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Teaching case: Leading the change - ERP implementation at Keda

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INTEGRATING VALUE-ADDING MOBILE SERVICES INTO AN EMERGENCY MANAGEMENT SYSTEM FOR TOURIST DESTINATIONS

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Abstract

Recently, several disasters have affected the tourism industry. In order to mitigate the effects of disasters, increasing the level of preparedness is essential. However, despite the devastating effect disasters can have on tourism, few tourism organizations have properly developed disaster strategies as an integral part of their business plans. Emergency management systems that utilize mobile communication infrastructures can provide prompt information delivery to save human lives. Several supra-national initiatives and research projects are working on possibilities to facilitate mobile communication networks for emergency management systems. However, the success of such systems depends on users being familiar with the service, which is difficult to achieve, if the system is solely used for emergency management. Therefore, we propose a system design that allows the integration of mobile value-adding services. We also present exemplary services, which offer value to tourists and create business opportunities for the tourism industry. The central component of our proposed system design is a service platform, which communicates with mobile network operators and provides basic services for service providers from the tourism industry and the emergency manager via service interfaces.

Keywords: Emergency Management, Tourism, Mobile Communications, Design Science.

1 INTRODUCTION

Disasters can have negative and lasting effects on the tourism industry (Faulkner 2001). In recent years, several crises and disasters have affected the global tourism industry (Ritchie 2004). Examples comprise terrorist attacks (Paraskevas and Arendell 2007), political instability (Fuller and Fugal 2008), economic recession (Kreimer et al. 2003), bio-security threats and natural disasters (Hystad and Keller 2007). Since tourism is also an important economic factor for many countries and many destinations depend on tourism for their growth and survival, there is an increasing pressure on managers and policy makers concerned with tourism to consider the impact of crises and disasters on the industry and to develop strategies to deal with their impacts (Ritchie 2004). In order to mitigate disaster effects and to accelerate the healing process, it is essential to undertake steps to increase the level of disaster preparedness, including infrastructure investments for warning systems and training activities (Johnston et al. 2007). However, despite the devastating effect disasters can have on tourism, few tourism organizations have properly developed disaster strategies as an integral part of their business plans (Faulkner 2001). Emergency management systems (EMS) provide the capability to address this dilemma and to enable disaster forces to manage disaster events, including detection and analysis of incidents (Carver and Turoff 2007). Persons in charge should be supported to prepare evacuations, control and support disaster forces and to locate victims (Carver and Turoff 2007). Since mobile communication infrastructures offer standardized wireless communication services in almost all countries (GSMworld 2008) and allow a fast diffusion of information, they provide a promising technological basis for saving human lives in emergencies. If a disaster event occurs, they can for example allow emergency managers to distribute warnings to the effected areas by cell broadcast to ensure warnings of potential victims in time (Fritsch and Scherner 2005). One of the most promising initiatives is described in the recently published report on the Commercial Mobile Alert System (Federal Communications Commission 2008) which is supposed to be in operation in 2010.

One of the most crucial requirements for preparedness is that ordinary people are used to the system in order to react on warning signals without any delay (Gruntfest and Huber 1989). Meeting this requirement is extremely difficult if the system design is solely used for early warnings. The success of emergency management systems clearly depends on well-trained users being familiar with the service functionalities provided (Turoff et al. 2004a). For an infrequently used emergency management system, limited practical experience of users can be expected (Manoj and Hubenko Baker 2007). Technically, many services used for emergency management systems do not differ from services used in day by day use cases. For example the upload of a picture could be used to inform emergency managers but also for online community services. The challenge is that both functionalities have to be integrated in a design, which allows both perspectives and supports the user to become familiar with the functionalities itself. We will therefore argue that offering mobile value-adding and emergency management services via the same infrastructure could create new business opportunities for the tourism industry. Services can be used to improve the holiday experience for tourists and to help tourist guides to manage the customers. For example, (Zipf and Malaka 2001) argue that location-based services in tourism settings can provide the basis for a range of novel tourism-related applications and open up new business opportunities to service providers. Integrating value adding mobile services into an emergency management system thus improves users' familiarity with the system while at the same time offering a perceived value to customers. Furthermore, revenue created by value-adding services could provide the necessary funds to finance the investments in the mobile emergency management system. Besides sharing the costs for operating the infrastructure, the idea of providing both commercial and disaster warning services based on a technically integrated platform positively affects users' experience due to a common client base.

