An Ecosystem for User-Generated Mobile Services

Dirk Werth, Andreas Emrich, and Alexandra Chapko
Institute for Information Systems (IWi)
German Research Centerfor Artificial Intelligence (DFKI)
Saarbrücken, Germany
{dirk.werth |andreas.emrich | alexandra.chapko} @dfki.de

***Abstract*—This paper presents an architecture proposal for mobile services. It covers server-side and terminal-side components for the simple creation, provision and consumption of mobile services. The specific characteristics of mobile services are reflected in this approach. In particularthe role of the prosumer, whonot only consumes mobile services but also modifies them or creates services of his own, is within the focus of this design. The paper concludes with a proof-of-concept that has been carried out in a European research project.**

Keywords-mobile services; user-generation;prosumers

I. INTRODUCTION

In the age of the smartphone, service orientation has receiveda new relaunch in importance. Mobiles make electronic services available anywhere at anytime. But in parallel they impose new requirements onsuch e-services. Those result in either mobile apps – whosenumber has rapidly grown with the appearance of App Stores – or in mobile services. Anticipating the upcoming HTML5 standard, the border is continuously blurring. However, in this article we mainly concentrate on mobile services.

Mobile services are nowadays created byprogrammers and published by service providers. However, we see from other domains that the consumer is increasingly integrated in the product development process. In particular,the Web 2.0 movement opened a broader perspective on the consumer and the consumer's capabilities. A stronger focus is now on the interaction of the user, and collaborative aspects move into the spotlight. In this respect, we can observe that "power users" intensively influencespecific products, becoming external product designers. Instead of companies' product developer staff, this group defines more and more aspects of the products. Following this line of thought, when investigating the role of power users with regard tomobile services, such users will produce their own mobile services if adequately enabled. This is the spinning point of our approach: How to enable users to generate mobile services and what are the conceptual requirements?

Hence, in this paper we will propose a conceptual architecture for IT service providers to offer user-generated mobile services. We will shortly present the state of research on mobile services and assess the role of the (power)user in such a context. In the main part, we will developan IT-architecture that supports the provision of user-generated mobile services. Finally, we will explicate our findings with a proof-of-concept implementation evaluated within a European RTD project.

II. RELATED WORK

In contrast withuser-generated services, user-generated content in the context of mobiles is widely addressed in research. With the Web 2.0 movement, mobile users became producers of content for the mobile Internet. Daugherty et al. [1] investigate attitudinal factors towards consumption and the creation of user-generated content. Girardin et al.[2] investigate how mobile services can be adapted based on user-generated content. They try to customise tourist services based on user-generated electronic trails. User-generated content and its application in a business environment is analysed by Bughin [3]. He found out that encouraging employees, who are quality content providers, to for example post suggestions about improvements tothe company boosted the number of contributions and improved the content quality of other employees'content. The issue of the authenticity of content created by untrusted mobile users is addressed by Lenders et al.[4].

In terms of mobile services, Jensen et al. [5] state that enabling easily generated services could help fuel the mobile revolution. They describe a prototype system named Streamspin which lets developers create and publish mobile services. Arbanowski et al. [6] present a reference model that puts the individual user in the centre of service provisioning. They envision a mobile user taking a central role in the production and distribution of new services.

Also highly related is the user-driven selection and recommendation of mobile services. Woerndland Schlichter[7] describe the recommendation of mobile applications to users based on what other users have installed in a similar context. A hybrid recommender system is created by letting the user select between several content-based or collaborative filtering components. Chen [8] discusses a context-aware recommendation system that predicts the user's preferences on the past experiences of like-minded users in a "tourist activities" domain. The recommendation engine suggests activities which similar users have done in a similar context. Van Setten et al. [9] describe a context-aware recommendation engine for mobile tourist applications which uses ontologies. In their approach a hybrid system is constructed by combining a recommender system and a context-aware system. Zhiwen et al. [10] developed a recommendation system which is based on user preference, situation context, and capability context for supporting context-aware media recommendations for smart phones. They define a recommendation model for dealing with a wide variety of recommendations. The model provides multimedia recommendations over multiple dimensions to generate a multidimensional output.

III. MOBILE SERVICES

Services are a special kind of added value that is generated by a business. Its main characteristics are that they are nonphysical and intangible in the dimensions output potential, process execution and process result [11]. In the context of this paper we concentrate on information technology (IT) based services. These are services that are provided or solely operated by computer systems, and where access is only possible via IT [12]. Such services are nowadays widespread and the majority of information-related services belong to this category.

