FAIRWIS: An Integrated System offering
Trade Fair Web-based Information Services – A R&D Case Study

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Abstract

Due to the effects of the Internet on global economy, organizers nowadays work, compete, and cooperate on a worldwide scale. They must be able to cope with the fast pace of worldwide competition by optimizing to-to-market and, especially, by being highly innovative in the products and the services they offer. Because of the dynamic nature of work processes, there is a need for new frameworks and integrated computational environments to model, develop and support business processes in all their steps.

In this paper, we will introduce a case study of an integrated system offering trade fair Web-based information services — the FAIRWIS system. Our scientific and software development approaches aim at offering on-line advanced Web-based computational environments offering a common platform for the activities of all the user groups involved in the trade fair business.

The underlying conceptual model integrates three basic different innovative aspects. Visual appearance: The deployment of an information visualization mechanism allows the generation of 2D and 3D representations to show retrieved data to the user in an appropriate and significant fashion. User centered approach: The employment of user models as a basis for user interface adaptation, in order to tailor information presented and functionality offered at the user interface to serve the user's needs best. Participatory design: The involvement of relevant users in charge of leading the business process definition of the organization they belong to into the development process as co-developers, not merely as consumers.

1. Introduction

Organizations nowadays work, compete, and cooperate on a worldwide scale, due to the effects of the Internet on global economy. They must be able to cope with the fast pace of worldwide competition by optimizing time-to-market and, especially, by being highly innovative in the products and the services they offer. Because of the dynamic nature of work processes, there is a need of new frameworks and innovative and integrated computational environments to model, develop, and support both B2B and B2C processes in all their steps, starting from the planning phase through initial contacts up to follow-up actions. In this paper we will concentrate on trade fairs.

In the last years, some Web-based information sites have been made available, giving information both on trade fair events and on companies participating at the events. Just like other companies trade fair organizers have developed "traditional" company Web sites. These sites are mainly used to promote their activities and their events agenda. Note that current information media, supporting trade fair events, are to a great extent paper-based (booklets, flyers, maps, etc.), but this situation is changing because Web sites are used as another important information media to promote such events. Even if there are now some specialized Web sites supporting trade fairs events, as reported in [1], they are not organized in a homogeneous or comprehensive way, and are usually provided in a rigid pre-designed in-house company style.

In this paper we introduce and describe FAIRWIS, an EU funded project that aims at offering on-line innovative services to support business processes of both real and virtual trade fairs. We describe the development process of the FAIRWIS system, as well as selected innovative features. The goal is to help the users (fair organizers, exhibitors, visitors) in the different phases of the decision-making processes they may undergo, in order to improve their own business.

Next section will show an analysis of the state-of-the-art of trade fair business processes and media, especially referring to the World Wide Web applications. Section 3 describes the approach adopted for the development of FAIRWIS, which clarifies the importance of a good visual

appearance, and outlines the effectiveness of a user-centered approach, together with a participatory design process.

Section 4 describes the conceptual model on which the system is based, while in section 5 the general architecture is depicted. In section 6 an exemplar session is introduced, and in section 7 conclusions are drawn, and future work is suggested.

2. State of the art

The State-of-the-Art analysis performed in the first half of the year 2000 shows, that fair services on the Web are either standard Web sites or portals. Portals are classified into Vertical and Horizontal Portals. A Vertical Portal is specialized in a single product sector and offers services gathering several fairs. A Horizontal Portal offers services on several different product sectors. For both Web sites and portals, only a few offer the possibility to virtually take part in an event. 2D or 3D graphics, Web Cams or other technologies can support the virtual participation.

The event virtually accessible over the Web can be either the virtual section of a real event, or it can just be a virtual event. It can also be the combination of several real events taking place as different real fairs, at different times.

The evaluation of the state of the art of Web-based trade fair information sites has been conducted by surveying a number of Web sites of exhibitions world wide. The main sources for this process have been specialized Web sites containing pointers to the reviewed exhibition sites.

The set of Web sites examined also includes the USA and other countries around the world. Interestingly, at the time the analysis has been carried out, no interesting Web sites were to be found within the USA, whilst those in Europe are among the richest with respect to both offered functionalities and attractiveness of user interface. The exhibition Web sites have been analyzed with respect to two factors: The variety of services offered, and the richness of user interface (possibly including 3D visualizations).

