A Q&A system considering employees' willingness to help colleagues and to look for help in different workplace-related situations

An analysis in the automotive sector

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Abstract— **Learning at the workplace is quite often based on sharing of experiences between workers. In this paper we present the results of a survey we made about the worker's willingness to help colleagues and about the prerequisites for the use of a question and answering (Q&A) system supporting mobile users in the automotive sector. Especially we investigate whether the willingness to help and the information need differs in different work related activities. A Q&A system is a widespread used tool to pass experience based knowledge between persons distributed over different locations. The analysis of the survey shows that help from colleagues is valuable during the knowledge acquisition process. We also get answers on what kind of information is helpful for technicians in the automotive sector. These insights have been incorporated into our concept and implementation. Our concept extends the fundamental Q&A idea to be used in automotive companies where especially strong requirements regarding the response time exist and where technicians work at different places and need mobile support.**

Workplace Learning, Informal Learning, Question & Answering, Mobile Learning, Knowledge Management

I. INTRODUCTION

Employees nowadays have to learn continuously considering the needs of their respective jobs. Knowledge and competences imparted during education and training often are not sufficient to meet the demand of their job. Learning from experienced colleagues by observing them or by asking them is a long established practice. Especially enterprise specific knowledge can be conveyed in this form and uncertainty regarding job-related tasks can be decreased. Workers feel safe within a corporate environment. However, it works only if experienced and less experienced workers meet.

This condition is not fulfilled in many cases. For example, service technicians are frequently on the move. Such a scenario we regard in a joint project together with manufacturers from the automotive sector, garages and training providers also in the automotive sector. The project goal is to provide car technicians with help and learning material during all work-related activities independent of their current activity and location. A specific characteristic of the scenario is the possibly high urgency of getting help, for example if the car technician has to repair a bus or truck at the roadside. The technician can attempt to call a more experienced colleague, but given the dynamic nature of the job, the aforementioned colleague will often be busy or driving somewhere and thus unable to give advice.

Thus we want to make information, mutual help and learning material available anytime at every location very fast, which is generally possible due to mobile Internet access. Our solution for mutual help is based on the question and answering concept, which has been extended.

In the following section related approaches and solutions are summarized. Section 3 describes the participants and the structure of a survey we carried out within the target group whereas Section 4 presents selected results. It is followed by a description of the concept for extensions to question and answering systems and the implementation. The paper ends with an outlook on current and future work.

II. RELATED WORK

Using question and answering (Q&A) systems for knowledge acquisition and management is an established approach. Workplace learning quite often takes place by asking questions to more experienced colleagues. This is valid if people are physically present or can be called via phone. The pattern to ask colleagues personally has been complemented with the evolvement of Web applications in past years by community-based approaches where questions are asked to a group of potential responding people. These groups, if they are accessible for everyone, are quite often characterized as communities of practice [10]. Web applications are also used by closed groups like companies or units of a company as means for learning and knowledge management. The applications differ in the kind of communication which is used. Synchronous chats [6], status messages of social network sites [9] or specialized Q&A Web applications [7] are examples. Web applications can be unspecific sites like Yahoo Answers [13] or regarding a specific topic. The Stack Exchange network [8], with its most renowned representative Stack Overflow, covers currently 112 Q&A sites to different topics. As part of this network a site for Motor Vehicle Maintenance & Repair exists.

Even if answers given in a question and answering system might be good [2], a major challenge are the possibly

high response times. In applications relying on synchronous communication mechanisms (e.g. chat or status messages), questions usually are answered by the users currently online only. In applications using asynchronous communication (e.g. Q&A systems), users usually search for questions they are able to answer once they access the site. Furthermore response times are dependent on the community size [11]. Also for very large communities response times can be in the range of several hours, for example in Microsoft' Live QnA [3]. A solution to reduce the response times is to push questions to colleagues using a separated communication channel instead of waiting for an answer. However, pushing questions can result in disturbances, reducing the acceptance of such an application.