Mobile services are services that are accessed by mobile devices. In other definitions, the more general term of portable or non-stationary information technology is used. In any case, they represent a specialisation of IT-based services. This means that the main criterion of such mobile services is its mobility, both in regard toservice access/invocation and of service provision/usage. However, this aspect of mobility has strong implications on the properties of mobile services, which are diverging from classical IT-based ones (e.g.[13]):

- **Portability:** Mobile services can be accessed independent ofa specific location. Moreover the user can move while using a mobile service.
- **Always-on:** Users usually rarely turn off their mobile device. As a consequence they remainonline and can potentially keep using mobile services infinitely.
- **Localisation:** Mobile services can include the location of the user in their processing. So mobile services can be location-aware and -specific.
- **Personalisation:** Mobile devices are usually not shared. Therefore mobile services can directly identify the individual user and adapt their offers depending on their profiled preferences and needs.
- **Limited capabilities:** Due to the mobile devices used to access and utilise mobile services, these are limited in the resources they request (e.g. bandwidth, screen, keyboard, …)
- **Security:** Mobile services are usually utilised in a more open environment in contrast to stationary services. Thus special requirements are needed to secure them.
- **Routing:** Often mobile devices have routing capabilities. These can be utilised in the service provision, e.g. to navigate the user to a specific location.

As aconsequence of these properties, users consume mobile services in a mannerdifferent tonon-portable IT services. Users usually access mobile services directly with a concrete demand. In stationary environments they often simply browse without a direct objective within service offers ("surfing"). Therefore the usage of mobile services is short and "one-touch". In contrast, users can browse classic IT-services for longer timespans and comprising of many interaction steps. Moreover, as a result of limited capabilities mobile services are rather simple and straightforward, whereas non-portable services try to provide a maximum of information and present themselves as being comprehensive. Because users of mobile services have a concrete and direct need, the information provided must be accurate and up-to-date. In many scenarios of mobile services, where situative data is queried, this even requires real-time-accuracy. Imagine the query of flight timetables. If you query them from home or the office, the service does not need to indicate actual delays. But the situation is different if you query the same information via a mobile service from the transfer terminal at the airport.

In summary, mobile services pose special requirements to the providers. In particular, they demand a higher quality of the service itself as well as of its provision. Furthermore, it is mandatory that the provider is imaging the possible usage scenarios and aligning its mobile service operations with these use cases. Inthe end, this means a change inparadigm for the service design. Originally, IT-based services are provider-oriented, i.e. the provider defines, configures and makes the servicesaccessible. In order to be successful and to give added value to the users, mobile services must deliver the information in a user-orientated way [14]. Therefore by its nature, the importance and influence of customers onmobile services is significantly higher than onclassical services.

IV. THE IMPORTANCE OF THE PROSUMER

Reflecting on the fact that users possess a special importance and influence onmobile services, we can investigate their role, especially in the development phase. In particular, we focus on the "power user". This is a user that is intensively concerned with a specific service, in a way that turnshim into an external service expert. In regard to service development, he becomes an external service designer: By actively contributing to the requirements development, the prosumer actually becomes part of the value creation process and thus "produces" valuable input for the service delivery [15]. This knowledge is usually inaccessible toindustrial producers. However, due to his extensive knowledge on the service, the prosumer strives for highly individualised services, that specifically fit their special expectations, abilities and needs [16]. For service providers, this implies that they have to enable prosumers to create their own mashups or service frontends. From this creation process the providers can derive their product knowledge, now externalised from the power users. E.g. some ERP vendors use this mechanism to design their applications more flexibly, in order to make them ready for customer-driven DIY customisation [17].

The first step in theinvolvement of prosumers was content. Content is a prominent example ofprosumerinvolvement. Web 2.0 technologies have started a hype on user-generated content, this content is mainly generated in a well specified way, namely by sitting in front of the computer, i.e. stationary and reflective. Mobile Web 2.0 technologies and services emphases the user as the content creator at the point of inspiration [18]. The user generates content while experiencing their daily life. Thus the scenario is fundamentally different: It is mobile and impulsive. The latter means that the content is generated on the fly, immediately after being needed and demanded, and not hours later when returning to a desktop station.

