HYBRID VALUE CREATION IN THE SPORTS INDUSTRY - THE CASE OF A MOBILE SPORTS COMPANION AS IT-SUPPORTED PRODUCT-SERVICE-BUNDLE

Leimeister, Jan Marco, Kassel University, Nora Platiel Str. 4, 34127 Kassel, Germany, leimeister@uni-kassel.de

Knebel, Uta, Technische Universität Muenchen, Boltzmannstr. 3, 85748 Garching, Germany, knebel@in.tum.de

Krcmar, Helmut, Technische Universität Muenchen, Boltzmannstr. 3, 85748 Garching, Germany, krcmar@in.tum.de

Abstract

Integrated product-service packages (hybrid products) can open new markets and target groups to companies. However, existing approaches to service or product development do not sufficiently address simultaneous development and domain-specific issues. A very promising new field for such bundles is the health and fitness industry. In this research, we designed and built an IT-supported training system for running (the Mobile Sports Companion, MSC) that closely interlocks a product and corresponding services using an iterative development process. We tested the pilot system with 14 recreational athletes.

The results of the field test show that the MSC proved to be a promising tool to offer athletes an effective individual, flexible and mobile training. However, the system, as it is, did not sufficiently represent the human trainer behind it, thus lowering its acceptance and the credibility of its recommendations. Our next step is to integrate features that could strengthen the athlete-trainer

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relationship. The MSC could turn out to be a promising field for future ebusiness applications in the sports service industry.

Keywords: Product-service bundle, service, training, iterative development, health, sport, fitness

1 INTRODUCTION

Services account for a large part of the value added in manufactured goods in developed countries (Sheehan 2006). Severe competition and cost pressures limit the growth of many companies across various industries, and, especially in the case of small and medium enterprises, threaten their existence. This has contributed to the expansion of the service economy over the last several decades. Integrated product-service packages (hybrid products) can enable innovative offerings and open new markets and target groups to companies (OECD 2006). However, companies mostly design services and products in separate processes, services being a mere add-on component to the product (Ernst 2005). This separation can also be observed in the research literature. Many widespread process models focus on product construction, as for example Sytems Engineering (Daenzer 1977), various VDI-guidelines (for example VDI 2223 (Verein Deutscher Ingenieure 2004)) or the Three-Tier-Model (Giapoulis 1996) or Software Engineering, as Unified Software Development Process (Jacobson et al. 1999) or eXtreme Programming (Beck 2000), to name only a few. Alongside this extensive literature about product development, there is also a distinct literature describing new approaches to service development (e.g. see (Hermann et al. 2005), (Scheer et al. 2004), (Bullinger et al. 2003)), but they both do not sufficiently address integrated, parallel development. Recent publications recognize this gap and present suggestions for integrated models, for example Spath et al. 2006. However, the concept remains rather abstract and general. In addition, it does not consider domain-specific issues. In this research, we try to fill part of this gap while focusing on an example product development in the health and fitness market in Germany, a newly emerging and very promising field for innovative solutions such as Computer Supported Collaborative Sports (Wulf et al. 2004).

Personal health and well-being gain more and more attention in today's industrial societies. In Germany, the sports / fitness / recreation market has a market volume of over 50 billion Euros. With an annual growth rate of 6% (Deloitte & Touche 2005), it is one of the booming markets in the health sector. The reasons for the rising attention are mainly twofold: For one thing, health awareness has increased throughout large parts of the population, being considered an important part of a modern lifestyle. Moreover, consequences of unhealthy personal lifestyles on the economy become more and more evident. Diseases as a consequence or complication of overweight and lack of physical activity, such as cardiovascular diseases, back problems and diabetes (Schwarzer 2004 summarizes the results of various studies showing the correlation between certain diseases and lack of exercise), account for approximately one fifth of the present health costs of German health insurances (Scriba et al. 2004), heavily burdening health insurances and employers. They amount to economic costs of about 530 million Euros per year in Germany (von Lengerke et al. 2005).

In spite of these developments, the market for fitness / health service providers such as gyms or equipment manufacturers in Germany has been steadily declining over the past 5 years (for a detailed market analysis see Kamberovic et al. 2005). Cost pressure and competition threaten especially small providers; many of them are put out of the market by emerging large franchise chains. To regain competitive advantage, especially above low cost operators, they need to offer innovative products and services going beyond the mere provision of sports equipment and occasional supervision that are common today.

