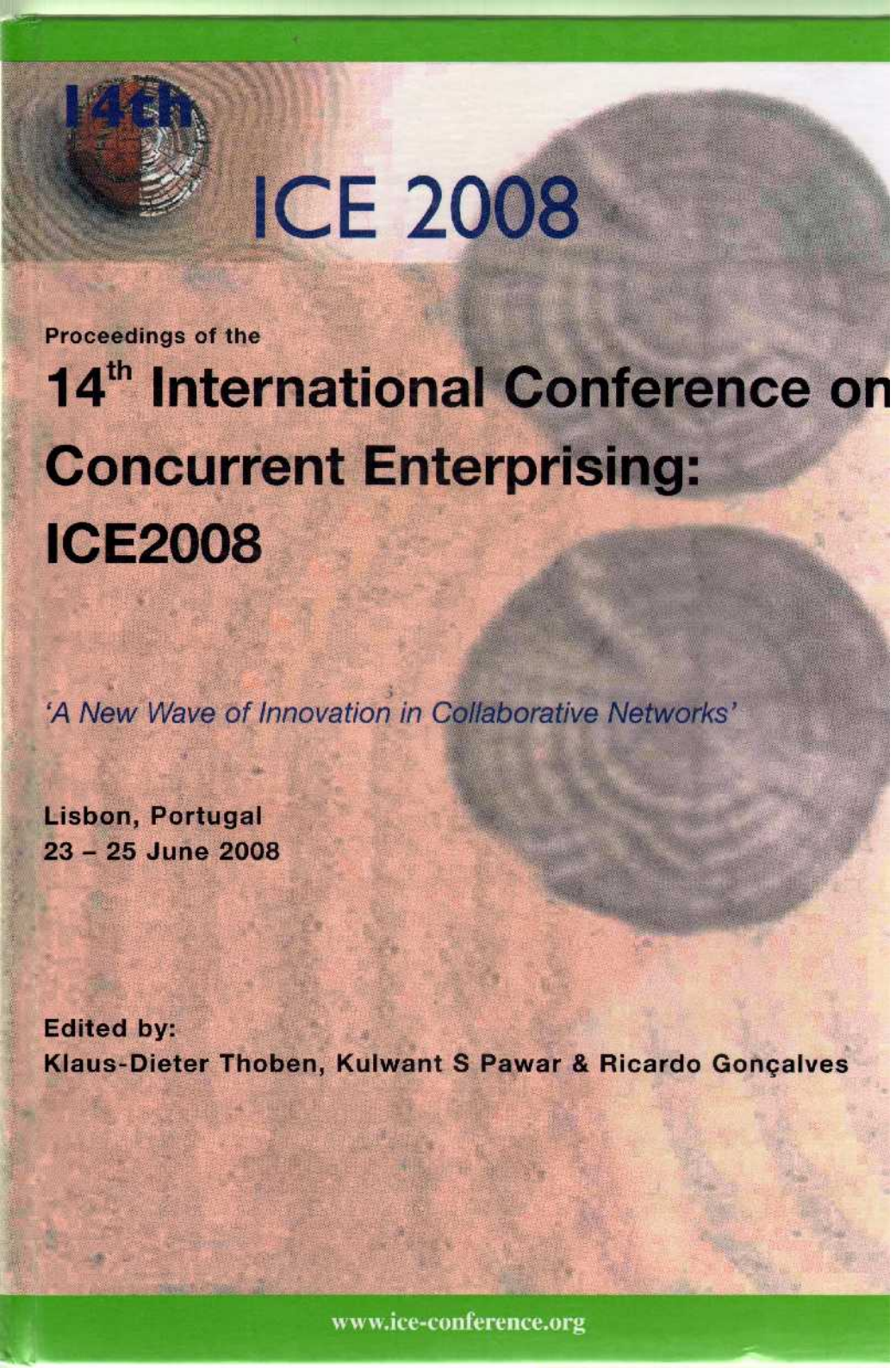

Exploiting Research Results in Practice

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Abstract

With the wearIT@work project the European Commission and 42 partners from 16 countries invested into a new technology empowering mobile workers. The first 42 months of this project are over and industrial demonstrators, evaluations and results and an exploitation strategy are available. Beside the four application domains of maintenance, production, healthcare and emergency response further domains like cultural heritage, a rural living lab for the prevention of environmental disasters and eInclusion are first extensions to new application domains. In this paper based on the results of the third development cycle of the project the general outline of the exploitation strategy is presented as a good practice example.

Keywords

Wearable computing, applications, exploitation of research results

1 Introduction

wearIT@work [1] was chosen by the European Commission as an Integrated Project to investigate "Wearable Computing" as a technology dealing with computer systems worn as unobtrusively as clothing. From 16 countries the project has 42 partners, among them EADS, HP, Microsoft, SAP, Siemens, Skoda, Thales and Zeiss. The consortium consists of end-user organisations with strong impact on the respective market like automotive and aeronautics. Furthermore strong partners are in the consortium to ensure that solutions found will benefit as far as standardisation is addressed. SMEs are in the consortium as consultants and application and system integrators as it is expected that based on solutions found new business for this kind of companies is created. With a project volume of 23.7 million € and a funding of 14.6 million € under contract no. 004216, *wearIT@work* is the largest project world-wide in wearable computing. In previous publications the background of the project [2], the research methodology [3] and earlier results [4, 5, 6, 7] were described. The project started June 2004 and has an overall duration of five years where the last 6 months are especially dedicated to exploitation.