His effect will even be boosted by the fact that mobile phone original equipment manufacturers are providing mobile devices with muchfunctionality to capture the context of a mobile user. This combination provides even more opportunities for mobile users to create content on-the-go than at home. Coevally mobile services can directly access these functionalities to gather contextual content information.

The shift from user-created content to user-created services is crucial. Social media sites are providing humongous amounts of user-created content, now reachable and extendable via mobile devices. Griffiths [19] describes that such sites are

mainly valorised by prosumers. However, content is passive, whereas services are active (e.g. [20]). Passive content is produced once, then queried by the user, and passed exactly as created. Services are active in the way that it is not the requested item itself that is created by the user, but the mechanisms for how to compute the item. Active services mainly build on knowledge-based systems, incorporating states and data. We can see this development in the market. Social media sides such as Facebook or companies such as Apple for its App Store are quickly moving from a provider of content towards a provider for (mobile) services.

V. ARCHITECTURE DRAFT FOR USER-GENERATED SERVICES

In the following an architecture proposal for user-generated services is presented as described in [21]. The initial draft of this framework has been implemented and refined in the project m:Ciudad and uService. In general, this architecture proposal describes a generic infrastructure for creating, providing and consuming user-generated services for prosumers. The proposed architecture has two major parts: A part on the mobile terminal itself and a backend framework part. The mobile terminal part serves as the frontend for the mobile user, in which he can use mobile services, search for them and modify them or even create new services. The backend framework part covers important functionalities for the backend provider, such as the repositories for services and context knowledge and assisting software components such as a search and recommendation engines for mobile services, user management and billing.

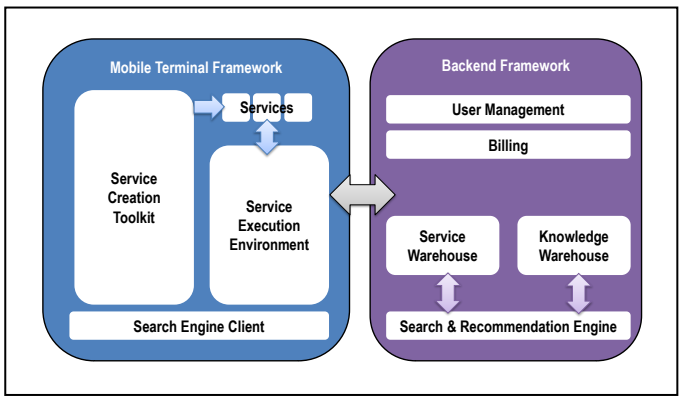

Figure 1. Architecture Proposal for a Mobile Service Ecosystem.

The architecture of m:Ciudad (see Fig. 1) consists of a server part, the m:Ciudad framework and an embedded platform which resides on the mobile device. Due to the limited bandwidth and processing power of mobile devices, data storage and processing is conducted on the server side. The most important components on the server-side are the Service Warehouse, the Knowledge Warehouse, and the Search and Recommendation Engine. Information about the servicescreated is stored in the Service Warehouse and the Knowledge Warehouse, whereas operational information about the service is stored in the Service Warehouse and meta information about the service is stored in the Knowledge Warehouse. The Service Warehouse implements a service lifecycle manager, whichinforms other backend components about creations or changes toservices. E.g. in the Search and Recommendation Engine, indexing activities are triggered only if a service is modified or in the Knowledge Warehouse facts are only being derived from data if interaction occurs. For handling search requests and for the provision of proactive recommendations, the Search and Recommendation Engine requests information from the Service Warehouse and the Knowledge Warehouse. On the mobile device the Service Execution Environment is responsible for downloading and running services. Services are created in the Service Creation Toolkit. Basic functionalities such as user management and billing are not the focus of the detailed component explanations, as they are not relevant tothe service creation process.

A. *The Service Creation Toolkit*

The Service Creation Toolkit enables the user to create services. It holds a repository for so-called blocks. These blocks are the smallest units from which mobile services are composed. Examples for such blocks could be text blocks, maps, forms, etc. The Service Creation Toolkit serves as a frontend for searching for mobile service templates that can be modified and adapted to create a new service. Moreover, the Service Creation Toolkit supports the creation of new services from scratch, i.e. without a predefined template. It is also used to publish the services, i.e. the required information is sent to the Service Warehouse, where the new services are registered and their availability is monitored.