Personal training, i.e. individual supervision and support of each athlete by a trainer, could be a way of addressing both of the above-mentioned problems. On the one hand, personal training is known to produce successful and effective results in competitive sports as well as in companies' management health coaching, and thus is also very likely to show effects in the mass market as well. On the other hand, personal training as a service could be a means of differentiation for small fitness providers. The major obstacle for translating the service of personal training into recreational sports and health management is cost. Health service providers cannot multiply their support services without an immense increase in personnel cost, whereas the clients, be it consumers or institutions on behalf of consumers, will not be willing and able to spend a considerably higher amount on health services. As in many other industries, the solution to this dilemma could be (partial) process automation.

The idea of automating sports training and health services is not new. Many vendors have already tried to implement IT-based training support integrated into a variety of devices such as heart rate monitors or mobile phones. The most important vendor on the German market is Polar, whose major products are running / biking computers. Apart from Polar, there are many small and very small vendors with different offerings (examples are PCSport.de, Technogym Wellness Wizard, iWorkout, PumpOne, etc.). However, virtually all existing systems fall far short of solving the above-mentioned issues of integrating service into design. Most vendors try to achieve a full automation of the sports training, concentrating their efforts on hard- and software development, while totally neglecting the design of a corresponding service. Therefore, most systems on the market

- Neglect necessary usage scenarios for efficient training. Most systems are designed bottom-up based on and limited to the characteristics of an existing device or software. To make the design fit for use, it should be derived top-down from usage scenarios, users' goals and requirements.

- Focus on single parameters. Existing systems base their training plans almost exclusively on heart rates. This is an appropriate method, when determined correctly but many systems operate on rules of thumb, neglecting important influencing factors such as physical well-being, stress, daily form, sometimes even age, sex, and sport discipline. Other effective methods for determining training intensities (for an overview, see (Neumann et al. 2002) are not applied.
- Require previous knowledge. Many systems offer possibilities for data analysis, but no guidance on how to interpret this data. Users who have little knowledge of training methods might not be in the position of adjusting the training to their needs. Especially in case of illness, professional advice is necessary.
- Depend on the users' discipline. Most existing systems are fully automated, no relationship between trainer and athlete is established. But especially inactive risk groups are not likely to motivate themselves for their training. To have a continued effect, the training must become part of the user's lifestyle and be supervised and supported by either a trainer or an institution

The objective of this research was to design, build and evaluate an IT-supported training system for running (the Mobile Sports Companion) that closely interlocks a product components and corresponding services. The development of both components was simultaneous; the result was an integrated product-service bundle, which was then evaluated in a field test.

2 DEVELOPING THE MOBILE SPORTS COMPANION

2.1 Research framework

This research is designed as an explorative study. As the research object „mobile information systems for fitness sport" is very new and not well-investigated, general theories about the research object do not yet exist. Stating and validating hypotheses purely deduced from theory as is common in empirical-analytical research designs are difficult to apply here. According to Ulrich, explorative research starts "...in practice, is focused on analyzing the context of use and ends in practice" (Ulrich 1981).

The intention of this research is to design an innovative system to improve real-world situations, following the tradition of the Action Research Method, which can be briefly described by its three main characteristics (Rapoport 1970), (Lau 1997):

- The researcher actively intervenes in a social organization to advance both the organization's well-being and scientific knowledge.
- The project consists of phases of interventions and of reflection for research purposes.
- The researcher has to live up to the ethical challenges of the intervention.

The effects of the mobile sports companion are therefore tested in a pilot study (field test). Such field tests can on the one hand test the feasibility and effects of an innovation in a natural environment, and on the other hand allow the identification of new demands that need to be addressed in further development. They have the advantage of high external reliability (Witte 1997). For the design of social innovations, such explorative methods are most fruitful (Szyperski 1971), (Schwabe et al. 2000b), as recent examples in Healthcare (Leimeister et al. 2005) and Government (Schwabe et al. 2000a) have shown.