Also some work exists about routing questions to users [13] based on information about the users, for example the questions they already answered or just finding/ singling out the experts in various fields [1,4]. This of course runs the risk that either the determined users are unavailable, or that just the few singled-out experts will receive the whole flow of answers they might not be able to handle.

III. SURVEY

As motivated in the introduction and shown in related studies, the support of the colleagues is accepted in many fields as mean for knowledge acquisition. Before focusing on technical solutions to facilitate this exchange in a concrete scenario, a fundamental question is whether the employees are actually willing to take the time and effort to help the others with their tasks. The success of online question and answer systems is a promising indicator, but cannot be a proof in itself.

Our system aims to push questions to people, so the second essential aspect we want to determine is during which activities people would be more likely and willing to respond to questions and during which activities they would be disturbed. To answer these questions we carried out a survey that we will describe in what follows.

A. Participants and Structure of the Survey

In the context of the requirement analysis and as basis for the conception of our Q&A extension we have carried out a complex survey within our target group. Overall 168 participants take part in a written survey. The participants consist of 36 employees from two big garages with different branches in Germany and 132 attendees in trainings offered by two training providers in Germany.

TABLE I. FREQUENCY OF CARRYING OUT TARGETED ACTIVITIES

	Daily	Weekly	Once a month	Never
Service order acceptance	45	15	34	50
Fault diagnostics	68	57	27	11
Maintanance and repair	69	41	22	23
Car Emergency Service	3	24	63	60

Thus we can ensure that results are not influenced by the belonging to a company. From the 168 participants all typical activities of car technicians are adequately covered as shown in Table I. Car emergency service is of course done rarer, since less technicians are used for this task usually.

The survey is composed of five sections:

- Socio-demographic information: age, gender, educational qualification.
- Availability of devices, network access and usual behavior: e.g. which devices and kind of internet access is used on business, and respectively privately?
- Need for support and usual source of information: e.g. how often do you find yourself in a situation you need support in? Thereby we distinguish different activities the target group has to perform.
- Willingness to support colleagues and use of different media: e.g. how far do you agree to the following statement? *If a colleague has a question or problem I would like to help.* Thereby we distinguished the willingness to help during different work-related and private activities.
- Expected acceptance by superiors in the company: e.g. how far do you agree to the following statement? *My superior accepts that I help my colleague using my smartphone.*

Altogether 26 questions were asked, using various question types like single choice and multiple choice, open answer and indication of quantities. To ask about the agreement to statements we used five point Likert items.

B. Selected Results

Absolutely 69% of the interviewees have got a mobile phone (43%) or smartphone (26%) from their employers. It can be assumed that the percentage of smartphones will increase within a short period. But the answers about the availability of different devices, presented in Fig. 1, show that considering all participants the smartphone is seldom available during activities in the garage.
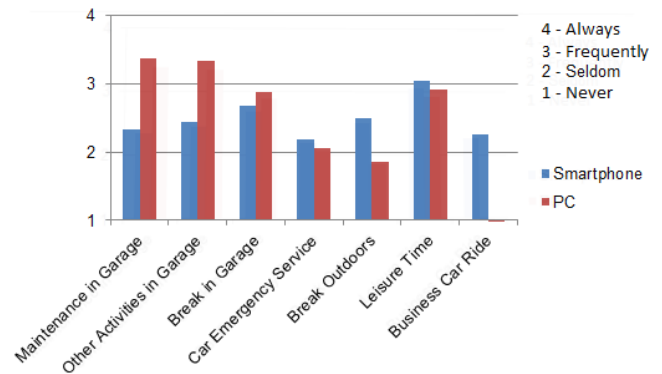