Most Web sites showed similar characteristics, not very interesting, a poor user interface, and provided few services. The most interesting sites have been selected for a more detailed analysis consisting of the following three phases:
1. Identification of the principal services offered by these sites.
2. Selection of services, among those identified at point 1, which support virtual events.
3. Identification of the user categories, which relate to the services identified at point 2.

The Web site analysis has identified the principal services offered by the sites (Table 1) as well as the categories of target users for each service (Table 2).

Table 1. Principal services offered by existing trade fair Web sites.

	Task description
T01	To obtain information on how to get to the fair (transportation, ticket costs, time schedule, etc.)
T02	To consult the calendar of the appointments and conventions
T03	To obtain detailed information on the exhibitors
T04	To obtain detailed information on the exhibited products
T05	To consult the map of the fair
T06	To have information on job offering in the fair
T07	To buy ticket on-line
T08	To buy fair catalogue on-line
T09	To obtain information on the receptive structures near the fair (possibly to make reservation)
T10	To consult the call for tender for service providers
T11	To consult the official news
T12	To contact the administrative secretariat
T13	To watch the fair through a web-camera
T14	To visit the fair in 3D vision
T15	To buy advertising banner in the fair Web site
T16	User registration for user profiling

Table 2. Distribution of service targets for the user categories within fair trade business.

	T01	T02	T03	T04	T05	T06	T07	T08	T09	T10	T11	T12	T13	T14	T15	T16
Organizer																X
Exhibitor	X				X							X		X	X	X
Professional Visitor	X	X	X	X	X		X	X	X			X		X		X
Generic Visitor	X	X			X		X	X	X				X	X		X
Service Provider	X									X		X			X	X

Press	X	X	X	X	X		X	X	X		X	X	X	X		X
Fair Worker	X					X			X			X				X

The study laid open several deficiencies within existing Web sites; Three key shortfalls are:

1. No fair offers all services that are indicated in Table 1. This implies no exhaustive integration of services.
2. No services specific for the fair organizer are provided in the fair Web sites currently available. This implies no dedicated support for the organizers business processes.
3. None of the added value services, such as provision of elaborated statistics about previous events, support for direct marketing and customer analysis, are supported on any fair Web site studied.

3. Overview and approach

In this paper, we will introduce a case study of an integrated system offering trade fair Web-based information services — the FAIRWIS system. The FAIRWIS system includes extensive support for the trading of intangible goods in the trade fair product and service business sectors. Our scientific and software development approaches aim at offering on-line advanced Web-based computational environments offering a common platform for the activities of all the user groups involved in the trade fair business, i.e. organizers, exhibitors, visitors, professionals, and also outside service providers, like e.g. stand production, catalogue publication, broadcasting, and press. Other systems have already been developed to support similar business processes including the trading of intangible goods in such a business application domain to some extent, but few efforts have been employed to integrate all of them.

The main FAIRWIS objective is not only to offer the services listed in Table 1 in the previous section as well as the shortfalls of other systems pointed out at the state of the art, but first of all to embed and combine these services within an integrated environment. To give further examples of new features offered by FAIRWIS, whilst little information regarding product categories is available in current fair Web sites, FAIRWIS features interactive catalogues; the system also not only checks whether a company is in the fair, as done in current sites, but also allows visitors to find the way to locate that company in a 2D or a 3D visualization.

In this way, FAIRWIS provides significant support for the various tasks of different types of users involved in fair events, and also improves the way they currently work, particularly for Small and Medium Enterprises (SME).

The conceptual model we have developed to support the trading of intangible goods like contacts, visibility, etc. in the trade fair application domain integrates three basic differential innovative aspects and corresponding research activities: Visual appearance, User-centered approach, and Participatory design.

3.1. Visual appearance

The deployment of information visualization (IVIS) mechanisms allows the generation of 2D and 3D representations to show retrieved data to the user in an appropriate and significant fashion. Examples are virtual stands, fair grounds and exhibitor's data.