This paper is structured as follows. We first present the methodological approach of our work in section 2. In section 3, we derive requirements for emergency management systems from the literature, discuss how current systems rate against these requirements and propose a system design to

address them. In section 4, we introduce exemplary value-adding mobile service in the tourism sector and discuss possibilities for integrating them into an infrastructure that can be used for emergency management systems as well as possible business implications. The limitations of our work are stated in section 5 and section 6 provides a conclusion.

2 METHODOLOGICAL APPROACH

We address the introduced problem with a conceptual system design providing a technological basis for emergency management and value-adding services being offered to different parties. This system design represents an IT artefact instantiation that aims at contributing to the problem's solution, i.e. at (1) minimizing the impact of crises or disasters and at (2) offering novel services to customers. As system architectures, system designs or prototypical software applications, IT artefact instantiations demonstrate the feasibility of an approach developed. Due to its utility-centric focus, design science research contributions present novel IT artefacts and suitable evaluation approaches that address the artefact's appropriateness to contribute to the problems' solution (Nunamaker et al. 1991). These two facets of rigorous design science-oriented research contribute to the foundations and the methodologies pool of Information Systems research, i.e. they contribute to its knowledge base (Hevner et al. 2004). In the following, we present a design of an emergency management system, which utilizes communication facilities of mobile communication networks such as GSM. In contrast to existing approaches such as the Global Disaster Alert and Coordination System (GDACS) (European Communities 2008), our system design provides facilities for integrating EMS functionalities and commercial value-adding services on the basis of a common platform. In order to evaluate our proposed system design, we then present exemplary value-adding services that demonstrate its feasibility. Further evaluation is provided by a qualitative analysis of potential benefits being provided to the different parties including the public sector, the industry and customers. We therefore follow the classic approach of design science-oriented research (March and Smith 1995) as we first present a developed IT artefact and we second evaluate the artefact's benefits for potential users. Therefore, and e.g. in contrast to behavioural science oriented research, the goal of this contribution is utility, namely the benefits our system design can provide (Simon 1969).

3 EMERGENCY MANAGEMENT SYSTEMS

Having outlined our methodological approach, we will now derive system requirements from the literature and review how they are addressed by existing emergency management systems. We then use these requirements as the basis for a proposed system design.

3.1 System Requirements

From the literature we derived the following high-level requirements that need to be addressed by an emergency management system, which could also be used for secondary purposes. They comprise (1) system effectiveness (Johnston et al. 2007), (2) reliability (Zeckhauser 1996), (3) cost efficiency (Zeckhauser 1996), (4) smooth service integration (Ritchie 2004), (5) multilateral user interaction (Turoff et al. 2004b), (6) availability (Faulkner 2001) and (7) security (Valtonen et al. 2004). In the following, we further explore these identified requirements:

Effectiveness: Effective early warning systems have to be based on regularly used communication infrastructures and people have to know how to react on visual and acoustic warning signals (Johnston et al. 2007). This requirement holds for commercially successful infrastructures (Buhalis 1998) as well as early warning systems. This requirement suggests that commonly used infrastructures, like those operating on the GSM specification provide a suitable basis for mobile services. GSM represents a standardized communication link between disaster management forces and victims being already used by a large installed base of more than 2 billion customers worldwide (GSM-Association 2008).

Reliability: Despite effectiveness, reliability of underlying networks is an important success criterion, as up-to-date systems have to be regularly maintained to ensure reliability. Therefore, this requirement is tied to regular usage (Kron and Thumerer 2002) of the system by parties involved into emergency management. Furthermore, potentially affected people have to be involved in preparedness measures. Otherwise, alerting systems that are not regularly used for other purposes often become outdated, unmaintained and do not get adapted to changing requirements (Gruntfest and Huber 1989).