B. *The Service Execution Environment*

The Service Execution Environment is the core of the mobile terminal framework and resides on the mobile device. Its main function is to handle the execution of services. Furthermore it interacts with the Service Creation Toolkit and enables the testing of new services on the mobile device before publishing them.

C. *The Service Warehouse*

The Service Warehouse is the module in the backend framework thatacts as a repository of services and interacts and communicates with several modules both in the mobile terminal framework and in the backend framework. Depending on the role of the user, different data is retrieved from the Service Warehouse. In the case where the user acts as a creator of a service, service templates are downloaded from the Service Warehouse. A user interested in providing data for an existing service downloads the full service code from the Service Warehouse. Finally, a user acting as consumer of a service can access the information of the user providing the service via their ID.

D. *The Knowledge Warehouse*

The Knowledge Warehouse is focused on describing services using semantically enriched data. It facilitates the search and discovery of services for the prosumer community. This component is used with the Search and Recommendation Engine to support the service discovery, selection, and creation. The Knowledge Warehouse resides on the server side and is linked to different types of ontology to represent domain knowledge in different applications. The domain ontologies specify common concepts and their relationships in the domains of application (e.g. tourism, traffic, entertainment). However, searching the content is not the main

objectivein Knowledge Warehouse design. The services and content are only annotated in a way that supports finding the relevant services based on different search criteria. This will be done in cooperation with the Service Warehouse and the Search and Recommendation Engine

E. The Search and Recommendation Engine

The Search and Recommendation Engine has the purpose ofsupporting the search for mobile services and their templates for users. By this means they can find appropriate services that match their search query and/or their personal preferences, their context situation (in terms of location or time) and the availability of service instances. For service creators the search for templates helps them make service creation much easier. Furthermore, the Search and Recommendation Engine serves as a supporting facility for the Service Creation Toolkit itself: By offering block recommendations it enables the Service Creation Toolkit to find the appropriate building blocks when composing a service. For instance, these building blocks can be recommended according to their specific inputs and outputs, but also context information can be included.

VI. PROOF-OF-CONCEPT: M:CIUDAD

We examined our architectural findings in creating an implementation based on these principles. This proof-of-concept system development was performed within the European-funded project m:Ciudad. M:Ciudad envisions a system for service providers which enables a mobile user to create and consume mobile services on the fly on his mobile device. This is a special case, since we neglected the desktop and concentrated solely on the mobile device. Within this project we focus on the enabling of the "mobile super prosumer", simultaneously consuming and producing on-the-go via a mobile device. A user interface on the mobile device enables this mobile prosumer to communicate with the back-end and discover the items to be consumed. On the other hand, via the user interface the systems tracks the direct and indirect feedback of the user which is then incorporated in an adaptive user experience for consumption. In addition, the user interface enables the user to generate mobile services to be consumed by other users. Again, the direct and indirect feedback of the user is collected via the user interface and incorporated in an adaptive user experience for the generation of items for consumption byother users. In this context a field test was conducted to test the different feedback mechanisms necessary for an adaptive user-centric system for prosumers.

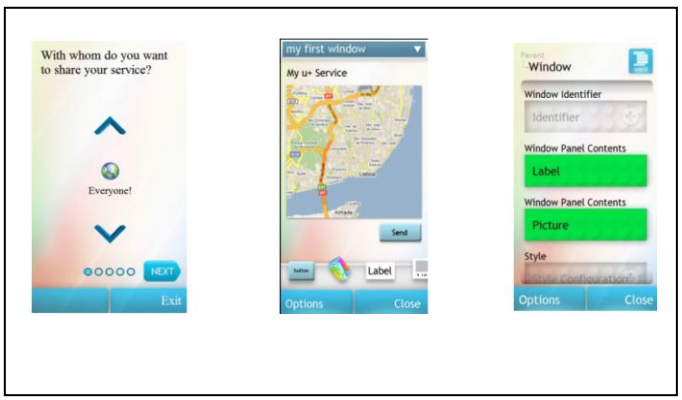

Figure 2. Screenshots of the Service Creation Toolkit.

The goal of m:Ciudadwasto enable mobile users to create services on mobile devices by combining existing service elements. In addition users are able to provide data for a service, i.e. participating in a multi-provider scenario or using content provided by a service. For all three scenarios a user needs to become a member of the m:Ciudad community by installing the m:Ciudad bundle on their mobile device.