The main advantage of presenting information visually comes from the capability of shifting load from the user's cognitive system to the perceptual system. Recent research has proved that a suitable visualization can reduce the time to get information, and to make sense out of it. Indeed, exploring large multi-attribute databases is greatly facilitated by presenting information visually.

In the process of perceiving information spaces, 3D display methods can be usefully adopted for managing large sets of objects because they take advantage of natural human skills for spatial perception, orientation and spatial memories [6].

Within the FAIRWIS system, the Graphical Engine is the module that performs the dynamic generation of databased 3D information visualizations. For this task, the engine has access to a repository set up to contain 3D-models for objects within the fair domain like the fairground, its halls, outer areas, stands, and parts of the structures. It is capable of recombining objects within the 3D-model repository on basis of the organizational, including non-graphical business data within the FAIRWIS system. By performing this operation, the Graphical Engine can visualize dynamically different aspects and parts of either physical or virtual fairs. The virtual environments resulting from this information visualization process are scaled with respect to

1. Objects included in the visualization and
2. Level of detail and richness in graphical appearance.

Organizational, non-graphical business data like exhibitor names will be incorporated into the constructed virtual scenery.

The underlying conceptual model is split up into three parts [9][11]. First, the information model provides the notion to structure the data to be presented to users. Second, the visualization model offers a notation to

describe potential visual representations. Third, the information visualization function maps the information model onto the visualization model, to provide proper visualizations of data. Compared to hard-wired information visualization systems, where data structure and appearance are joined inextricably, this design permits flexible configuration for authoring as well as adapting to new requirements.

Due to this most generic approach, the use of 3D graphical visualizations is not limited to a single task within the information system. Moreover, from the point of view of the Graphical Engine, there is no difference whether the organizational data on which the visualization is based actually refers to a physical fair event or not. For the business process aspect, this permits a smooth migration and integration between real and virtual instances of the same trade fair, in which real events and face-to-face interaction are not eliminated but supported and finally integrated in a timeless and spaceless business process, in which the real events will represent concrete milestones in continuously running virtual fairs.

3.1.1. Navigation support. During the preparation, as well as during the fair event, users highly depend on a proper map of the exhibition in order to orient themselves. Nowadays these maps come printed on paper and mostly show the immobile layout of the fair venue and the functions of its entities like, e.g., parking places, entries or bistros. Other maps visualize the arrangement of thematic areas on the location. Only a few maps display the location of single exhibitors in the halls and on the outer areas. However, even the latter type lacks of supporting the user in finding the elements he's interested in: due to its static character it cannot adjust to the user.
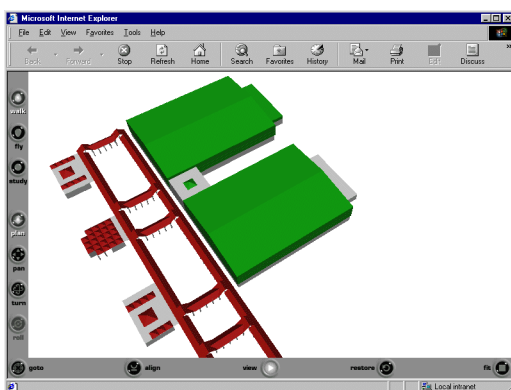
Figure 1. Navigating the 3D representation of fair ground with two halls.

Within FAIRWIS, the 3D Graphical Engine will, in combination with the exhibitor catalogue, provide not merely for a better map of the fair venue but for significant representation of the exhibition in the fair. This functionality supports real fair events, showing the user, in a well-directed way, where specific items are found in the fair venue and how they are organized in the overall context.

In this way, the system presents an abstract presentation of the fair venue true to the original. The model's level of detail is kept low. The system is able to highlight fair venue elements, e.g. halls, or stands, or important regions. In combination with the exhibitor catalogue, these highlighted element sets can be the result of the user browsing the indexed catalogues or performing a search on the database. Additionally, application data, e.g. exhibitor company names or logos, can be incorporated into the visualization.