Cost efficiency: The system shall offer interfaces to existing legacy systems providing the opportunity to include available information from sources of the public sector and third parties. Furthermore, it should provide functionalities to direct messages in a cost-efficient manner (Zeckhauser 1996; Zhao et al. 2005). Major revisions on mobile communication infrastructures and on mobile devices of customers will thus violate this requirement. Secondary use of early warning systems in terms of offering value-adding services shall be supported. The European Telecommunications Standards Institute (ETSI) is developing a worldwide interoperable architecture for emergency management services, in which commercial use is explicitly mentioned (European Telecommunications Standards Institute 2007)

Smooth service integration and device interoperability: End-users should be able to use their already existing equipment without being forced to invest in additional technology. High prices for new equipment tend to result in reduced acceptance by end-users (Chen et al. 2002) and therefore the interoperability with already existing mobile devices must be considered. In the E911 project, end-user technology is regulated and mobile operators have to ensure that certain technologies are available at the end-users side (Federal Communications Commission 2001). In a report for the Federal Communications Commission (FCC) (Hatfield 2002) argues that the lack of integrated commercial services is one of the major obstacles E911 is facing. We therefore conclude that the lacking integration of emergency management and commercial location based services needs to be addressed in holistic manner.

Multilateral user interaction: For supporting front-line responders in forming dynamic teams, the underlying system design shall support multilateral point-to-point communication and provide availability of locally available human and technical resources. This requirement implies that the system design is able to assign access control right on the spot in emergency cases (Turoff et al. 2004b).

Availability: Availability of emergency management systems has been investigated in depth by many authors and is a common problem for systems dealing with disasters and other events with similar impacts on human life (Faulkner 2001). Taking into account that the convergence of data services in terms of using common communication infrastructures, such as internet protocol-based networks, affects all levels of preparedness, the problem of limited availability is not unique to our suggested design infrastructure. Looking at the category of predictable events within an expectable timeframe, such as storms, heavy rain and to certain degree earthquakes, the problem of limited availability during events is clearly dominated by the benefit that warnings communicated in textual and acoustical form can be brought out to potential victims.

Security: Besides availability, other security-related requirements have to be fulfilled by emergency management systems. End-users should be able to verify integrity and authenticity of emergency messages at any time (Valtonen et al. 2004). Furthermore, the system has to ensure that no party could deny its responsibility having sent notifications to potential victims. (Fritsch and Scherner 2005) proposed a system in which early warning functionalities, enhanced by privacy-preserving mechanisms, are described. Based on this work, a detailed analysis how authenticity, integrity and non-repudiation can be provided by using electronic signatures has been provided in (Roßnagel and Scherner 2006).

3.2 Existing Emergency Management Systems

Several supra-national initiatives and research projects are working on possibilities to facilitate mobile communication networks for emergency management systems. Most initiatives, as those described below, are mainly concentrating on certain phases of disasters (McEntire et al. 2002), such as detecting events and forecasting the impact. Other approaches concentrate on early warnings by providing mechanism for delivery of warnings and instructions to potential victims. The GDACS (European Communities 2008), an initiative initially launched by the European Commission, focuses on gathering information about earthquakes and tsunamis. The system automatically evaluates their impact and disseminates the information to prior registered persons around the world. Messages are delivered by SMS or E-mail, depending on the customers preferences. We conclude that the approach addresses the requirements of cost efficiency by using commonly available communication channels. However, effectiveness is only partially addressed since it can not be ensured that the addressee realizes the warning and could act accordingly.

The SMS-alert initiative in the Netherlands allows local residents to subscribe, and receive SMS text alerts from the local police regarding activity in their geographic area (Korteland and Bekkers 2007). Like the GDACS, the system does not process any personal data besides the region the subscriber wishes to be informed about and the contact details. Being used to the system could be achieved by permanent training of the recipients. However, it needs the right level of training to prevent that training is perceived as false negative alarms. Therefore, secondary use of the system could help to make users familiar with the functionalities without raising unnecessary alarms. Both initiatives are cost-efficient and comply with device interoperability. They concentrate on disseminating already existing information to a broad audience in case of emergencies, rather than providing multilateral interactions with decision makers. A backchannel for providing reliable information, provided by people in the affected area, could significantly improve the quality of decisions that have to be made by authorities (Sutton et al. 2008) and help to avoid the “crying wolf syndrome” in the case of false negative alarms (Rosenthal et al. 1991). Due to applying point-to-point technologies for notifying potential victims, both initiatives require that the recipient has registered in advance which violates the requirement of effectiveness and reliability. Ensuring availability during emergency cases is always extremely difficult to achieve and by far not unique to the presented initiatives. However, being able to generate additional revenues by stable networks may lower the reluctance for investing into the reliability of networks.