The Service Creation Toolkitin m:Ciudad enables the user to create services. Three approaches for service creation are investigated. On the one hand a question-based approach is analysed. In this scenario the user is asked questions, and depending on the answers the service elements are recommended to the user (left screenshot in Fig. 2). Technical details of the service creation aretransparent for the user. The intermediate mode allows the easy configuration of existing services using pre-defined components, e.g. a map as seen in the middle screenshot in Fig. 2. The block-based approach of the advanced mode (right screenshot in Fig. 2) is another approach which is evaluated in the m:Ciudad project. Here, the user can define new or modify existing building blocks, define their data types, styles, etc. Service creation is based on the logical connections of autonomous black boxes which are high-level parts of a service. It will also feature the annotation of services, which are stored in the Knowledge Warehouse. As far as mobility is concerned, the Search and Recommendation Engine supports the recommendation of building blocks for the services. These recommendations leverage the personal and situational factors of the user, i.e. the personal preferences and the user's location, time, etc.

Laboratorytests with 12 participants have been conducted. Most of the participants thought that the block-based approach is too complex, in order to have services composed on the mobile phone, whereas the intermediate mode is intuitive and yet powerful in its expression.

Our implementation wasmainly used for evaluation and field testing purposes. One of the use cases in the field study wasCoolCity, where users can create a mobile event service by themselves. Such mobile services are user-centric and communicate events within a certain geographical space (in the field test within one city) to other users, allowing them to discuss and to exchange ideas. It has been tested with 80 students in Saarbrücken. The test results have shown that the majority of users found the recommendations relevant and adaptive, i.e. that the recommendations were adjusted over time to the specific needs of the users.

VII. FUTURE DIRECTIONS FOR BUSINESS MODELS

Traditional business models for mobile services can be classified into user oriented, third-party orientated, and operator orientated. Operator orientated business models started with the "walled garden" principle, where a mobile user could only use services which were exclusively provided by the network operator. With the appearance of third-party providers the "walled garden" principle was unlocked. Different services from different providers were now available. Finally with the provision of application programming interfaces (API) users were able to generate their own services, and profit from it.

Due to the Internet, and in particular developments such as Web 2.0, the user is not only more integrated in applications but also a transparent stakeholder in the value chain. Mechanisms such as feedback or collective intelligence make it possible to dynamically align supply and even personalise it.

"Perpetual Beta" displays this change inmind set. Perpetual beta expressesthat the focus is shifted from the provision of perfect applications to applications which can be more easily adapted to the ever-changing demands of the market [22]. As a result, technological innovation spreads faster and product lifecycles become shorter. In view of the mobile super prosumer the question is whetherperpetual beta is applicable tomobile platforms. The amount of different mobile platforms pose an additional problem for mobile user generated services. One the one hand a service could put in perpetual beta for all mobile platforms, on the other it could be limited for only a few platforms. Either way, perpetual beta for mobile user-generated services is difficult to implement and the questions remains whetherit is useful for a super prosumer.

Furthermore, open source software becomes more and more important. In particular, strong penetrated markets cannot withdraw from the pressure of competition and network effects induced by novel business models based on open source software. However, companies developing open source software develop new means to make businesses with open source software. Since there is no profit inthe software, they focus for instance on training, integration and maintenance services, customising, subscription models, or on "software as a service" [23]. In addition to product development, internal software services can be transformed into services. For instance, insurance companies transform intra-organisationally shared service centres into a service provider for other insurance companies. Such as the German insurance company VHV Versicherungenwhich not only acts as direct seller of insurance policies but also handles liability cases for other insurance companies. Hence, business models are not fixed but have to evolve with the software ecosystem. In a nutshell, on the one hand business models have to be flexible, on the other the company has to be aware of the changes to adapt the business model accordingly.