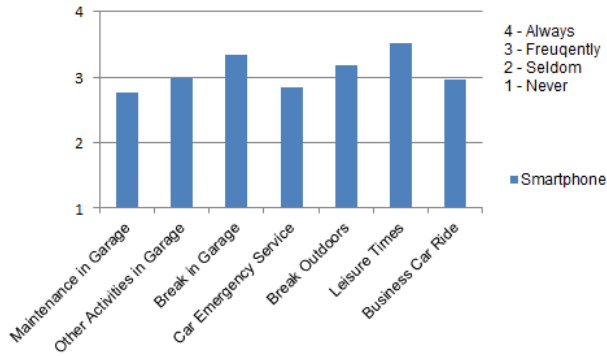
Figure 1. Device Availability (N=168)

Figure 2.   Device Availability of Smartphone Owners (N=40)

Having a closer look at the technicians which are provided with a smartphone by their garage holder, shown in Fig. 2, the availability during all activities increases and reaches such a degree, it seems reasonable to provide a smartphone application. In the garage the availability of PCs is higher than of smartphones. Outside the garage it is vice versa. The lower availability of smartphones in the garage maybe caused especially due to possible dirt working with oil and other materials.
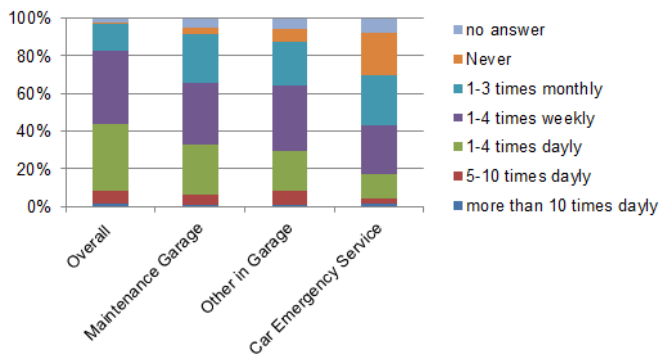

Figure 3.   Need for Support (N=168)

Examination of the results about the need for support shows that in general service technicians have work-related questions. As can be seen in Fig. 3, a great majority has questions at least once to 4 times a week. Regarding different activities, more questions arise during maintenance in the garage than during other activities in the garage or car emergency service.

The survey also shows a very high willingness to help colleagues in the case they have a question, as shown in Fig. 4. The willingness is higher during working hours than during leisure time or at break. There is a minority who will not help during these activities.

Finally, we present some results about the usefulness of different media to understand the problems of colleagues in Fig. 5. To be considered most valuable are photos and information about the car like car's construction year, model range and type.
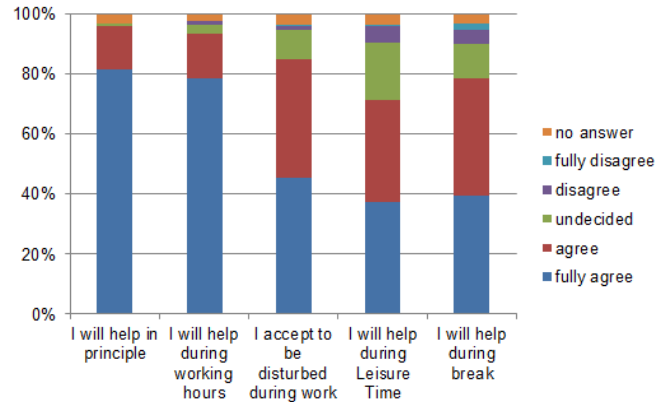

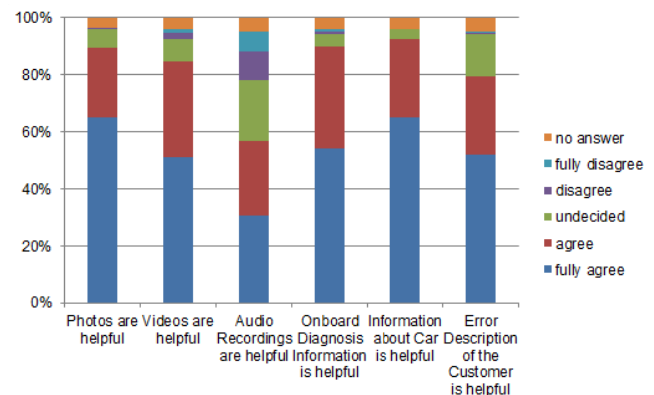Figure 4.   Preparedness to help Colleagues (N=168)

Figure 5.   Usefullness of Media to understand Problems (N=168)

A final result which should be mentioned here is, that only 40% of the technicians agree or totally agree with the statement, that they are prepared to write down an answer to a colleague's question.