The worlds built up by the Graphical Engine are hierarchically structured. For the fair domain these are the levels (i) fair ground, (ii) hall or outer area, (iii) stand, and (iv) product. When exploring the visualization, the user is always situated at one of these hierarchy levels. Only the elements of the current and the next lower level are displayed, e.g. the fair ground and all its halls, as shown in Figure 1. Clicking on a hall, the user moves into a specific branch one level deeper in the hierarchy, the visualization is updated and the user can now inspect that part. For updating the scene, the Graphical Engine either manipulates the current scene or switches to another scene. Users can also maneuver up in the hierarchy again. Clicking on a stand lets the users enter the virtual stand of an exhibitor, if such 3D model exists. For exploring the virtual world, the user is in "fly" mode [10]. Navigation is supported by predefined viewpoints.

3.1.2. Virtual experience support. Not always a 3D computer model of real exhibition stands can be provided. And even if, such data is available not before two weeks before the fair actually takes place. For complex interaction within the virtual world, these models would lack functionality anyway. Moreover, real stands have to comply with real world constraints like gravity and shortness of place. In order to present fairs as 3D visualizations, it is not necessary to stick to the real fair design, no exact copies of real stands are needed. Instead, they have to be tailored to the characteristics of virtual space and the user capabilities, exploiting the features of 3D scenes to easily accommodate standard as well as multimedia content. Exhibitor stands may contain individually designed, entertaining, interactive elements not to be found in the physical fair.

Virtual fairs can be built up on the basis of real fair data. But in contrast, also exhibitors that cannot effort being physically present can be naturally integrated into the virtual fair representation, side-by-side with exhibitors

participating at the real fair event. For virtual fairs, the Graphical Engine will be able to automatically arrange such stands according to their characteristics and not the manually predefined position, thus structuring the virtual world in a logical way, enabling the user to easily navigate. For example, the system could build up a world showing only the stands of exhibitors that are part of the user's search result, grouping them by their country. This could result in five spherical halls, each one responsible for one country and exactly the size necessary to host the number of exhibitors of that country. Due to the experience characteristic, users explore this virtual world in "walk"-mode [10]. Though, appropriate real world constraints that contribute to helping the user to navigate the virtual world — like being unable to pass solid walls — can be applied.

3.2. User centered approach

Potential users have been involved from the very beginning of the planning stage, and identifying user requirements becomes a crucial phase. The user requirements analysis was performed in the first half of the year 2000 and covered the countries United Kingdom, Italy and Spain.

3.2.1. Actors in the trade fair business. From the analysis, the following types of users emerged as the most relevant for a trade fair information system.

- **Venue Owner/Manager** The venue owner and/or manager is the organization or individual who owns the hall, exhibition center, etc. He sells venue space to the organizer in combination with a number of specific services.
- **Organizer** The organizer is the organization or individual responsible for the event organization.
- **Exhibitor**
- **Contractor/Service Provider** The contractor or service provider is the organization or individual, who renders a specific service by order of the venue owner, the organizer, or the exhibitor. This user type includes audio-visual equipment providers, catering services, electricians, etc.
- **Visitor/Delegate**
- **Fair Worker** The fair worker is an individual who works at the fair, usually when running a fair. This user type includes hostesses, language translators, florists, etc.
- **Press and Media**
- **Sponsor**

The analysis suggested that the key users and beneficiaries for the system would be the event organizers (principally), the exhibitors, the service providers/ contractors and the event visitors/delegates themselves.

Trade fairs are an integral communication space, which allows simultaneously commercial promotion, advertising, face-to-face contacts, selling actions, public relations and market research — the production and trading of intangible goods. The complete fair business process can be divided into three phases: before the exhibition, during the exhibition and after the exhibition. The key areas of change, in which a system like FAIRWIS can contribute to enhancing the trade fair business process, can be outlined as follows.

Preparing the fair, the *organizer* needs to analyze fair opportunities, identifying competitors as well as target users. Promotion of the fair is essential. Web-based information systems enable well-targeted advertisement to both exhibitors and visitors. From the organizer's point of view, contracting is a key issue. Web-based communication-support for planning and contracting among the partners in fair business can reduce time, cost and also strengthens customer relationship. In a well-integrated system, the fair results assessment, normally done after the event took place, can be performed right on basis of the electronic data that was operative for running the fair, also during the fair already.

