this technology:

4 Thought Principles

Digital Graffiti is considered a mobile location- and context-based social communication-, collaboration- and interaction platform where arbitrary users are capable of observing their “friends” current locations in near real-time (their revocable permission provided) and of consuming and placing location-bound information within their current whereabouts using their mobile phones (Pomberger, 2011). The novelty in this service is included in the type of information that can be placed: information does not only contain static data, like text, pictures, videos or sound, it also encloses code fragments or triggers to external services which will automatically be executed when the appropriate authorized user reaches spatial proximity to this information without pressing a button or glimpsing at a display (Narzt, Schmitzberger, 2009).

Figure 1: Automatic Interaction at Spatial Proximity

Figure 1 gives an impression of this innovative interaction paradigm: We have put a graffito (i.e., a location-bound information element) containing executable code near the Ars Electronica Center building in Linz, the LED-facade of which is capable of displaying marquee text running around the walls of the building. An authorized person approaching the graffito automatically triggers the execution of the contained code, which causes the facade to welcome the user personally. Of course, this application is more of a playful approach rather than a business scenario; however, it demonstrates the potentials of the service enabling its users to initiate any electronically controllable action just by their physical presence.

5 Technical Background

For consuming the Digital Graffiti service users are supposed to use their mobile devices. The software can be executed on any mobile platform, either as a native application particularly designed for the device (currently for iOS, Android, Symbian, Windows) or as a web application (utilizing the novel W3C standard and HTML5 for accessing GPS out of a browser and complying with the requirements of a bare device without the needs of installing client software).

Once registered and logged in, the user is visualized as an avatar at his exact residing position in front of a map and his geographical position is textually resolved into a human readable address (e.g., building names, floor descriptions or office numbers). Alternatively to outdoor GPS tracking Digital Graffiti supports a seamless transition from and to indoor WLAN localization as well (Schmitzberger, Narzt, 2010) (Schmitzberger, Narzt, 2011). The position of the user is updated at a near real time frequency (every second at GPS usage and – due to the configurable transmission cycle length in WLANs – every three seconds). Figure 2 shows a typical user interface scenario at the second floor of an office building at the University of Linz. The user's own position is determined via WLAN indoor localization and illustrated by the blue avatar. The user's friends reveal their real-time position by green avatars with their appropriate names below.

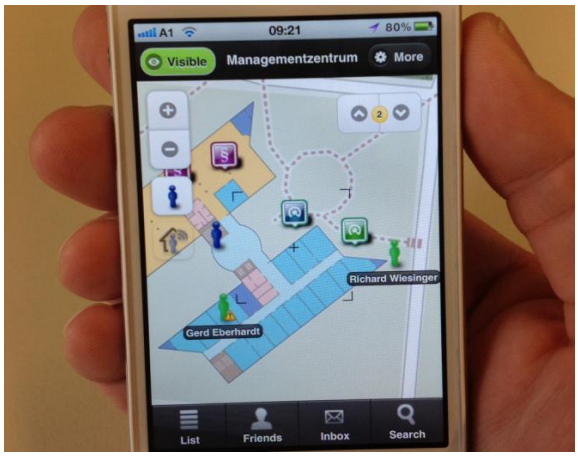

Figure 2: Digital Graffiti User Interface

The Digital Graffiti service has been developed in the course of a research cooperation between the University of Linz in Austria, Siemens Corporate Technology in Munich, Germany and the Ars Electronica Futurelab also in Linz. Similar to cellular telephony the system uses a distributed provider model for the server-side component where users all over the world can join the provider of their choice in order to take part in the mobile location-based information service. This proven model distributes the load ensuing from (asynchronously) communicating users and guarantees scalability of the service all over the world.