In terms of the super prosumer, revenues encourage super prosumers to create their own services. For business models including the super prosumer the essential factors are charging (billing), revenue sharing and QoS guarantees. As a result, factors such as investment, business risks, costs and revenue sharing need to be defined and distributed. Putting it differently, since the end-user becomes one of the stakeholders and at the end shares the profit and risk, charging mechanisms need be modified. Advertising is another source of revenue, since the end-users may share the revenue through providingthe opportunity of displaying an advert in their mobile service. Questions arising in terms of revenue sharing models are: What is the relation between the service creator and the third-party services providers? How to bill end-users using a user generated service? Should service providers calculate the price or should the service creator define the price? Since a creator can use other services to create his own service, who is going to pay for the usage of the used services, in caseswhere the service creator assigns the price? In this context, are the basic services used billed at the time of creation or at the time of execution and how cana user generated service bebilled,especially in the case where the basic services used have a different payment method (pre-paid, post-paid)? In terms of QoS the question is how the QoS of user generated services are guaranteed and maintained? Thereforeservice level agreements (SLAs) should be established between end-users, service providers and third-parties. Moreover the QoS features should be utilised to ensure the SLA as agreed. Especially for inexperienced super prosumers,real-time feedback about business models regarding advertising, service availability and pricing of premium services are a great opportunity to support themwiththeir business model [24].

VIII. CONCLUSIONS

In this paper we discussed the concept of mobile-services generated by usersthemselves. We investigated some conceptual requirements and concluded with an architecture proposal for IT service providers. With our implementation, we demonstrated the feasibility of this proposal and the possibility ofexperiencing user-generated mobile services in selected domains.

There is some evidence that the impact of user-generation in the mobile market will be significantin the near future.

The use case shows that the prosumer approach is an important aspect inmobile service design. Without prosumerisation, providers can only barelyhandle the requirements resulting from the direct usage of mobile services. Neglecting the user, mobile services can rarely keep up-to-date in regard to the actuality and the completeness of information. On the other hand, the user is a powerful instrument and source of information. If service providers succeed inincorporatingprosumer users in the production process, they empower the mobile services and generate a sustainable market advantage.

In further research we will concentrate on the business context of mobile services in regard to prosumers. Currently we mainly use the feedback mechanisms to adjust the service processing, while the underlying business model of the mobile service remains unaffected. As described in the previous section, we want to leverage the monitored user behaviour to identify core characteristics of a service which contribute to its perceived value. According to that we want to create an ecosystem that detects new demands from user interactions and aligns the service creation and delivery with the actual business demands. Hence, dynamic business models evolve that will enable true user-centric services. This is the next step to a consistent prosumerisation of mobile services.

ACKNOWLEDGMENT

This paper describes the work undertaken in the context of the m:Ciudad project, m:Ciudad - A metropolis of ubiquitous services (http://www.mciudad-fp7.org/). m:Ciudad is a medium-scale focused research project supported by the European 7th Framework Programme, contract number: 215007.

REFERENCES

[1] T. Daughtry, E. S. Matthew, and L. Bright, "Exploring consumer motivations for creating user-generated content," J. Interact.Advert.,vol. 8, no. 2, 16–25, 2008.

[2] F. Girardin, J. Blat, F. Calabrese, F. Dal Fiore, and C. Ratti, "Digital footprinting: Uncovering tourists with user-generated content," Pervasive Comput., vol. 7, no. 4, pp. 36–43, 2008.

[3] J. R. Bughin, "How companies can make most of user-generated content," The McKinseyQuarterly, 2007. http://www.cs.ucl.ac.uk/staff/d.quercia/others/ugc.pdf,Accessed on 25May 2011.

[4] V. Lenders, E. Koukoumidis, P. Zhang, and M. Martonosi, "Location-based trust for mobile user-generated content: Applications, challenges and implementations," Proc. 9th Workshop on Mobile Computing Systems and Applications, Napa Valley, CA, USA, 2008.

[5] S.C. Jensen, C. Vicente, and R. Wind, "User-generated content: The case for mobile services," Computer, vol. 12, pp. 116–118, 2008.

[6] S. Arbanowski, P. Ballon, K. David, O. Droegehorn, H. Eerting, W. Kellerer, H. van Kranenburg, K. Raatikainen, and R. Popescu-Zeletin, "I-centric communications: Personalization, ambient awareness, and adaptability for future mobile services," IEEE Comm. Mag., vol. 42, no. 9, pp. 63–69, 2004.

[7] W. Woerndl, and J. Schlichter, "Introducing context into recommender systems," Proc. AAAI'07 Workshop on Recommender Systems in e-Commerce, 2007.

[8] A. Chen, "Context-aware collaborative filtering system: Predicting the user's preferences in ubiquitous computing," Conf. Human Factors in Computing Systems, 2005.