Exhibitors need to analyze the fair market, too, in order to identify fair opportunities matching their market segment. Preparing their fair participation, exhibitors can profit from a system like FAIRWIS by planning and contracting stand and services on-line, including additional services like hotel accommodation and travel. SMEs that cannot effort presence at the physical fair can exhibit in the virtual fair pendant, smoothly integrated in the overall event. Electronic lead sheets allow immediate assessment of fair results in the follow-up.

Professional visitors need to gather information on exhibitor company profiles. Being both users of a system like FAIRWIS, the communication space "fair" is extended with respect to the time dimension, i.e. first contacts can be established much earlier and in the follow-up phase additional data can be collected from the system.

As outlined above, the single user's information needs as well as his functionality needs depend on his role within the fair business. To accommodate this, the FAIRWIS system differentiates between user types and adapts data presentation and action options accordingly.

3.3. Participatory design

Using a user-centered approach in the design and specification as well as in the implementation of FAIRWIS, potential users have been involved from the very beginning. This means, that already in the planning stage

an iterative cycle of development from the user requirement analysis, through design and specification to the implementation and prototype through repeated analysis and design cycles, has been performed to meet user needs. During this, several considerations have led towards the design (and the prototyping) of powerful domain oriented design environments, the so-called FAIRWIS authoring tools within the overall FAIRWIS system.

The predominant activity in designing complex system like FAIRWIS consists in the fact that users as well participants teach and instruct each other [15]. For example, domain experts understand the practice, and system designers know the technology. Furthermore, also within domain experts' communities, the stakeholders belong to different cultures; they use different norms, symbols, and representations of the information. Thus, also the knowledge relevant to a problem, to be formalized during the user requirements analysis, is often distributed and controversial: this "asymmetry of knowledge" can be a limiting factor, and can force errors in designing the system, despite the accurateness of the user requirements analysis. Because of that, software systems are unlikely to be completely designed at design time before of their use, but software systems have to be capable of evolution for two mainly reasons:

• Users at use time can discover mismatches between their needs and the support that the system provides, although this possibility is dramatically reduced by performing user-centered design.

• Designing a system deals also to create a shared understanding between all stakeholders; once the users find themselves working using the same system and exploiting this shared understanding, this can lead to new insights, new ideas, and new artifacts.

Figure 2. FAIRWIS authoring tools.

The challenge is to implement systems supporting a kind of "participatory design" in which all stakeholders should be designers and co-developers, not just consumers; that is, the systems to be implemented have to be designed from a "meta-design" perspective [14] and the final implementation should result in a so called "Domain Oriented Design Environment (DODE)".

For the development of the FAIRWIS prototype, examples for the "meta-design" approach have been instantiated by means of a special set of FAIRWIS authoring tools called "Managers" (Figure 2). In consequence, the power of the current FAIRWIS system design is that it is neither a simple Web site (relatively static), nor a Web application (already more dynamic). A Web application is certainly a dynamic system capable of changing the state of the business as a result of user interaction. Yet, FAIRWIS is designed to be even more; it is designed to be a "DODE for Advanced Trade Fair Information and Communication Systems". Organizers can use the authoring part of the FAIRWIS system framework to design the behavior of the Web applications they need to support their business process, and to change the design itself as their business processes and communication changes.

Entering the FAIRWIS system via the Web the organizer can use the authoring tools (the "production and administration area" of FAIRWIS system) for producing the Web based application front end to interface their own customer, thus affecting the resulting Web application with their essential contributions.