2.2 Research Design and development process

Since system requirements were neither completely nor exactly defined, a linear model did not seem to fit the uncertainty that arose from the field. An iterative model seemed to be more appropriate for several reasons. It allows to build the system step by step, and to evaluate the outcome of each interval of the iterative development periodically. Moreover, the type of development can be shaped according to the demands of the situation. To achieve this, we took up Arnold et al’s Community Platform Engineering Process “CoPEP” (Arnold et al. 2003).

The heart of this process model is an iterative process, adapted from the generic spiral process model (Boehm 1989 and Wigand 1998). It is combined with a prototyping approach. Each iteration consists of four phases: planning, analysis, engineering and evaluation. Different than in the original spiral model a much stronger focus is put on the building of prototypes and the involvement of users in evaluations. The goal of the engineering phase of each iteration is the generation of a prototype (hardware, software and services) in order to get a tangible version of parts or the whole product (for a promising conceptualisation of service systems see e.g. Mora et al. 2009) very early in the development process (for a similar, but rather heavyweight approach to service design see e.g. Moller et al. 2008). Each prototype undergoes an evaluation at the end of its development cycle in cooperation with experts. After each evaluation phase, the next iteration starts over with planning again, but uses information that was learned from the previous iteration in the design.

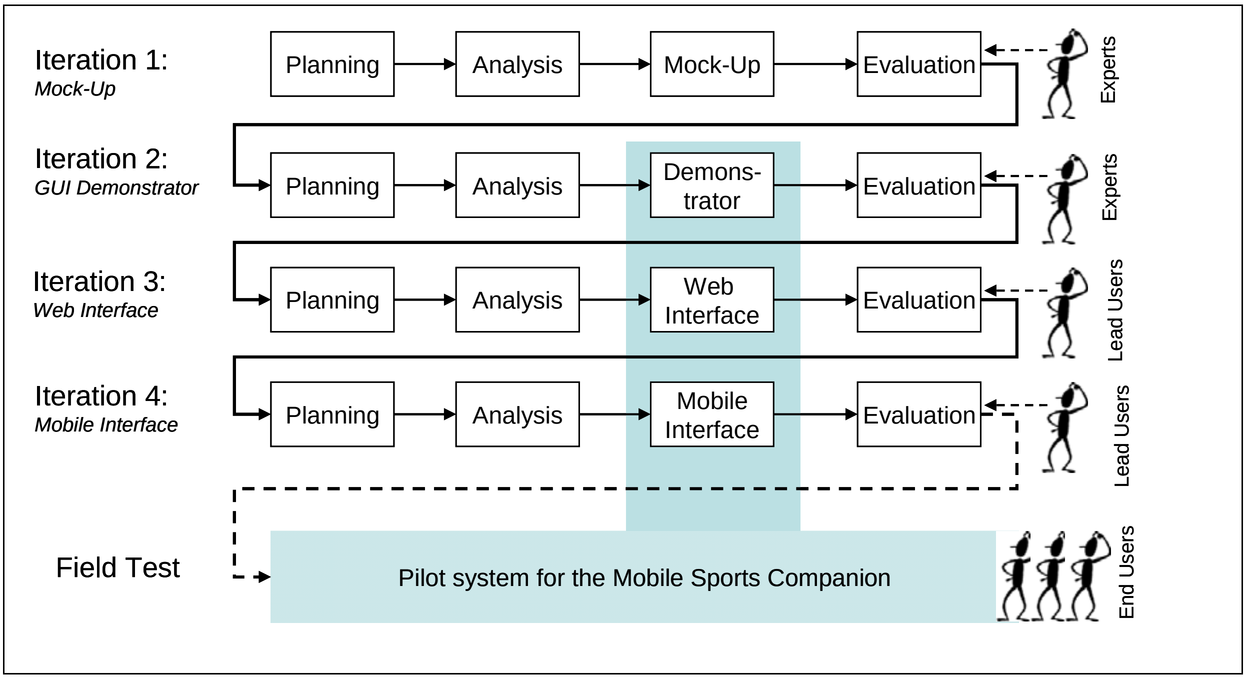

Figure 1: Development Process (Source: adapted from (Arnold et al. 2003))

We adapted CoPEP's iterations to our research topic, and decided to involve target users in the evaluations in addition to experts as their representatives. Figure 1 shows the adapted process model that was used for the development of the mobile sports companion. The method used for evaluation was a mixture of interviews and group discussions. We presented the results of each cycle to a group of experts (iteration 1 and 2) and to a group of users (iteration 3 and 4) during the development phase. User and expert feedback was integrated into the planning of the next iteration. Finally, the finished prototype was tested in a field study.