[9] M. van Setten, S. Pokraev, and J. Koolwaaij, Context-Aware Recommendations in the Mobile Tourist Application COMPASS, Lecture Notes in Computer Science, vol. 3137/2004, pp. 235–244, 2004.

[10] Y. Zhiwen, Z. Xingshe, Z. Daqing, C.-Y. Chin, X. Wang, and M. Ji "Supporting context-aware media recommendations for smart phones," Pervasive Comput., vol. 5, iss. 3, pp. 68–75, 2006.

[11] S. L. Vargo, and R. F. Lusch,"The four service marketing myths – Remnants of a goods-based, manufacturing model," J. Service Res., vol. 6, no. 4, pp. 324–335, 2004.

[12] A. Sahai, V. Machiraju, and K. Wurster, Managing Next Generation E-Services, Technical Report HPL 2000 120, Palo Alto, California, USA: HP Laboratories Palo-Alto, 2000. http://www.hpl.hp.com/techreports/2000/HPL-2000-120.pdf, Accessed on 23 May 2011.

[13] E. Kaasinen, "User needs for location-aware mobile services," Pers.Ubiquit.Comput.,vol. 7, no. 1, pp. 70–79, 2003.

[14] R. Geer, and R. Gross, M-Commerce: Geschäftsmodelle für das Mobile Internet, Landsberg, Germany: Moderne Industrie, 2001.

[15] A. Toffler,The Third Wave, New York, USA: Bantam Books, 1980.

[16] E. Von Hippel, Democratizing Innovation, London, England: MIT Press, 2005.

[17] C. Dörner, S. Draxler, V. Pipek, and V. Wulf,"End users at the bazaar: Designing next-generation enterprise resource planning systems," IEEE Softw., vol. 26, no. 3, pp. 45–51, 2009

[18] A. Jaokar, and T. Fish, Mobile Web 2.0: The Innovator's Guide to Developing and Marketing Next Generation Wireless/Mobile Applications, London, United Kingdom: Futuretext Limited, 2006.

[19] M. Griffiths, "Oxygen: Social intranets, collective intelligence, and government practices," Electron.J. e-Government, vol. 5, no. 2, p. 177, 2007.

[20] A. Leben, and M. Bohanec, "Architecture of an active life-event portal: A knowledge-based approach," Paper presented at the 5th IFIP International Conf.(KMGov2004),Krems, Austria, 2004.

[21] A. Emrich, A. Chapko, and D. Werth, "Context-aware recommendations on mobile services: The m:Ciudad approach," Proc. 4th European Conf. Smart Sensing and Context, pp. 107–120, September 2009.

[22] T. O'Reilly, What Is Web 2.0, http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html?page=4, Accessed on26 August 2012.

[23] D. Riehle, The Commercial Open Source Business Model, http://dirkriehle.com/2009/05/01/the-commercial-open-source-business-model, Accessed on 26 August 2012.

[24] Z. Zhao, N. Laga, and N. Crespi, "The incoming trends of end-user driven service creation," Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering, Digital Business First International ICST Conference (DigiBiz 2009), London, UK, 17–19June 2009.

BIOGRAPHIES

Dirk Werthis Head of the project group Business Integration Technologies at the German Research Centre for Artificial Intelligence (DFKI) at Saarbrücken and Berlin. One of his research interests are proactive assistance systems for mobile services. Dr.Werth teaches business information systems and enterprise software at several German universities. He holds a PhD in economics as well as Diplomas in computer science and business administration.

Andreas Emrichhas beena researcher at the Institute for Information Systems (IWi) at DFKI since 2008. He received a masters degree in Business Administration and Computer Science from the University of Kaiserslautern in 2008. His main research interests are semantic search and recommender systems as well as proactive assistance systems for business process management. He has led several national and international research and industry projects. In the European FP7 project m:Ciudad he was work package leader and was responsible for the development of the semantic-enabled knowledge warehouse and search and recommendation engine.

Alexandra Chapkois a researcher and PhD Candidate at the Institute for Information Systems (IWi) at DFKI since 2009. She received a masters degree in Business Administration and Mathematics from Augsburg University in 2006. After graduation she worked for the Electronics Research Lab of the Volkswagen Group of America.Her main research interests are recommender systems as well as proactive assistance systems for sport, health and fitness applications. Shehas led national and international research projects. In the European FP7 project m:Ciudadshe worked together with Andreas Emrich on the development of the semantic-enabled knowledge warehouse and search and recommendation engine.