For instance, considering the first FAIRWIS prototype, as final user representative in the consortium, Foundation Semana Verde de Galicia (FSVG) is using the "production and administration area" of the FAIRWIS system to both design the appearance of the Web front end, and design the behavior of the MITE 2001 FAIRWIS Web application (Figure 3) hosted by FAIRWIS as they need it to support their business process; and, of course, they can change such a design as their business changes or they develop new idea of business process.
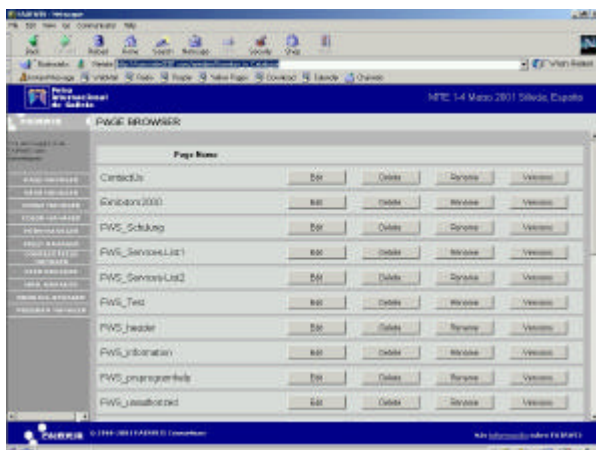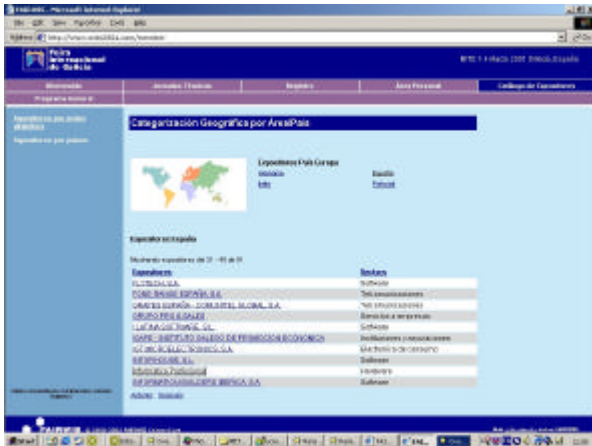
Figure 3. FAIRWIS Web application.

However, the FAIRWIS authoring and manager tools not only implement administrational interface modules that enable the organizer to manage and maintain business data and the way it is presented to the user, but they extend them significantly by allowing organizers to design the implementation of typical use cases, such as identification and registration, and the implementation of administrational interfaces for maintaining operational application data.

Therefore, the FAIRWIS system design implements an open system allowing users to modify the information contents as well as the system functionalities by means of providing opportunities for its extension and modification that are appropriate for people who need to make changes during the use of the system. However, this does not mean that the users have to construct the system from scratch. The system has an initial core functionality that facilitates the construction of incremental changes.

Eventually, designers and users may enhance the system by incorporating further functionalities created during the system's evolution into the core of subsequent versions of the FAIRWIS system.

At current state of implementation, the set of authoring tools available comprise: Page Manager, Image Manager, Color Manager, Menu Manager, Form Manager, Booking Manager and Complex Field Manager, User Manager and Mail Manager, and Program Manager.

4. Analysis and conceptual model

The model defined has been applied to a well-defined trade fair scenario, which led to the development of an advanced system. An iterative and evolutionary software development process has been carried out, starting from a large user requirement analysis up to the definition of the system architecture, and has been articulated in the following steps: a) in the user requirement analysis a set of business use cases has been identified and mapped against a set of system functionalities within design modules, which are the building components of the system architecture; b) the set of business use cases has been the input for the analysis and design phase, and have been translated into system use cases.

The FAIRWIS system has being designed as an open system provided with an integrated design environment. Specifically, trade fair organizers can use such a design environment to design and manage the trade fair information and communication system on their own. This feature greatly speeds up their business process.
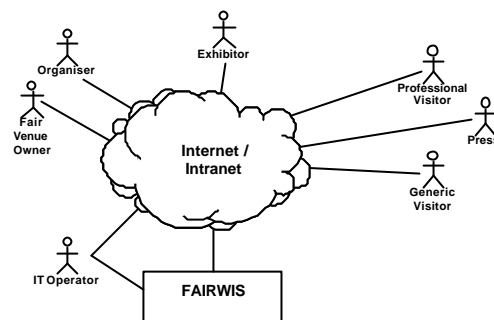
Figure 4. Topography of deployed FAIRWIS server and clients.

The concept of a "Domain Oriented Design and Authoring Environment" (DODE) has been introduced and applied to the FAIRWIS system development process. This means that a basic set of system functionalities enhanced by a set of powerful authoring tools has already been implemented as the core of the system. This allows for an easy and flexible extension of the system's functionality without the need for any further expert programming effort after the end of setting up and integrating the complete system.