Through an early involvement of various stakeholders in the development cycle and the visualization of parts of the end product through prototyping, the described process counteracts the danger of dragging wrong requirements fixed in the beginning along to the end product. General requirements get more detailed as the development process goes on and mistakes created in the beginning of the process can be repaired.

2.3 Results of the iterations

2.3.1 Iterations 1 – 3: Mock-up to web interface

In the first iteration, we conducted in-depth interviews with a group of 4 experts. The experts represented 4 different scientific disciplines, including training theory, sports psychology, sports medicine and runners training. The basic idea was to define a service level for training supervision and support in between the high service level offered to professional athletes and the virtually non-existent service level offered in recreational sports; detailed enough to ensure an effective training, but as simple as possible. Through brainstorming and discussions, the experts specified the relevant measurement categories, interdependencies and interplays between them and developed a relatively simple model for training supervision and control. We then determined which data must be collected by professional trainers, which data should be collected and documented by the runners themselves, and which calculations the system was to make automatically. Limits and tolerance regions were determined. This model required the service to be made up of two components: first, a face-to-face support where trainer and athlete meet in person, and second, computer-mediated or fully automated support, where users interact with the system only. Based on this input, we developed a mock-up (i.e. a paper and pencil-prototype) of the mobile sports companion, which was approved by the experts.

In the second iteration, we implemented the runner's perspective in a first clickable prototype. The previously described experts checked if all relevant data was collected correctly, and tested the usability of the prototype. Their feedback was documented and implemented in the next iteration.

The third iteration produced a functional prototype, including a web interface for the runners and trainers, and a server backend. Apart from the experts, four lead users tested and evaluated the system by means of a structured questionnaire. The lead users generally felt that the quality of their training was improved, but complained about the missing flexibility and the long time needed for documentation, as they had to memorize their training parameters, then find internet access after the training, and then reproduce all data from memory or copy it manually from other devices. They wished for a mobile interface.

2.3.2 Iteration 4: Fully functional prototype with web and mobile interfaces

In the fourth iteration, a mobile interface for the runners was added to increase the athletes' independence and flexibility while training. This implied the development of new software to fit the mobile device, including an interface to receive data from heart rate monitor devices. Figure 2 shows the data flows in the system.

