GIS-based sales support by company knowledge reuse in the telecommunications sector

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1. Introduction

A quick and timely response to a customer request provides an important competitive advantage for a company. Experience reuse as intended by experience management [Ber02] facilitates an acceleration of the process of preparing offers. From a technology-oriented point of view, experience is "valuable, stored, specific knowledge that was acquired by a problem solving agent in a problem solving situation" [Ber02, p. 11]. In the situation of creating an offer in response to a customer request, such valuable knowledge from a company's experience might include past prices of products or services for a similar customer request. Especially in the telecommunication market such prices are volatile and depend on many impact factors such as the required technology, bandwidth of available lines, or the time period in which the telecommunication service is required. In the run-up for a large sports event, for instance, purchase prices might be significantly higher than after the event when the investment in new infrastructure has provided additional capacities and when there is less demand.

This paper presents on a technical solution for the experience-based sales support of mitcaps a virtual network provider in the telecommunications sector. The technical solution enriches pricing information from previous offers with a reference to time and puts it into the context of a geographic information system (GIS) in order to facilitate a GIS-based search for former purchase prices. Further, the paper provides some lessons learned from the introduction of this solution. The work is the result of a half-year project of students from Goethe University

conducted under supervision of a teaching person and in close cooperation with mitcaps as an industry partner.

The technological support of sales persons in their task of preparing offers is a very promising field of action for knowledge management research, in alignment with the secondary fields of action business processes and business culture [LK+13]. The scope of such work is on knowledge sharing at an organizational level [LK+13]. According to the literature [Not13, p.74], knowledge management in sales support mainly addresses the tasks to organize, to coordinate and to use knowledge on the customers, the market, and the own products. The proposed solution addresses these issues for the sample area of selling telecommunication services.

2. Sales support for virtual networks

A Virtual Network Operator (VNO) such as mitcaps does not possess own infrastructure. The company combines telecommunication services from different carriers to customer-individual solutions. Figure 1 illustrates the role of a virtual network operator for small and medium enterprises.

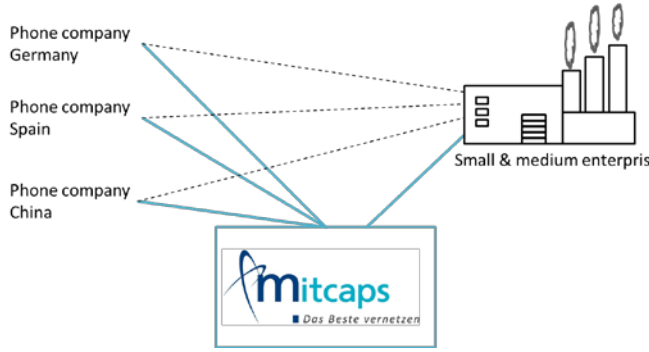

Figure 1: The role of a Virtual Network Operator (VNO).

A sales offer of a VNO includes the virtual network for multiple sites as well as additional services for maintenance and quality assurance. The sales person

considers pricing information for each site that has to be integrated. In the simplified sample scenario depicted in Figure 1, for instance, two carriers for the European sites and one for the Chinese site could be investigated. Getting in contact with all potential carriers to ascertain the exact purchase prices would take approximately six to eight weeks. In contrast, a budget offer can be created from estimated costs within a few days. The sales person reuses former carrier proposals to estimate recent pricing information.

2.1. Requirements analysis

However, the main challenges for this task are to find the relevant carrier proposals and to transfer the pricing information to the recent situation in a plausible manner. As a result of a half-day workshop conducted with mitcaps' sales persons, the following requirements to a system supporting the creation of budget offers have been achieved:

- Store carrier proposals in a harmonized form
- Store recent sales offers
- Navigate among carrier proposals and sales offers
- Keyword search, GIS-based search
- Create new carrier proposals and sales offers
- Calculate estimated prices for sales offers from carrier proposals

Store: The harmonization of the carrier proposals deals with the transformation of the different conditions and technical parameters how carriers describe their proposals into a unified form. For instance, some carriers calculate with monthly fees while others deal with one-year contracts as a calculation unit. A clear distinction between purchase prices and sales prices is crucial for storing both, carrier proposals and sales offers.

Navigate and search: A well-structured design of the graphical user interface is required in order to avoid confusion between carrier proposals and sales offers

during navigation and search. Initially, the contents shall be ordered by reference to time. The user shall be able to rearrange contents by alternative sorting criteria. In addition to these navigation capabilities, two different approaches for search are required: A keyword search filters the contents according to user-specific search criteria. A GIS-based search complements the keyword search by geographical reference.