3.3 Proposed System Design

The proposed system design is based on Fritsch and Scherner (2005), in which early warning functionalities of a mobile emergency management system are described. To open up the system design to commercial service providers, we have defined roles of the public sector and the tourism industry. Both entities are operating on a subset of responsibilities and features that the whole system provides. Therefore, their roles are introduced as sub-roles. They have access to the underlying communication infrastructures and thereby, each provides specific services the stakeholder is specialized in. Figure 1 illustrates how the different parties interact within our system design and which services are provided by and to whom.

The central component in our design is the service platform, which is maintained by the platform operator. The platform communicates with mobile network operators and provides basic services for service providers from the tourism industry and the emergency manager via standardized service interfaces. The basic services include localization of mobile subscribers, message delivery via SMS and CBS, multilateral data transfer, access to information databases, support for mobile communities and billing services for mobile payment and mobile ticketing.

The platform operator can be a public or private entity. Its main task is to operate the information system infrastructure and to provide basic services via service interfaces to the involved parties.

Several different entities could take on this role. The platform could for example be operated by the tourist office of the destination. The tourism experience could be improved by new tourism services offered using this platform and by establishing a powerful emergency management system signalling preparedness to potential tourists. Naturally, commercial service providers could operate this infrastructure on behalf of the tourism office. Also, companies with a strong commitment to the destinations community, such as public transport providers, could take on the role of platform providers. For example the German research project VeRSiert (Projekt VeRSiert 2008) has proposed a similar infrastructure (Roßnagel et al. 2008a), which is operated by a public transport provider for coordinating major events in Cologne (Roßnagel et al. 2008b). The role of platform operator could also be fulfilled by commercial service providers, who charge for the basic services that are offered over the service platform.