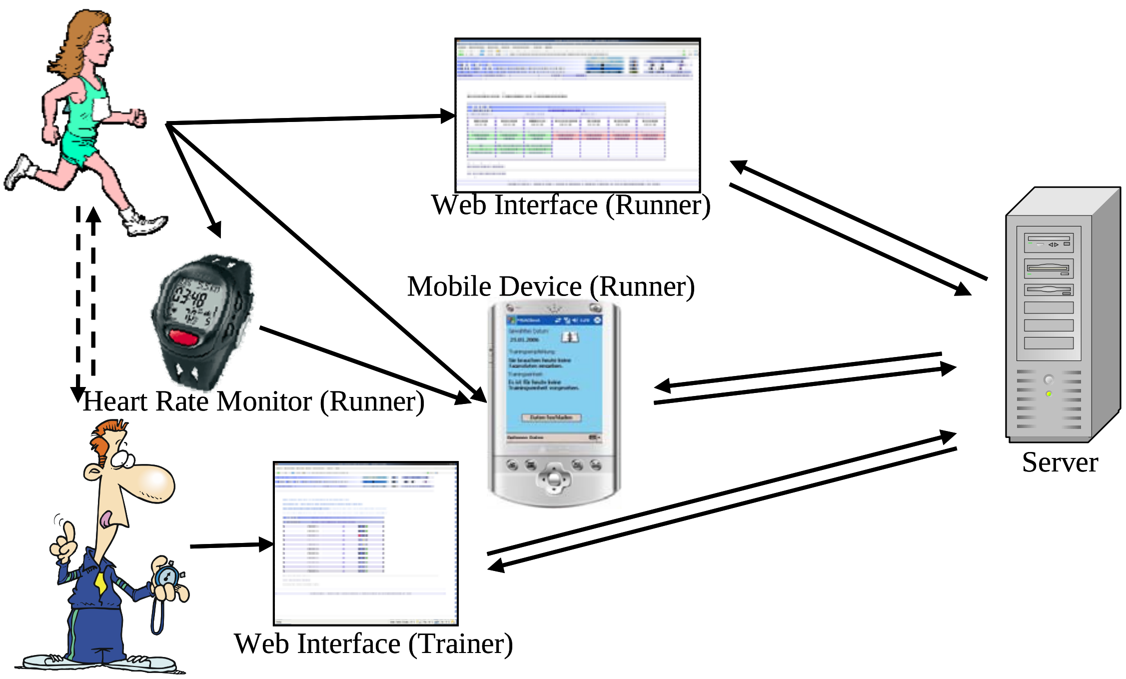

Figure 2: Data flows

At the beginning of a training period, trainer and runner meet personally. The trainer gathers basic information on the runner, such as height, weight, resting pulse rate, sport history, and conducts a standardized fitness test. Together, trainer and runner define the runner's training objectives. Using the trainer web interface, the trainer creates a personal electronic file for the runner. Based on the training objectives and considering the runner's physical condition, the system suggests value ranges for the number, length, frequency and intensity of training units the runner should complete to reach his objective in a predetermined period of time. Within this range, the trainer adjusts the plan.

The runner can interact with the system either by web interface or by mobile device. Every morning during the training period, he enters his resting pulse rate, and rates his subjective feeling of well-being on a scale from 1-10. The system answers with a recommendation to do the training unit as planned, or to modify it. After having completed the day's training unit, the runner feeds a number of performance indicators – either using the mobile device or the web interface – into the system, namely time and duration of the training, perceived well-being, and average heart rate. Heart rates can be transmitted directly from the heart rate monitor to the mobile device. Once uploaded, the system analyzes the data, compares planned and actual values, and assigns the result to the stages of a traffic light (green = ok, yellow = contact trainer, red = stop training, contact trainer urgently).

The trainer can access all data uploaded to the system by his runners, and so monitor and supervise their progress. The traffic light system allows him to screen the state of all runners quickly, and to focus on the more problematic cases (i.e. red light) first. This cycle repeats until the training objectives are realized or until the next control meeting. Independent from the system's recommendations, if necessary the athletes can contact their trainer at any time via a "contact trainer" button.

As in the previous iteration, four lead users evaluated the system. The mobile client was highly appreciated, as it enhanced the user's flexibility in documenting their training units. They also found the daily recommendations for their training very useful. Overall they felt that the quality of their training had improved. On the other hand, they felt a strong dependence from their trainer. As a consequence of these results, some more functions were added to the system in close cooperation with the before-mentioned experts.

To better supervise the runners' progress and by this increase the quality of the training, we increased the service level and introduced periodical test runs and corresponding analysing tools. In addition, a tool for weekly comparison of the planned and actual training units was implemented. The trainer was given more possibilities to adjust the system-generated training plans according to his own recommendations. With these alterations, the system was ready to be tested by a larger number of users.

3 FIELD TEST

3.1 Purpose

The purpose of the field test was to examine:

- If the mobile sports companion could support users in reaching their training goals (perceived usefulness)
- How users felt to train with an automated training system (Usage, perceived ease of use, perceived well-being)
- If the mix of face-to-face, computer-mediated and fully automated service components gave the impression of continuous individual support (perceived service level)
- How the system could be further adapted to the user's needs

It is important to state that the MSC was evaluated as a whole, it is not adequate for an integrated product-service bundle to try and evaluate the single components separately.

3.2 Setting

The field test was conducted with 14 employees of a telecommunication company, 9 male and 5 female, all between 25 and 40 years old. The participants represented the whole range from sports novices to experienced runners. Figure 1 shows their training habits and weight classification.