Create and calculate: While it is quite straight-forward to enter new carrier proposals, the creation of new sales offers is more sophisticated as it uses the search and pre-calculation capabilities of the system. Former carrier proposals that are relevant for the current sales offer are retrieved by means of the GIS-based search. An interactive guidance of the user is required to perform GIS-based search operations for each of the sites to be integrated. Step-by-step, the user shall select the most promising carrier from the retrieval result for a particular site. Based on the proposal's date specification, the user shall specify the calculation factor for the price estimation formula. Obviously, the newly created sales offer has to pass a technical approval before it can be communicated to the customer. Approved offers shall be retained to extend the system by useful experience made during the recent problem solving situation.

2.2. Concept of the technical solution

The technical solution comprises of a Web-based system. As depicted in Figure 2 it uses a conventional 3-tier architecture with a client tier, a business logic tier, and a database tier.

The database tier consists of a relational database to store carrier proposals, budget prices for sales offers, technology data on network and access types, location and currency data as well as carrier data, customer data and user data. The location data combines the address of a site with the according GIS coordinates.

The business logic tier adopts the Django framework [Dja15] for a Web-based application. Django is an open source framework including Python as a programming language, an object relational mapper (ORM) of Python objects to

database models, and Nginx as a Web server. The Web-based application interacts with the google maps api [Goo15] to retrieve GIS coordinates to an address.

The client tier follows the Model-View-Controller pattern [Bal11] to implement the Web-based graphical user interface with Django.

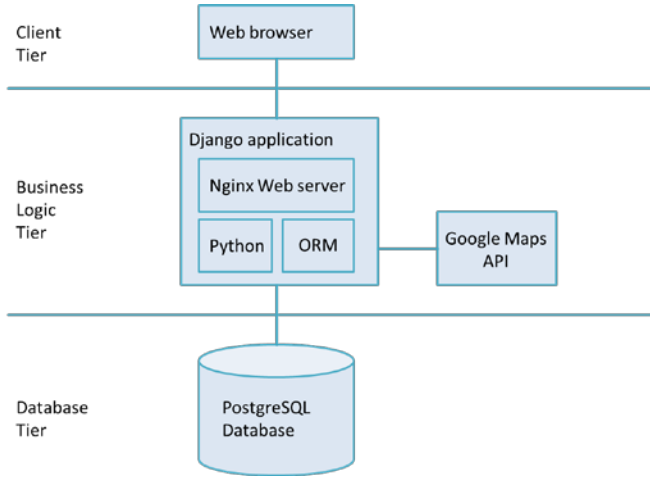

Figure 2: The system architecture.

Figure 3 illustrates by a snapshot of the graphical user interface how the Google Maps API is integrated with the system in order to insert new addresses and enrich this information with the GIS coordinates automatically. The snapshot has been taken during the creation of a new sales offer where three sites in the United States, in Germany, and in Singapore were already processes. The user is looking for carrier proposals for a forth site in Australia. In the lower part of the snapshot, the matching proposals are displayed including the time difference to when the proposal has been made (“Angebotsalter”).

The difference between the purchase price (“EK-Preis”) and the sales price (“VK Preis”) is described by a percentage value for the surcharge (“Differenz EK/VK”).

Please note that all numbers and other data depicted in Figure 3 are purely fictitious.