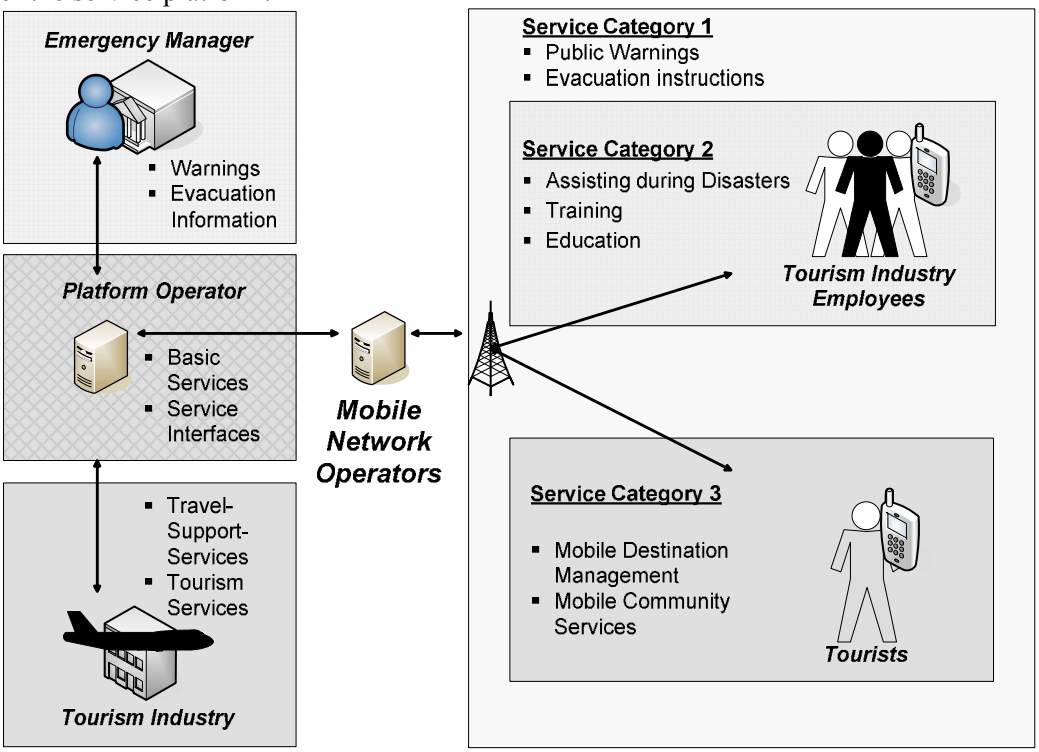

Figure 1: Proposed system design

The emergency manager provides all emergency management related services to ordinary people and ensures efficient notifications, which is henceforth classified as service category 1. Furthermore, this role makes services available to the tourism sector and its employees (service category 2) in order to help them to prepare for emergencies and to offer guidance in emergency situations. For the implementation of these emergency services, the emergency manager utilizes the basic services provided by the service platform. The tourism industry offers commercial services to tourists (service category 3), which we elaborate in section 4. These services are built upon the basic services provided by the service platform, which allows a rapid development of services due to the already existing building blocks. The service aggregation on behalf of the tourism industry is done by the platform operator who takes on the role as an information intermediary (Bhargava and Choudhary 2004) providing *n* to *m* links between different entities of tourists and the tourism industry. Offering commercial services via the same infrastructure is one of the major challenges. The contribution of this approach is therefore that a) people get involved in mobile services as they are offered by mobile emergency services and b) commercial players have a vital interest in keeping the used infrastructure up-to-date. The presented system design allows sub-roles for providing different services via the same infrastructure. Thus, the integrated communication infrastructure (service platform) provides the public sector (emergency manager) and the tourism sector (tourism service providers) with access to their customers and clearly separated duties and responsibilities, solely for their use cases. Thereby the

emergency management system can meet the requirements effectiveness, reliability and cost efficiency by using the same infrastructure for several different use cases. It is not a stand-alone system, which has to be maintained separately and necessary adaptations to changing requirements are becoming more likely. The system now serves a regular secondary use. Furthermore, the stakeholders get used to the system in day-by-day use cases and gain experiences how to react to different messages.

4 MOBILE VALUE-ADDING SERVICES

We will now focus on exemplary mobile value-adding services and their integration with the emergency management system. After a description of potential exemplary services we will discuss service integration and economic feasibility. A broader discussion of tourist services that are suitable for integration into an emergency management system can be found in (Scherner and Muntermann 2008).

4.1 Exemplary Services

Buhalis (1998) and Buhalis and Licarta (2002) analyzed that information intermediaries are a suitable infrastructure component for offering services to an installed base of travellers by providing information from various sources in a concise manner. In Lee and Mills (2007) it is suggested that the key factors for travelling customers' satisfaction regarding the support through mobile devices are determined by a) the degree of perception and b) by the perceived value of services provided. Satisfaction of customers is, following this argumentation, determined by using attractive (e.g. location- and profile-based) services compliant with privacy settings. In a tourism context, there are several such services imaginable. In many cases, a service may be offered free of charge to enhance the tourism experience. Examples are mobile hotel reservation services (Hotel Reservation Service 2008), services provided by local authorities for promoting points-of-interest as well as events and services (State Capital Stuttgart 2008). The same services could also be offered as commercially by charging for the added value they provide. We will now present two use cases in more detail to illustrate the potentials of mobile support in tourist destinations.

4.1.1 Mobile Destination Management

The Aladdin research project funded by the European Union aimed at developing a prototype of a mobile destination management system for tour guides, travelers and local small and medium enterprises (SME) (Aladdin Project 2008). The system provides incoming tour operators with an improved and cost-efficient mobile workspace to support their business processes, allowing small companies to compete with larger incoming tour operators. Furthermore, it allows SMEs located at the tourism destination to offer their services and content in an easy accessible way to potential customers. In addition, tourists can enhance their experience by using the offered services and by obtaining additional information about the tourist destination (Altenhofen et al. 2008). The Aladdin project had a focus on the business processes and on use cases that take place at the destination. Based on this research, different prototypes that support tour guides and travelers have been developed. An evaluation of the Aladdin prototype including field tests in three different destinations showed that users are particularly interested in information on points of interest, routing services, access to information services such as weather and traffic reports, as well as an emergency support (Aladdin Project 2007).