	Training Units / Week			**Total**
	0-1	**2-3**	**4-5**	
male	4	3	2	9
female	3	2	0	5
Total	7	5	2	**14**

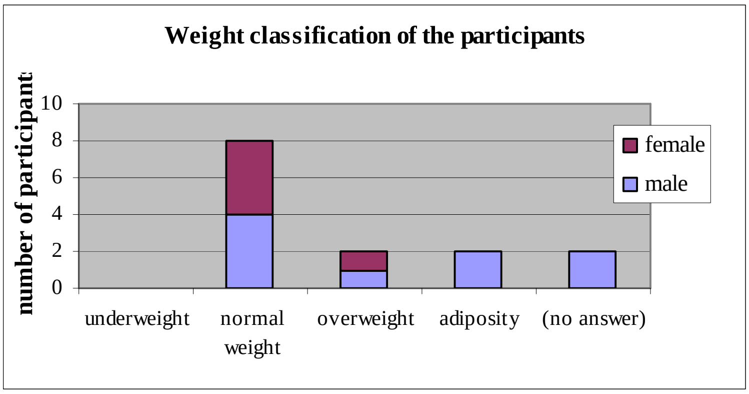

Figure 3: Characteristics of the participants of the field test

For the field test, the training period and goal was standardized for all participants: being able to run a half marathon (21 km) after 12 weeks of training, following an individual training plan managed through the mobile sports companion. The training period began with a thorough analysis of the participants' anthropometric data, such as height, weight, sports experience, past and present diseases, and medications. It also included a lactate threshold test, an individual performance test to assess the physiological condition of each of the runners, lactate being a key indicator for determining training intensity and evaluating training results in endurance sports. In addition, the participants assessed their perceived exertion on a Borg[1] scale. Based on the diagnostic data, the individual training plans were created.

We provided all participants with a mobile device (PDA) and a heart rate monitor. They were asked to document their resting pulse rate and perceived well-being everyday first thing in the morning. In reaction, the system recommended them either to train as planned, do not train and recreate, or to contact the trainer. The training units were divided into three categories with different training intensities (for details on the intensity levels, see (Neumann et al. 2002), setting a time and pulse rate.

After four, eight and twelve weeks, all runners made a test run at given constant speed over a given distance. The heart rate served as an indicator for endurance improvement. The participants repeated the Borg rating. At the end of the 12 weeks training period, the lactate threshold test was repeated.

To evaluate the subjective training success, perceived well-being and motivation, we used a structured questionnaire both at the beginning and at the end of the training period. Figure 4 illustrates the procedure.

[1] The Borg Rating of Perceived Exertion or Borg Scale is a method of determining the intensity of physical activity. Perceived intensity is rated on a scale from 6 (no exertion at all) to 20 (maximal exertion). A person who wants to engage in moderate-intensity activity would aim for a Borg Scale level of "somewhat hard" (12-14) (Borg 1998). The Borg Scale is widely used in clinical studies and in professional sports, it is considered an appropriate method for controlling physical activity intensity (Löllgen, 2004) .

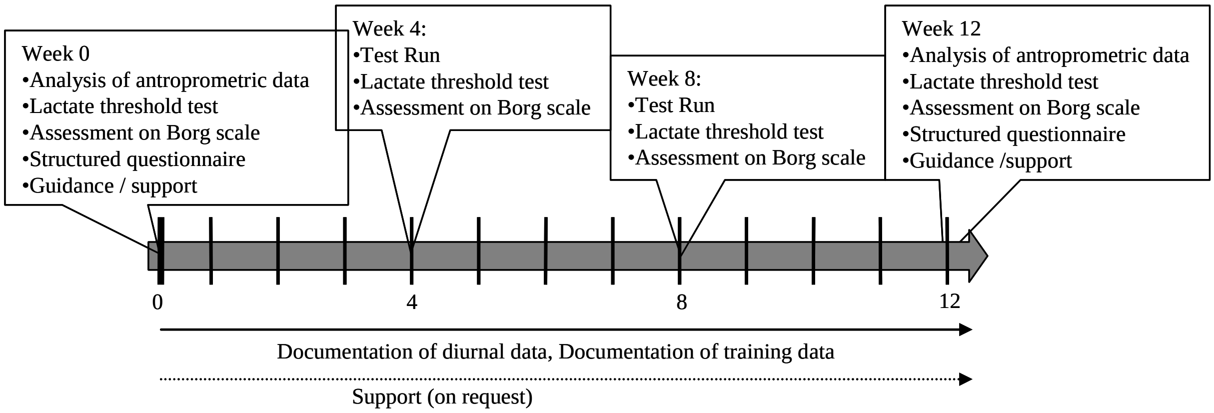

Figure 4: Field test procedure

3.3 Technology

The server was implemented as a J2EE web application based on the Struts framework. A MySQL database in the backend worked as a persistent data memory. A web service interface at the server using the Apache Axis framework enabled the communication between the mobile devices (the clients) and the server. The client software was written in C# and based on the .NET 2.0 Compact Framework. It runs on PDAs with Microsoft Windows Mobile 2003 or newer versions.