4.1. Users relationship concept

The FAIRWIS information system is understood as a common platform on which the heterogeneous group of actors involved in trade fair business meets and interacts. The platform itself is meant to be of independent character as a catalyst in fair business. Any user constellation regarding organizers, fair venue owners, exhibitors, press, professional visitors, and visitors in general is welcome on this platform and empowered in their business. Therefore, FAIRWIS by design is not bound to any of these actors. Instead, FAIRWIS will be deployed and run by the IT operator, a new actor within the domain of fair business (Figure 4).

All actors access the FAIRWIS system by means of Internet based technologies (TCP/IP, HTTP, etc.) and interact through FAIRWIS graphical user interfaces (GUI), which are not necessarily direct manipulative. As an exception from this rule, the IT operator additionally is granted direct access to FAIRWIS underlying enabling technology like Web-servers, Database servers and operating system. This task of system administration can be performed remotely (using FTP, TELNET, etc.) and does require direct hardware access in loco in rare cases only. As pointed out before, a user can cover more than one role. Most likely, organizer and IT operator, or fair venue owner and IT operator, respectively, will be the same user.

4.2. Back office systems relationship concept

Due to time and resources limitations, the FAIRWIS prototype will not be able to cover the whole set of ascertained functional requirements at once. The business process covered by FAIRWIS prototype will be coherent. However, FAIRWIS prototype system functionality will lack completeness. Since back office system functionality is vital for organizers none will agree on replacing existing productive systems all at once. For this reason, the consortium decided to deploy FAIRWIS in co-existence with pre-existing organizer's back office systems. These systems will synchronize using data import/export interfaces. The organizer will stick with his traditional back office system for functionality not handled by the FAIRWIS prototype. This approach enables fast deployment and minimizes organizer's risk in committing on FAIRWIS. Since FAIRWIS is thought of an independent platform, import/export capability is not restricted to a single organizer.

Aiming, in the long run, at replacing today's back office systems employed by the organizers FAIRWIS itself is in need of storage capabilities for the organizational business data. Moreover, addressing the Internet community as a working information system immediate data access is essential. Data inaccessibility arisen from organizer's possibly weak Internet connection cannot be accepted. Finally, FAIRWIS will operate data like user profiles or 3D graphics currently not handled by organizer's systems. Consequently, FAIRWIS deploys its own local database (Figure 5). Resulting data redundancy will be met by synchronization mechanisms .
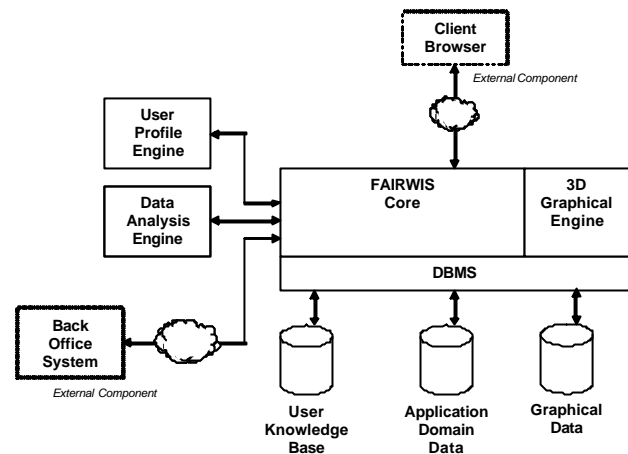
5. System architecture

Figure 6. FAIRWIS overall software architecture.

The architecture (Figure 6) consists of six main building blocks. **FAIRWIS Core** manages the communication with the user's **Client Browser** and provides most modules that implement the system functionality as well it provides basic services like session management, user knowledge database, and application domain database. The **3D Graphical Engine** is tightly coupled to FAIRWIS Core, managing its own database for graphical data. **User Profile Engine** and **Data Analysis Engine** add functionality needed for FAIRWIS adaptive user interface capabilities and marketing tools. The **Back Office System** is considered an external building block of the FAIRWIS system. All users access the FAIRWIS information system by means of standard Web browsers supporting HTML, VRML, Java VM and JavaScript.

6. An exemplar session

Evaluating the system design against the user requirements is essential within software development. For this purpose, the user centered design approach proposes prototype production and test, also at early stages of the development. Following the user centered design approach, the FAIRWIS system has been implemented and tested in a first pilot site.