Every provider stores a set of geographically linked information in appropriate fast traversable geo-data structures containing text, pictures videos, sound or executable code. Figure 3 illustrates the common principles of the system architecture. Clients repetitively transmit their own (commonly by GPS-based) position to a server (1) which evaluates the geo-data considering visibility radiuses and privilege constraints (2) and transmits the results back to the clients (3). Generally, when the information contains text and pictures, it is immediately displayed on the output device of the client (4). The basic idea for triggering actions is to store executable code inside instead of text or binary picture data. Therefore, we propose a web-service-based mechanism which is both effective and simple to extend: Smart information elements contain a simple URL or XML-based web-request to a remote web-service, which is the actual component to execute the code. When a client receives information containing a smart element, its URL is resolved (5) which is handled internally (6) and finally triggers the desired action at the third-party vendor (7). A response back to the client (8, 9) can additionally be illustrated as a visual confirmation whether the action could have been executed successfully or not (10).

This approach is simple, because the clients just have to handle standardized HTTP-requests. A majority of currently utilized mobile platforms support these mechanisms. Important for third-party vendors: Their internal data representations, servers and control units are hidden from the publically accessible location-based service, guaranteeing a maximum of data security for the vendors.

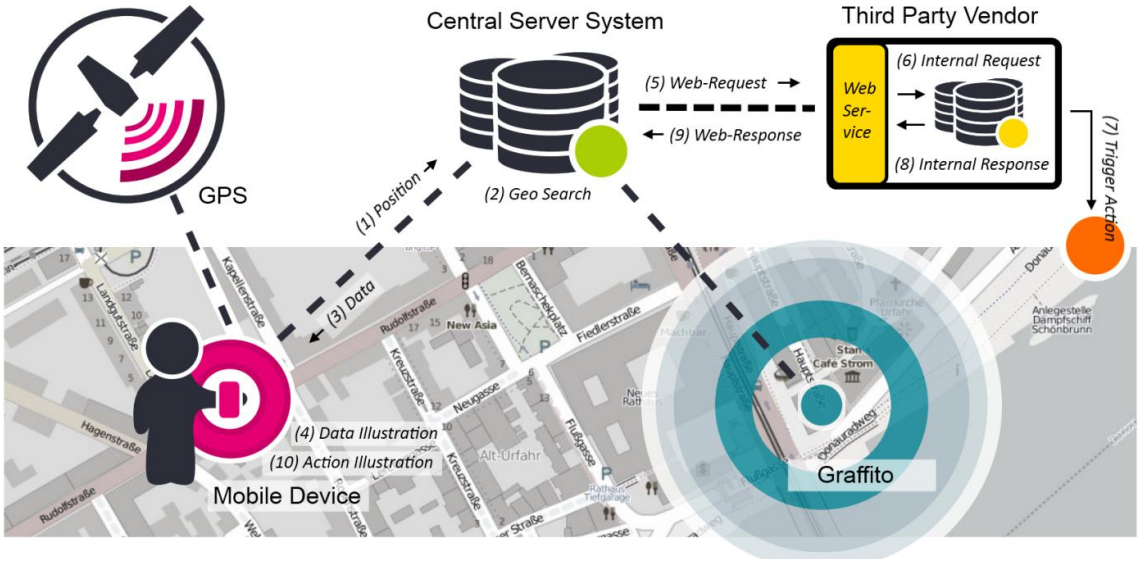

Figure 3: System Architecture

6 Use Cases

The applicability of this innovative CAS is currently being demonstrated in the course of a reference implementation at the campus of the University of Linz. Students as well as lectors and administrative staff are able to perceive location-based information on the university campus and to place information for other users. Lecture rooms are marked by smart graffiti displaying current lecture information for these rooms. Teachers are able to ad-hoc exchange documents with students just because of their geographical attendance in a lecture room. This reference implementation is called Smart Information Campus and has so far been downloaded approximately 3000 times.

In cooperation with the University of Applied Sciences and MAN Nutzfahrzeuge in Steyr, we have designed and developed a new service infrastructure for road-based supply chain event management based upon the Digital Graffiti service platform (Graf, Narzt, 2012). The moving entities (trucks) are identified and tracked by a simple mobile device carried by the driver. The cargo is modeled as a dynamic part of the driver's (or the truck's) personal user profile, enabling a clear mapping of driver/truck and load. Individually adjustable access- and visibility privileges guarantee privacy protection on a technical basis, leaving legal privacy concerns up to negotiations among the participating parties. The control mechanism in this system is built upon the smart graffiti placed along the affected road network, automatically announcing e.g., the arrival of cargo and simultaneously transferring corresponding cargo data in order to optimize the supply chain process both outside premises and inside, e.g., supporting loading and unloading procedures.