In the field test, the participants used mobile devices (PDAs) of the type O2 XDA II, XDA III and XDA mini S respectively. The interface for the communication with the heart rate monitor was optimized for Polar S625X, as it is one of the most widespread heart rate monitors in the German market. Integrating the Polar device into the system was most challenging, as the communication protocol was not laid open.

A role concept defined the rights to access and manipulate data; it comprised the three roles of trainer, runner, and administrator.

3.4 Empirical results

The first questionnaire was administered at the beginning of the field test. It was completed by all 14 participants. The second questionnaire was administered at the end of the testing period. It was only completed by 10 participants. Two of the participants had already left and another two participants were not able to keep the appointed date of the survey.

3.4.1 Usage and perceived ease of use

On average, the users tended to agree that by use of the MSC, they trained more regularly than before. However, they did not document their training data and even less their diurnal data very accurately. Most of them felt especially the measuring of the resting pulse rate in the mornings as too time-consuming and even annoying. Another reason could be the usability of the web and mobile interfaces. Though their usability is rated slightly positively, the users do not judge it good (Table 1). Some users reported repeated difficulties in loading up their data from the mobile device to the server.

Table 1: Usage and usability of the MSC

	mean	std. dev.
By use of the MSC, I trained more regularly than before.	0.4	1.9
I have documented my diurnal data regularly.	-0.7	1.7
I have documented my training data regularly.	-0.2	1.6
The web interface was easy to use.	0.5	0.8
The mobile interface was easy to use.	0.7	0.8

*Annotation: 5-point scale from “totally agree”=+2 to “do not agree at all”=-2

3.4.2 Perceived Usefulness

In respect to perceived usefulness, the respondents tended to assess the quality of their training and training supervision. Moreover, they clearly agree that using the MSC has advantages for them and consider technical devices in general as helpful for training (Table 2)

Table 2: Perceived ease of use

	mean	std. dev.
With the MSC I feel better supervised and supported*	0.7	1.2
By use of the MSC, the quality of my training was increased.*	0.4	1.6
Using the MSC has advantages for me.*	1.2	1.2
Technical devices during training are…**	0.8	0.9
*Annotation: 5-point scale from “totally agree”=+2 to “do not agree at all”=-2 ; **+2=very helpful to -2=not helpful at all		

The physiological data confirmed these perceptions. In the lactate threshold tests, the heart frequency measuring as well as the self-assessment according to the Borg scale, the participant’s performance had continously increased.

3.4.3 Perceived well-being

After 12 weeks of training, the participants had the impression that their fitness level had increased, though still being far from good. They also felt more energetic and satisfied with their bodies (Figure 5).

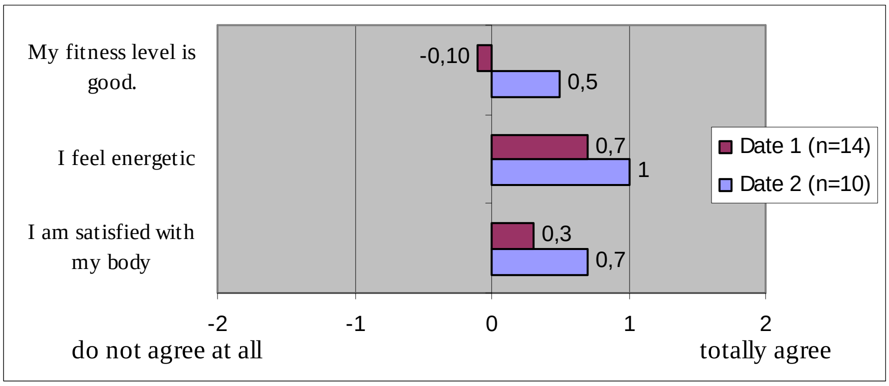

Figure 5: Perceived well-being

3.4.4 Perceived service level

It was the idea of the field test that the trainers stayed in the background as much as possible, leaving the sportive guidance to the MSC. Personal interference should only happen if an athletes training data was so unexpected that the trainer's traffic light set to "red". This however was not accepted well by the participants. Most of them repeatedly tried to contact the trainers instead of relying on them to communicate their recommendations via the MSC, if necessary at all. When the trainers gave no or very little additional information, some participants were extremely dissatisfied, and the research team had once again to explain the reasons for their approach. Nevertheless, in the final discussion the majority of the group wished for more personal advice.