The project follows a cyclic research approach in Living Labs as described in [6]. This ensures that solutions found are evaluated in a rapid manner. To ensure that the project results can be used beyond the project team a Business Model working group was established. To initiate the discussion the working group took a tutorial on business models [8]. In two Stakeholder Workshops with more than 100 participants each time the team gained experiences concerning the concrete implementation. The working group discussed with different partners on their marketing strategy to better understand restrictions coming e.g. from globally acting companies as well as SME.

2 Objectives

The objective of this paper is to explain for the innovative technology of wearable computing the exploitation strategy and technology implementation plan and the overall business model

and business models for the four pilots as well as the three take-up projects after the 3rd year of the project. All seven wearIT@work solutions are based on the Open Wearable Computing Platform (OWCP) and the Open Wearable Computing Framework (OWCF) as described in [6]. The basis of exploitation in wearIT@work are the specific value chain and simple, but we believe important, rules for implementing the wearIT@work corporate model for doing business. The adoption of those rules creates a learning cycle that let each single initiative take advantage of benefits coming from the partnership and, on the other hand, contributes to enhance the value of the organization.

3 Methodology

Components and technologies adopted in the different pilots are many and heterogeneous. A common business model among pilots due to the complexity behind the work done so far is impossible. However, creating business by combining and integrating components and services based on the software framework and the platform was already shown by the take-up projects which are very close to the market and represent test beds for many components and technologies of wearIT@work. Furthermore there is no need to deal too much with the IPR issues as take-up partners are full members of the project consortium. Thus we can focus on solving the technical problems enhanced and gain experience in know-how and technology transfer during the last phase of the project.

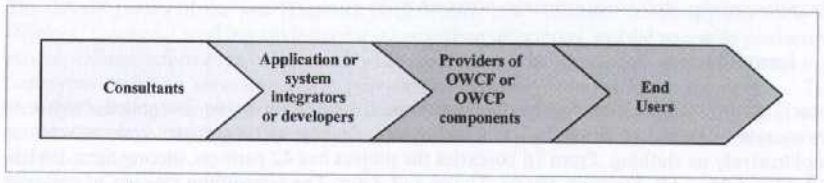

Figure 1 - Value chain of wearIT@work project

As the wearIT@work solutions are not yet final, such is the exploitation plan; here the actual approach: All 42 wearIT@work partners benefit from the findings of the project and, at the same time create value providing competence, services, methodologies and technologies. The partners are clustered to the four groups indicated in Fig. 1:

Consultants identify the potential benefit out of a wearable computing approach. They also cover all organizational aspects and derive a concrete wearable computing solution or at least a pilot for evaluation by end users. Consultants define the job for application developers and system integrators as far as these are not able to define it independently. In so far consultants prepare a market for application developers and systems integrators. They can also consult other consultants based on their wearIT@work experience and knowledge. Furthermore, they might also consult application developers and system integrators from outside the wearIT@work project or within their networks.

Application or systems integrators/developers can start based on a concrete specification given by a customer (end user) or as subcontractor of a consultant in case a turn-key solution is required. Application developers need based on the specific requirements the components of the software framework. Application developers or systems integrators involve the partners of the OWCF and/or OWCP.

Providers of OWCF/OWCP components create business by consulting their clients getting another access to the value chain. They involve application developers, systems integrators and other component providers based on our implementation rules (see next section). They deliver their competence in a project or product approach depending on their company's rules.

Providers can also consult application or system integrators/developers to use the OWCF/OWCP.

Finally **end-users** (our pilots) create business as they at the end or on top the value chain ask for improvements of their core business and address committed to our implementation rules the wearIT@work partners for the solution.

4 Business Rules

The goal of the rules as indicated in the following table is to create a common framework in which partners operate facilitating the creation of business.

No	Business rules
1	All partners are committed to invest marketing efforts in disseminating the results of wearIT@work.
2	Dissemination of results is focused on creating a business support group (BSG) which generates leads for training, consulting and solution providing services. This is a subgroup of the OWCG (www.owcg.org) – just dedicated to business development; the initial members are the consultants within the wearIT@work team. All partners can benefit from this important activity. Creation of a brand identity is aimed at.
3	All partners give other relevant partners "first right of refusal" when an opportunity emerges for proposing a service: The partners ask one another to join a business opportunity before one gives an application integration or system integration to another contractor not member of the wearIT@work business support group (BSG). This should stimulate cross-fertilization of technologies and reinforce collaboration among partners.
4	Generic lessons learnt from successes and failures of marketing and sales efforts as well as from training, consulting and solution providing projects are shared with the other partners for effective knowledge sharing. This is organized by the BSG avoiding repeated mistakes and strengthens success stories. This activity is managed by the OWCG which will stay beyond the wearIT@work project.
5	The consortium partners committed to stay in touch as a learning community and contribute to the OWCG website and to IFAWC (www.ifawc.org) as the two major marketing tools beyond the end of the project.
6	One partner volunteers and then be elected to lead the OWCG learning community beyond the end of the wearIT@work EU funded project. First right of refusal for this opportunity is given to the coordinator of the wearIT@work consortium.
7	Each partner pays a minimum annual membership fee determined before the end of the project to the wearIT@work learning community. Marketing efforts are made to attract new members to this community and to recruit sponsors for additional fund raising for more activities such as a newsletter, etc.
8	In the IFAWC annual meetings there is a business meeting serving as a management tool of the OWCG.