The variety of applications that can be built upon the core of Digital Graffiti is large. It ranges from consumer-oriented usage (e.g., in the field of social communication platforms) to economic process optimization systems utilizing location, context and automatic code

execution. In the course of several research and also commissioned projects we have built a control application for one of Austria's largest logistics corporations, a prototype of a fleet-tracking service at airports, an operations control service for the police and are currently elaborating a public travel information service in cooperation with Austria's federal railroad company and further public transport associations (Narzt, Wasserburger, 2011).

So, Digital Graffiti can be considered a mature platform with a manifold of (partly proven) alternatives for commercial applicability. However, the variety of choices is also a major problem, leaving the developers unclear which direction to choose for acquiring business.

7 Business Model Development

The first kind of mobile, context-aware services which became widely usable concentrated on location as the single context information (Kaasinen, 2003). The business model at that time was dominated by mobile network operators (MNOs) and large content providers. This is due to the fact that the positioning of the mobile devices was conducted network-based, therefor the MNO was inevitable for the service provision (Bellavista, Küpper, Helal, 2008). With device-based positioning, performed via GPS, the business model has dramatically changed. Nowadays, a variety of context data can be gathered device-based due to the implementation of various sensors in mobile devices.

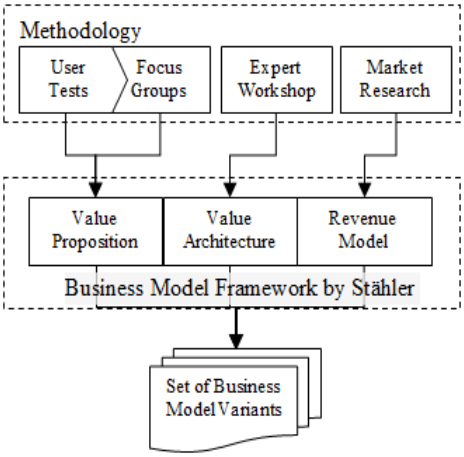

Figure 4: Business Model Development Process Framework

Based on the adapted business model definition by Stähler (2002) mentioned before, current CAS were analysed referring to the three key factors *value proposition*, *value architecture* and *revenue model*. Independently from those results, a set of users were equipped with the 'Digital Graffiti' prototype, conducting field tests for the service. Based on the use case recommendations from the user tests, focus groups discussed the results and the implications for the value proposition of the service. Additionally, workshops with experts took place regarding the value architecture for a CAS. As for the revenue model existing CAS were analyzed. The process model can be seen in Figure 4.

The then available portfolio was evaluated regarding the feasibility with the existing prototype of 'Digital Graffiti' and a cost-benefit analysis was conducted. Based on these results, the most promising business model was chosen and elaborated.

8 The Value Proposition

As results from de Vos et. al. (2008) indicate, simply adding context-aware features to existing mobile services does not necessarily lead to a perceived added-value by the user. We decided to integrate potential users into the business model development process to avoid the problem of having a service being technically well executed, but failing to provide an added-value compared to a non-context-aware service.

For a period of two weeks, testers (n=8) from the *evolaris Mobile Living Lab* test panel were equipped with handsets with the 'Digital Graffiti' prototype preinstalled. The aim of the user tests was to get user feedback for the key features of the service and the usage and usability of these features outside of a laboratory environment. Therefore the tester were instructed on applicability of the service and had to perform predefined tasks. Based on the information gathered during user tests, two sessions with focus groups were conducted. In the first session, the users involved in the user tests generally discussed possible use cases for context-aware mobile services and the added-value from a user's perception. In the second session, further participants were added. One group of these (n=4) has had experience in the use of mobile and CAS. The other participants added (n=3) were cell phone users which haven't had used CAS so far. From the first session four of the users participated in the second session. By bringing in experienced and non-experienced users, we got some very valuable insights regarding the relevancy of certain use cases, the list of use cases was extended with further options and grouped in categories.