4.1.2 Mobile Community Services

There exists a large variety of mobile communities, which focus on satisfying needs of different types of mobile users, such as mobile gaming or mobile dating. Common to all of them is their reliance on mobile communication technologies for providing value-added services to community members. One

such community that represents an economically powerful sector within the tourism industry is the sports fishing community. Sport fishing enjoys a huge popularity in many industrialized countries and the economic impact of sport fishing itself has been well recognized in recent years (Arlinghaus 2004). The study reports that the total economic impact in Germany alone amounts to more than six billion Euros per year including direct and indirect impacts on the domestic economy[1]. Similar estimations have also been reported in the literature for other economies with only small variances for many highly industrialized countries (US Fish and Wildlife Service 2001; Moon and Souter 1995; Schwärzel-Klingenstein et al. 1999). In Arlinghaus (2004) the behavioural pattern of German sport fishers was analyzed and it was revealed that 60 percent of the sample population spend more than half of their total fishing time in foreign countries. Each fishing trip is characterized by different subsequent phases, which are the planning phase, the event itself, and a recollection phase (Arlinghaus et al. 2002). The first and the last phase can easily be conducted without any mobile support. However, the users' demand for mobile services increases shortly before and during the event, because fishing is a location and event-driven activity. Sport fishers and other stakeholders of the sport fishing industry could benefit from multilateral mobile interactions: Sport fishers share secrets on fishing hotspots and favourite baits only with well selected buddies and many of them communicate their catches immediately to their community members. While looking for new and promising fishing places, sport fishers need to know where to obtain fishing permits and what the terms of usage (catch and release, allowance of living bait, etc.) of certain water courses are. Location-based services could support them in obtaining permits and help targeting advertisements for equipment, hotels and further services. The Norwegian fishing administration of Oslomarka[2] already offers some of these services on their website (Oslomarkas Fiskeadministrasjon 2008), including delivery of fishing permits via SMS. Another use case for mobile support is the determination of the genus and species of the fish caught. The phenotype of fish is heavily related to environmental conditions, like water and food and therefore the same species might look entirely different in varied watercourses (Militz et al. 1984). Thus, sport fishers often see themselves confronted with a fish they cannot easily identify and might violate closing seasons or allowed minimum length by keeping the fish. Traditionally, consulting and gossiping is done between community members who need to be reachable in a reasonable timeframe and need sufficient information for valid decisions. The FishBase initiative (Froese and Pauly 2008) has set up a database which can help to figure out what kind of fish has been caught. The success of this database is due to the broad audience that contributes and enhances the data entries and provides knowledge to the on-site audience.

4.2 Service Integration and Benefits

The service platform provides a centralized access point to the mobile communication infrastructure, which can be utilized for emergency management and commercial mobile value-adding service as described in the previous section. It offers basic services on which tourism and emergency service can be build upon. Since the same underlying technology is used for both services, economies of scale have a significant impact on the cost structure of these services. By utilizing the basic services provided by the service platform, a quick development of value adding mobile tourism services can be achieved. Furthermore, the central platform offers service providers from the tourism industry, which is largely driven by small and medium enterprises (Werthner and Ricci 2004), a possibility to offer mobile services without the necessity to maintain the underlying infrastructure. By including tour guides and other employees of the tourism industry into preparedness activities, tourists have a contact point they are familiar with. Furthermore, these persons normally have an increased foreign language competence which is an advantage during crisis (Manoj and Hubenko Baker 2007). Combining emergency activities and mobile community services, e.g. by forming spontaneous first aid teams or

[1] This is based on the assumption that all spending is done in the domestic economy.
[2] Recreational Areas around Oslo

providing up-to-date information (Palen et al. 2007), shows on the other hand that preparedness can benefit from commercial services provided on the proposed infrastructure. Integrating these services into an emergency management system could improve users' familiarity with the system while at the same time offering a perceived value to the customers. Figure 2 illustrates an infrastructural concept for such an integration.