IV.   CONCEPT AND IMPLEMENTATION

The results of the survey confirm our basic assumption that technicians in the automotive sector need support quite often during their work related activities, that assistance from colleagues is necessary due to insufficient information sources and learning material, provided by car manufacturers, which have not been shown in detail in the previous section. In principle technicians are disposed to help their colleagues. Thus, the results of the survey, partially presented in the previous section, have been considered in our concept for an extended question and answering systems for the support of experienced based learning in the automotive sector.

A. Conceptual Extensions to a common Q&A System

As described in the introduction, service technicians often need an answer to a question quite fast and also outside the garage, as shown in the survey. As the availability of devices differs for activities in the garage and outside the garage, there is a need of a solution available on fixed PCs but also on mobile devices, preferably on smartphones. Due to the urgency of many service orders, technicians can not wait until a colleague will coincidentally see an open

question sitting at a PC and answer them. In our concept, we take this into account by actively informing the community of colleagues about a new question. At the same time the survey has shown that the level of preparedness to help colleagues differs depending on the activity the technician is currently performing. There are colleagues who do not want to be disturbed during some activities. To respect this and to not overwhelm colleagues with a high amount of questions, our concept intends to inform not every colleague and only when performing an activity where the colleague is willing to accept a question. The simplest form of realization is, that users in a mobile Web application manually indicate whether they are available, interruptible or not. As it might be reasonably assumed that users forget to change the state quite often, we will integrate a mechanism to detect the technician's current activity based on sensor information.

Besides the activity-aware forwarding of questions the extensions to a common question and answering system are the use of different media types to illustrate a question and the automatic capturing of additional question related context information. The latter reduces the manual input and results in better retrievability of answers already given.

The survey shows the high benefit of images and videos as well as error codes to describe and understand the problem of a service technician. For example, it is more difficult to describe an unusual engine noise than to record it. Therefore our mobile application allows to take photos or record videos and to attach them to a question. The advantages of modern smartphones can be used by this. Further the survey confirms that the knowledge about the car's construction year, model range and type is helpful to understand a question. To not call for a manual information input we read out these data via Bluetooth from the on-board-diagnosis (OBD) system of the car and add them as question attributes.

B. Implementation

The described concept has been implemented based on Microsoft SharePoint as server. The overall system architecture is shown in Fig. 6. Each question is represented by its own thread in a SharePoint discussion board.
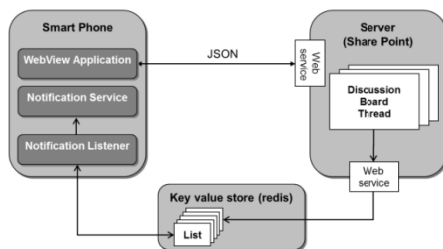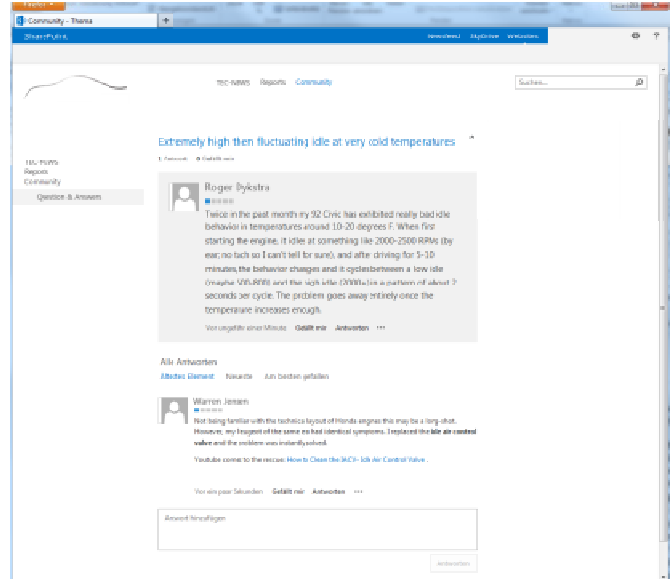