The preliminary results, rated by the participants according to the presumed highest added-value from a user perspective, concentrated on two different kinds of services: information services regarding the users surrounding, e.g. restaurant/bar-information, traffic information or digital city guides, and context-aware services where the user can gain a pecuniary advantage, e.g. digital coupons or price information services.

In Table 1 an excerpt from the rated list is shown, listing the two highest rated categories and the assigned use cases. Each participant had the possibility to (but did not necessarily have to) award 2+1 points to the use cases he/she presumes to deliver the highest added-value from a user perspective, so in total a maximum of 3 points per participant (n=11) could be awarded. All of the use cases were developed in the focus group discussions based on the functionalities the 'Digital Graffiti' prototype delivers. Therefore, the basic functionality of location-based information provision by geotagged notes applies to all of these use cases.

Use Case		Points
Ambient information services		13
	Restaurant-/Barinformation	6
	Digital city guides	4
	Location-based traffic jam information	1
	Accommodation information	1
	Indoor university guidance system	1
Services with a monetary benefit for the user		9
	Price information service (where to get an item for less)	4
	Digital couponing system	3
	Digital classified ads	1
	Indoor discount shopping guide (for malls, retailers)	1

Table 1: Excerpt from the rated use case list

Missing the perspective from partners in a possible value chain, this aspect was added later on after the selection of a shortlist of business models (see 4.4). The respective partners (n=8) gave their input regarding a value proposition from this perspective in a questionnaire-based interview.

9 The Value Architecture

With the use cases developed and defined by end users (experienced in the use of mobile services to a greater or lesser extend), a more professional and business oriented input was still missing. The main goal of the expert workshop (participants: n=6) was to extend the present use cases with corresponding value architectures to meet the respective value propositions, addressing the internal and external architecture options.

Different variants of value networks along with product/market configurations were discussed and analyzed, leading to an enriched list of use cases and their value proposition along with possible value architectures.

The main conclusion drawn from the various value architecture variants was a recommendation for the University of Linz to focus on the role of the service provider, concentrating on their core capabilities (the provision of the service itself) and integrate specialized partners for other value creation steps, e.g. marketers for an advertising-based revenue model and the respective value architecture or specialized content providers for the integration of information databases needed for the implementation of certain use cases.

10 The Revenue Model

For virtual communities, which could be one potential field of application for a service based on the 'Digital Graffiti' prototype, Timmers (1998) refers to a revenue stream consisting of membership fees and advertising revenues, giving us a first indication for a possible revenue model.

Further literature review and market analysis was conducted regarding the revenue models of existing context-aware services. Some limitations had to be set to narrow the focus on services and their revenue models which could provide valuable information for the business model development, meeting the functionalities and limitations of the 'Digital Graffiti' prototype:

- The service is publicly available (no limitations regarding the regional availability though)
- Context information are a core factor of the service provision
- The service covers one of the following kinds of information provision:
  - Information centrally provided by the application provider
  - Information provided by the community of users
  - Information automatically retrieved from connected external systems and databases
- The service provider is profit-oriented, hence applications in a research stage are excluded.

From 168 services[4] observed, only a set of 8 services met those criteria.

Revenue Model	Source of Revenue	No. of services
Commercial Partnerships	Business Partners	6
Ads	Business Partners	4
Virtual Currency	Service Users	2
Direct Marketing Promotions	Business Partners	1

Table 2: Revenue models for context-aware services similar to Digital Graffiti

As the market for CAS is still in its infancy, the services as much as the revenue models are still in a process of optimization for many of the players in this dynamic environment[5]. Also there have certainly been limitations to the extend we had insights into the services respectively the revenue models. The data were derived from publicly accessible sources[6].