The developments of the project were all made public using the homepage of the project. There a Technology Repository was set up listing all hardware and software components and solutions developed so far together with an indication of the technology readiness at the beginning of the project and at its actual state. The above value chain of exploitation and the business rules might be applied when initiating a wearable computing project by any of the project partners.

5 Business Benefits

There are quite some examples of results ready for immediate exploitation. The *LINKVest* is a vest based on a design that was originally developed for the aircraft maintenance showcase (fig. 2). It integrates wearable technologies as a container and is an example of a product ready to be marketed. It was developed by the project partner Grado Zero Espace as shown in figure 3 for different application domains like production, logistics and service. It is a solution ready for any application where based on RFID tags context relevant information can be accessed using a wireless IT infrastructure.

Figure 2: Vest and interaction glove for aircraft maintenance

The evaluations with end-users in the aircraft maintenance domain with its demand on structured information and extensive documentation we found that 50% of the time workers spent to catch up print outs and document on paper tasks performed. However, this approach is not only applicable for the aircraft maintenance domain but also for other application areas like maintaining machines, trains, chemical or power plants as in all these domains paper based work can be replaced by wearable computing solutions. The figures might be different in other domains; however, there is an approach to increase productivity by replacing paper bound processes by wearable technology using process analysis as a basis for the return on investment calculation. The business benefit of the technology can thus been easily shown.

As a result the new generation of optimized collaborative man-machine interfaces (glove with WUI toolkit of the OWCF), with body near context detection will already be marketed at this stage of the project. Further hardware and a first version of the software framework are available. For this purpose we developed based on the maturity level definition of the US DoD[1] for all components and solutions the achieved maturity levels and published this in the

[1] TRL: Technology readiness levels (US Department of Defense) DOD Deskbook 5000.2-R

technology repository of the project homepage as mentioned above. This allows other parties to start a dialogue with the project partners for further development and exploitation.

By this public approach the project also addresses standardization issues and pushes developers of devices, components and systems to participate in the process.

Figure 3: *LINKVest* as a reconfigurable clothing device

6 Lessons Learnt

The basic idea to use an open and common ***software framework*** (OWCF) as middleware for the application development was the right approach, as the tools have significantly sped up the development and made the applications easily modifiable. Industrial partners in one pilot (healthcare) have even made the use of the Framework a condition to the integration of the application with their system.

Although the ***virtual reality simulation*** was only used on the emergency scenario we believe it to be a crucial instrument in the design and implementation.

Our evaluations have confirmed the significance of ***context*** for real life use of wearable systems however with variability of requirements. There are applications requiring detailed task tracking, others where the proximity between different protagonists is relevant or elaborate location and physiological sensing. Concerning indoor localisation we found that there is no unique approach so far and still research required. Some sort of ***speech input*** has been a common wish made by users in all pilots. However due to technical concerns and after some more detailed analysis it has not been implemented in all scenarios. Instead the tests so far have exposed the diversity of possible input modalities and the optimal modality has not yet been. ***Head mounted displays*** have met with acceptance in three pilots. However, conventional tablet PCs and stationary displays can nicely harmonize with wearable systems. There is still research required to further test what type of information presentation is optimal for which application. In particular the interplay between display complexity and context, as way of reducing the communication bandwidth between the system and the user, is still not sufficiently understood. The ***form factors*** of modern micro PCs such as the OQO are acceptable for most applications and their robustness and standard interfaces are preferred by the users to nice, yet more exotic devices such as the QBIC. More problematic are ***battery life*** and ***heat production***.

7 Conclusions

The most significant result of the wearIT@work project so far is the diversity of wearable applications that it has exposed. Across such different fields as healthcare, production, maintenance, and emergency response we have demonstrated not just plausible application scenarios but also user acceptance and technological feasibility. There's strong indication that wearable technology has the long-term potential to change the out-of-office workplace just as much as personal computers changed the office environment.

With the creation of the Open Wearable Computing Group (www.owcg.org) and organizing annually the International Forum on Applied wearable Computing (www.ifawc.org), a community building process in industry and science has been initiated that is planned to sustain long after the official end of the project in 2009. The value chain, the business support group and the business rules are designed to further strengthen the field but also give an idea how to bring new technology in a knowledge society in place by a learning cycle.

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