Figure 6.   System Architecture

Figure 7.   Browser Interface showing a Question and an Answer

In addition to asking questions and getting answers the application allows the garages to provide edited experience reports, describing how to operate in case of a specific problem. These reports and the existing questions and answers can be searched to reduce the number of forwarded and asked questions. The overall functions are shown in Fig. 7.

For the mobile use we implemented a mobile Web application. It uses the Android WebView component to render the mobile user interface developed in HTML5 and Java Script. Fig. 8 shows (a) the list of questions and (b) the entry of a question with multimedia objects and vehicle data attached.
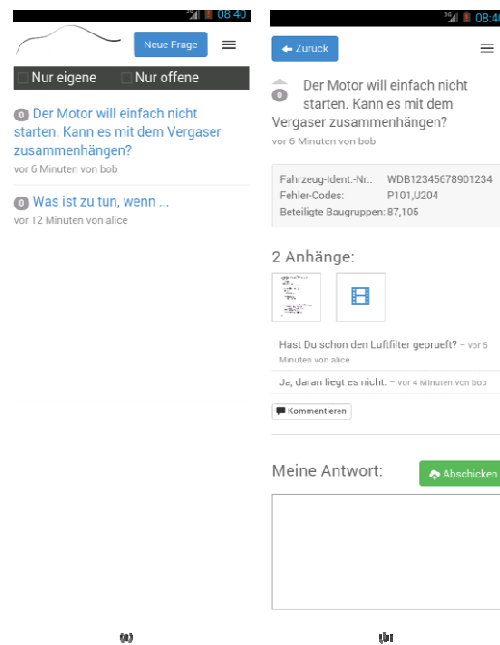

Figure 8.   Mobile Web Application Interface showing
(a) a Question and (b) the List of Questions

For the purpose of implementing the notification of the users we use redis [5], which is a networked key value store. In redis we distinguish three lists of strings for each user, storing information about new questions, answers and comments. If there is any change on the server-side entries, the corresponding question ID is added to everyone's list, who is related to the question. For example, if a user enters a new question, the server adds an entry in the question list of every user. After integration of the activity detection it will be added only to lists of users who are currently available. If there is a new answer to a question, the server adds an entry in the answer list of the questioner only.

We employ a background service on the Android phone to register to the users lists using a blocking read. By this the user is informed in the Android notification area about new relevant activities in the question and answering system. Once the list entry is read by the phone it is deleted from the list. This method ensures in contrast to a conventional publish/subscribe notification that notifications which are generated while the user's phone is not available (switched off or without Internet connectivity) are not lost.

V. CONCLUSION AND FUTURE WORK

In this paper, we have shown that a survey performed with representatives of our target group supports our basic assumption regarding the usefulness of a question and answering system for the workplace, and for situational knowledge acquisition processes. The survey gives us hints about the variety of preparedness to help colleagues during different activities and about the usefulness of different media to the formulation of questions and answers by the targeted users. These hints have been regarded in our concept and form a basis for our implementation. Currently we are working on the integration of the automatic sensor-based activity detection. We will perform a usability study to evaluate our mobile application and the Web-based solution, as well as a field study with a group of technicians from two different companies for the evaluation of the concept. Further on we currently work on a learner model, which models the expertise of the different users based on formally acquired competences, for example in trainings, and the competences which could be possibly deduced from the behavior in our system. This knowledge about the expertise of the users will be used to select the colleagues a question is forwarded to as additional criteria. As the acceptance to write down an answer to a colleague's question is relatively low we plan to allow the entering of a question as well as of an answer via voice and use an automatic transcription of the recorded audio.

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