4 including web-communities where the presence of mobile, context-aware features has been analyzed
5 As an example Brightkite (www.brightkite.com) was experimenting with direct marketing promotions, ads and commercial partnerships before (temporarily?) closing down their service.
6 mainly credible, well known tech news sites and the websites of the application providers

Supplementary to this output, possible revenue models for the various use cases and value propositions were also subject to the expert workshops, enriching the options for the configuration of this pillar of the business model.

In a cost/benefit-analysis a revenue model integrating commercial partnerships and an advertisement-related revenue stream seemed to be most promising, taking into account the given infrastructure and deployed software modules. A revenue model which is solely or partly built on end-user revenues on the other hand was classified as less practicable as the investment in building or integrating a transaction engine seemed to be very high.

11 Selection of a Business Model

Having a set of use cases, extracted from the user tests and focus group discussions, enriched by the output from the expert workshops and market research, a clustering of the use cases was conducted, aggregating to a portfolio and avoiding entries on the list with strong similarities on all three factors (value proposition, value architecture and revenue model).

The portfolio was assessed by a group of experts (n=4) familiar with the 'Digital Graffiti' prototype via a balanced scorecard. Main factors of the assessment have been the technical feasibility, a cost/benefit-analysis with a strong focus on required investments and estimations of the future prospect. Based on the evaluated portfolio the business models with the highest overall ratings led to a shortlist of 3 business models with a potential to be implemented short to medium term.

The highest rated business model was chosen for further description, implementation and evaluation.

12 Description of the Business Model

As the framework by Stähler was our guideline to elaborate a whole set of different business models, we will also describe the chosen business model according to this framework.

In an outline, the service consists of a backend (Digital Graffiti server) and a frontend (mobile application), integrating primarily but not only university-related information, letting users exchange information via the application based on certain factors such as time, location and recipient context, also enabling advertisers to provide their context-aware ads to the users. The target group of the application is primarily, but not limited to, students on campus.

12.1 Value Proposition

Which core benefit of the service provides which added-value?

Three key actors and their respective value proposition can be described:

The university is able to push and provide real-time information to its students on a permanently available device, targeted by dynamic recipient groups (e.g. based on course attendance). Also a stronger interconnection and interaction with the students can be achieved. The content can be provided automatically via integrating information from several

university-related information systems such as the library system, the course information system and eLearning-platforms amongst others.

The students gain immediate access to contextually relevant information via their mobile device, based on the use context, their set preferences and also study-related data (e.g. which courses he/she actually attends or attended in the past). The service is also a platform for a stronger interconnection with both the university and other students.

The marketers and/or commercial partners get access to a valuable target group with highly accurate targeting possibilities for their advertisements and other commercial services, although they don't get direct access to any personal user data.

12.2 Value Architecture

How is the value network configured? Which actor adopts which part of the value architecture? Which market is targeted with which product?

The service is marketed by the service provider to universities which aim to provide a superior information system to their students. Commercial services and/or advertisement content are provided by marketers.

The actors in the value network as much as the revenue streams are illustrated in Figure 5. The service provider is responsible for the provision and stability of the service and offers additional training services.

Two different packages of the service are marketed: a standard package providing a basic set of functionalities and a limited number of linked systems/databases for automatic information provision included, targeted on small- to medium-sized universities, and a premium package providing the full set of functionalities and a wider range of university-related information systems integrated, targeted on large-sized universities.

The standard package has a predefined set of Points-of-Interest (POIs), enables static text, image, video and audio content implementable in the graffities, includes the link of the universities course system and a targeting mechanism build on the students field of study and demographic data.