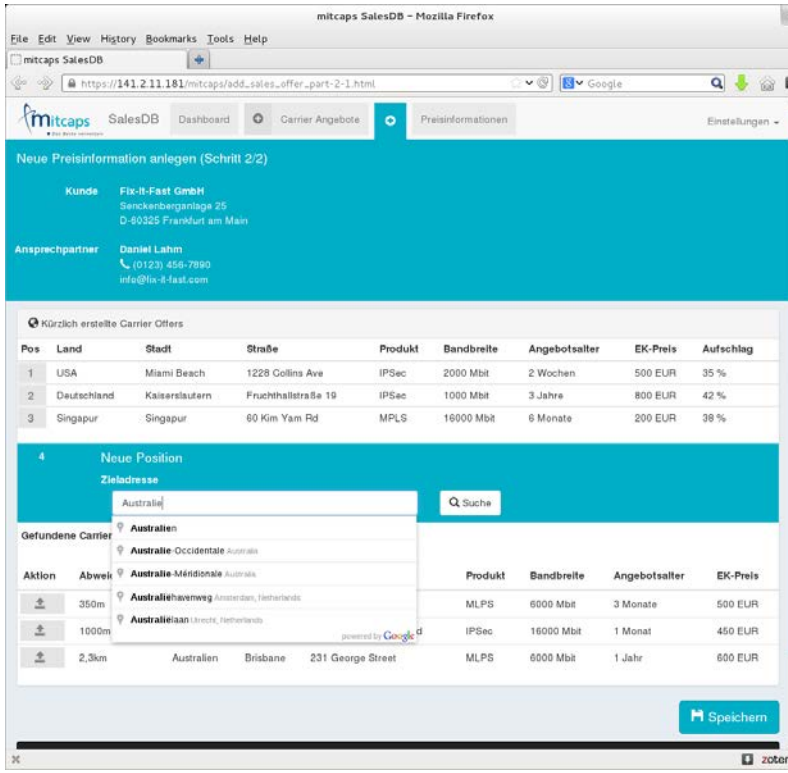

Figure 3: Snapshot of the graphical user interface.

3 Lessons learned

The demonstration of the prototype and the introduction of the pilot system at mitcaps lead to some lessons learned. In the following, we will discuss some of them and provide suggestions for solutions where appropriate.

Knowledge sharing: Sharing knowledge at an organizational level was well-accepted in the sales team. There could not be observed any obstacles in using and populating the system with proposals and offers so far. One reason might be that mitcaps is still a young company with a well-motivated, cooperative sales team.

Data import: It was surprisingly difficult to transform the information from the carrier proposals into the unified data format. Reasons are the multiple document formats in which the carriers submit their proposals such as pdf, word, and excel files. In addition, various naming conventions and units for technical parameters, currencies, etc. occurred in the sample documents. In order to automate the import of proposals, for instance by an extract-transfer-load (ETL) process like in data warehouses, a form for carrier proposals would be preferable. However, it is not sure whether large telecom companies will fill these forms.

Performance: The GIS-based search has been shown to provide good results but to take several seconds. Since the interaction with the google maps api was quite efficient according to expert observations probably the data base should be optimized in order to improve the performance of the retrieval.

Search results: The search results still contain integral parts that have to be compared by the user, such as the bandwidth or type of network technology. A fully similarity-based retrieval as it is part of a case-based reasoning system [RiW13] might further alleviate the burden of manual work in reusing former experience.

Calculation function: The surcharge on a percentage basis to estimate sales prices from past carrier proposals was not very useful for the sales persons. It seems promising to develop more sophisticated estimation functions.

Language: The German language of the user interface was ok for the moment. However, a multi-language approach would allow to address international members of the sales department in future.

4 Related work

There is a large body of work on GIS-based knowledge management in application areas focusing on societal benefits such as public participation in urban planning [PI+13] or environmental monitoring [GiL12]. A major issue is the interaction of the user with the GIS data as a task of knowledge management. In contrast, our work uses GIS-based information in an automated manner in order to improve the search capabilities of a system.

Some work has been done on GIS-based knowledge management with a business focus. Sreekanth et al. [SK+13] have developed a GIS-based system for recommending retail outlet locations. Similar to our approach, geo referenced datasets including decision-relevant parameters are used. However, the set of parameters (such as size of population, income potential, level of competition) differs significantly from ours (technical parameters) as well as the intention of the spatial analysis (recommendation of a location vs. recommendation of a carrier proposal to be reused). Gürder & Yilmaz [GüY13] report on different further applications of GIS for knowledge management in business-oriented tasks, such as opportunity management or geo marketing. In contrast to our work, technical parameters are not addressed.

Shultz et al. are holders of a US patent on GIS-based search [SR+03]. In contrast to our work that searches data entries according to geographical information, their approach enables search results to be directed in a geographical area.

5 Summary and conclusion

This paper presents on a novel, technological solution for the support of creating sales offers for virtual networks in the telecom market. A sales support system provides a sales person with relevant carrier proposals from the past via a GIS-based search. The contents of the system are annotated with temporal information to automatically calculate and display the age of information. A calculation function computes estimated pricing information for offering telecom services at multiple sites.

The system concept has been derived from a requirement analysis at mitcaps. The pilot implementation provided some lessons learned at a technical and organizational level. The results have shown that a technical solution for knowledge sharing in creating sales offers can be developed fairly simply. Knowledge on the market that is contained in carrier proposals has been automatically put into a GIS-based and temporal context. Further, the system allows to combine it with the customer-individual products of the past and to use it for the present tasks of the sales department.

6 Acknowledgement

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