4 SUMMARY AND OUTLOOK

We developed a concept and iteratively implemented a prototype of a semi-automatic training system. The starting point in each iteration was the athlete's requirements and the necessary service elements deduced from them. We field-tested the prototype with 14 volunteers with different sports experience. In general, the MSC proved to be a promising tool to offer athletes an individual, flexible and mobile training. In contrast to most automated training systems on the market, the MSC concept integrates personal services such as the initial health checkup or face-to-face meetings with a trainer. However, the system, as it is, did not do a good job of representing the human trainer behind it, thus lowering its acceptance and the credibility of its recommendations. As a consequence, the service component seemed insufficient to the test users.

Based on the experience gained in these studies, we have two major action points for further developing the MSC. First, to adapt the computer-mediated and automated service components to better resemble an individual support, and second, to reduce cost and effort of the face-to-face service components. The next steps for our research are:

- Develop motivational features: The voluntary participation of the field-test participants attests to a certain degree of intrinsic motivation for being physically active. However, training progress is a long-term process. Many people will not discipline themselves to follow the plan without strong extrinsic incentives. A combination of motivational features implemented in the software, e.g. game elements (Lin et al. 2006) and virtual group experience (Mueller et al. 2005, Li et al. 2008) would contribute to the perseverance in following the training plan. Incentives, for instance set by a company for their employees, could enforce this trend.
- Set individual goals: Running a half marathon in 12 weeks proved to be too high a goal for the greater part of the participants. Especially in the field of recreational or preventive sports, more general goals such as “loose weight” or “stay fit” should be addressed (Stevens et al. 2006).
- Extend and diversify methods of performance measuring and training plan design: The training plan design and control based on the lactate threshold proved to be very time-consuming and tiring for both athletes and trainers. Based on personal goals and proficiency level, other ways of testing and planning might be appropriate. Training

documentation could be enhanced by further data, such as GPS data, weather, amount of sleep etc..

- Establish trainer-athlete relationship: Seeing the trainer for control sessions and in case of unexpected events apparently was not enough to give athletes the impression of a good supervision, even if they knew he would check their training data on the server. We need to examine if this perceived deficiency can be reduced by altering the look and feel of the software, and at what time the trainer has to interfere personally. Based on the frequency of this interference and on the variations of data collection and performance tests mentioned above, a large variety of service levels could be developed. Business models and pricing are further questions in this area.
- Further field tests including control groups: A large-scale field test including control groups who train without the support of the MSC would allow a comparison of cost and effect.

We developed the MSC along an iterative process model, turning learnings from earlier stages into requirements for later stages. Service components were considered from the beginning. Experts and users were integrated in all phases of development. The process seemed appropriate to collect and react to user suggestions and requirements in all phases of the development. However, in the pilot test the MSC did not fully satisfy all participants. We therefore have to further explore and evaluate our method.

In this research, our pilot study was carried out in a German telecommunications company with a quite homogenous group concerning education and cultural background. For future work, we plan to explore the MSC in multi-cultural environments in Germany (as for example with staff of a manufacturing company) and in international contexts. The creation of business models and the design of value networks that could offer the MSC also hold great potential for further research.

5 LIMITATIONS OF THE STUDY

This research has certain limitations. First, the test group was rather small, the statistic calculations showed a considerable variance. Second, as the members of the test group participated voluntarily and out of interest in the study, their motivation and positive attitude towards the MSC is not necessarily representative. Third, there was no control group to compare the effect of the MSC-supported training to a conventional training. Finally, self-report measures as we applied among others, can always be biased by the participants' intended or unintended false answers.

We believe that the major advantage of MSC is that it allows supervision of and situational reactions to user behaviour, but at the same time, the computer-mediated delivery and supervisor support functions allow a fast and efficient supervision and administration. Therefore, practice will find the MSC and similar designs eligible and useful for large-scale corporate or public health programs, providing an alternative to conventional interventions requiring personal presence.

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