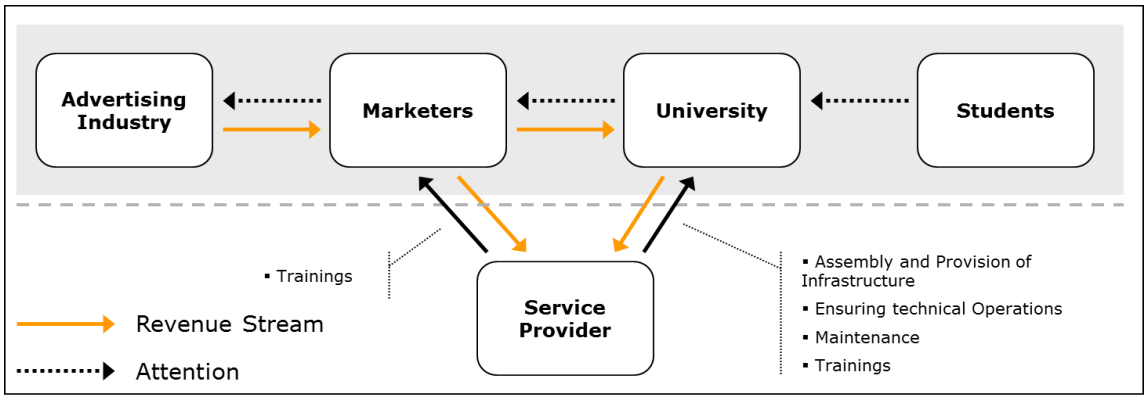

Figure 5: Value Architecture

The premium package comes with administrable POIs, enables the broader range of linked systems (library system, notification system for institutes and deanery, eLearning platforms,…), dynamic content (Livestreams, Podcasts, Votings, Forms) implementable in the graffities and a more extensive targeting mechanism, tracking the user's attended courses, events and preferences.

12.3 Revenue Model

How can revenues be obtained with the service?

The service provider is able to obtain revenues from two actors in the value chain. The assembly of the infrastructure needed for the provision of the service can be seen as project-based business, depending on the given infrastructure (e.g. Wi-Fi-infrastructure for indoor positioning) as much as the amount of systems and databases which should be connected. Additional trainings are offered to the staff responsible for the content administration.

The university pays a monthly maintenance fee to the service provider which has to ensure the service availability and stability.

Additional sources of revenue for the service provider are the marketers which are trained on the system and delivered with analytics regarding their advertisements and general insight data.

The University gains revenues from the marketers for the placed ads based on a CPM[7]-model.

13 Conclusions, Limitations & Future Work

For a provider of a platform like 'Digital Graffiti', being technologically capable to execute a comprehensive range of use cases, the development of a valid business model as a foundation for market success is essential.

In this paper we presented a business model development process framework, based on the business model framework by Stähler, gathering input from mobile and CAS experts,

7 Cost per mille

experienced and non-experienced users as well as potential partners in the value chain. We regard this as a valuable outcome of the whole business development process, as it provides implications on how to apply the business model framework in a practical context.

The value proposition was basically developed integrating potential end-users, enriched by input from possible (revenue model) partners. For the value architecture experts brought in to extend the use cases. The revenue model variants were mainly developed by market research findings and partner interviews.

By integrating end users in an early stage of the business model development process the focus could be narrowed to a manageable set of use cases with high value-added. A mix of mobile and CAS experienced and non-experienced users as well as users familiar with the service (by participating in the user tests) and those who were not, gave us outstanding results during the focus group discussions. Adding expert knowledge and market insights enriched the information needed to base a qualified decision regarding which business model variation to pursue.

All pillars of the business model are subject to some limitations. Whereas the value architecture and, with bigger constraints, the revenue model can be considered almost as a standard model when it comes to ad-funded digital services, the value proposition is highly dependent from the platform capabilities. The following factors are influencing the business model to a great extent and therefor limit the validity for other CAS:

- The set-up of an indoor positioning infrastructure where the service provider is highly experienced is crucial for the selected use case, therefore being an additional source of revenue.
- The business model is not focused on end user revenues as the service provider is specialized in B2B implementations.
- The test users and focus group participants as much as the experts and interviewed marketer representatives have been recruited in german-speaking countries, therefor reflecting a mindset, which might not be valid in other regions.

For evaluation of the chosen and elaborated business model we see the necessity to conduct a field test with a broader and more heterogeneous test group (n>200) to confirm the present results regarding the value proposition by means of quantitative survey data.

Future work will also concentrate on methods for business model development evaluation, as an evaluation of the process model within the context of differently designed mobile CAS is hampered by a lack of appropriate tools and methods.

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