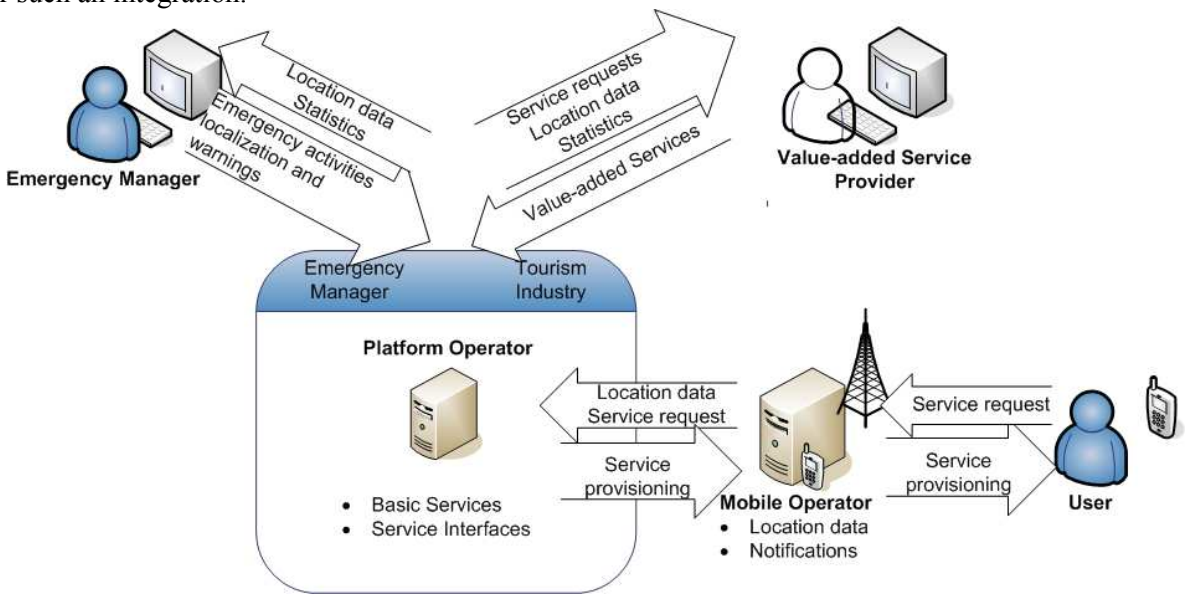

Figure 2: Service integration

The public sector at the destination can also profit from the service integration. Signalling preparedness to prospective customers (i.e. tourists) has a positive impact on the destination's image and can therefore positively influence the productivity of the domestic economy (Paraskevas and Arendell 2007). A positive image can contribute to a positive reputation in the long-term and therefore increase the popularity of the destination (Paraskevas and Arendell 2007). Via the sub-role of emergency managers, the public sector has an instrument at hand for optimizing the training and preparedness of emergency forces as well as the overall coordination of safety services. One contribution of the proposed system is that the pool of emergency forces has been enlarged to members of the tourism industry. Due to the vital interest of the tourism industry and community service providers to offer attractive services to their customers, tourists and community members could benefit from a wide range of potential services. Using the same infrastructure for emergency services and commercial services increases the familiarity of users with the system, its messages and provided functionalities. In touristic settings, the system design can be used to form dynamic travel teams for enhancing everyone's safety and convenience in an unfamiliar environment. The same holds for mobile communities in which single members can benefit from the experiences and willingness to communicate of other community members. Furthermore, having a reliable link to a trusted group of entities may result in many use cases in an increased perceived usefulness of location-based services.

5 LIMITATIONS

First steps on how to combine emergency and commercial services via the same infrastructure have been sketched out. However, a detailed analysis and estimation of the impacts and interdependencies of a jointly used infrastructure on the development and the acceptance of mobile emergency services is still missing. The discussed advantages of this approach are limited by the degree of cooperation which decision makers of emergency services might be willing to allow. Also, usability aspects of such systems, like possible steps to ensure that the users pay attention to incoming messages, need to be further researched. A first step in that direction is to use different acoustic and visual signals for

emergency and commercial services to raise the awareness of the users. Furthermore, the availability of different infrastructural components is a major issue and precautions against breakdowns have to be incorporated into networks. Evaluating the readiness of infrastructures for mobile emergency services remains a challenging subject for further studies.

6 CONCLUSION

In this contribution, we proposed an emergency management system design based on mobile communication infrastructure, which allows the integration of mobile value-adding services to improve users' familiarity with the emergency system. Following the design science research approach we first derived system requirements from the literature. They comprise (1) system effectiveness, (2) reliability, (3) cost efficiency, (4) smooth service integration, (5) multilateral user interaction, (6) availability and (7) security. Based on these requirements we addressed the introduced problem with a conceptual system design. In addition, we presented exemplary mobile value-adding services that could be integrated into the emergency management system and discussed the benefits to the users of such a system. We conclude that the proposed system design could help to increase users' familiarity with the system, offer a perceived value to the tourists and create new business opportunities for the tourism industry.

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