6.1. MITE 2001 pilot trial site

The "Mercado de la Información y las Tele-comunicaciones" (MITE 2001) is the information and telecommunications market fair that took place during March 1-4, 2001, on the International Fair of Galicia venue in Galicia, Spain. This event related to the IT industry was particularly suitable to test the FAIRWIS prototype as MITE aims at demonstrating the advantages of the use of

communication and information technology to SMEs and professionals.

6.2. System modules

The prototype implementation included a coherent set of functionalities, well structured in six modules:

Identification and Registration. Users interact with the system mainly for two motivations: a) to collect data, and b) to provide data. The single user's information needs as well as his functionality needs depend on his role within the fair business. To accommodate this, the FAIRWIS system differentiates between user types and adapts data presentation and action options accordingly. During the human/computer-system interaction users pass through different stages. In the first stage, users are anonymous. By identifying themselves to the system, formerly anonymous users become individual actors. Within the identification procedure, the user specifies the user group he belongs to. From this point on, the information system can offer personalized services to the user, i.e. identified users have at their command a password-protected personal area that summarizes all individual transactions and planning states. Having performed the registration, users become a contractual partner.

Booking of Stands & Services. Users can request the booking of services on-line. Whereas stand services are reserved for exhibitors exclusively, a wide range of general services, e.g. hotel accommodation or travel, is offered to other types of users as well. For the planning of stands and services, a new Web-based business process is foreseen. Within a planning period, the exhibitor can enter and modify stand specification and booking information. During all this time, both the exhibitor and the organizer can access and refine the preliminary planning stored in the FAIRWIS system, enabling the organizer to consult the exhibitor in his planning activity. The on-line planning data is permanently up-to-date. Furthermore, this process is supported by automatic input validation. As the planning is finished, or at least far advanced, the exhibitor requests for contracting the booking information.

On-line Publication, Navigation and Search. During all phases of the fair business process, FAIRWIS displays fair information and all relevant information related to the exhibition, in on-line catalogues. To do this, relevant organizational business data is stored in the FAIRWIS database. Exhibitor catalogue and event catalogue form the essential part of the on-line publication, navigation and search. Four main navigation paths lead through the exhibitor catalogue: exhibitor by name in alphabetical order, exhibitor by category, exhibitor by product category and exhibitor by geographical area and country. Over and above these flexible browsing approaches, a search engine will provide retrieval capabilities aside the classified hierarchies for browsing. Both interaction paradigms, browsing and searching, will be supported by the Graphical Engine.

Meeting Scheduler. The meeting scheduler is a personalized service for identified users. It allows for arranging face-to-face meetings among attendees of the fair, i.e. between exhibitors and professional visitors. The FAIRWIS system manages an individual meeting agenda for each user.

Internal Messaging System. The people involved in a specific fair event constitute a community that shares common interests. Basically, fairs aim at establishing contacts among members of this community. Whereas the catalogues serve to identify potential business partners, the internal messaging system serves for communication between them. Since the FAIRWIS system also comprises the fair's business data, messages within the system can be generated on the basis of or referencing to such data. Additional functionality empowers the organizer to set up mailing lists on the basis of querying the user profile database.

Marketing. The aim of the FAIRWIS marketing module is to manage and improve interactive relationships between fair visitors and the fair organizer as well as between the fair organizer and exhibitor companies. The marketing functionalities enable the management, in a personalized way, of all relevant relationships among fair users through the Internet channel. The personalization features, exploiting user profiles, allow configuring, target and tailoring in a one-to-one way marketing campaigns, information delivery and site information.

Arrival Recording. For the assessment of the fair, the exhibitor depends on well-founded data on the fair attendees. The arrival recording aims at pinpointing the known visitors that actually enter the fair ground.

Respecting the results of the user requirement analysis and targeting at the first pilot site, the model has initially been developed to support real trade fair events, emphasizing functionality needed in the first place in a real exhibition information system. However, to a great extent this functionality can also be applied to run a virtual exhibition information system. The originally introduced distinction between a virtual trade fair information system and a real trade fair information systems turned out to be more or less artificial and has been dropped. Most of the functionalities are shared between both applications. They do not differ from a technical point of view and it is only a matter of the application designer's decision, whether the implemented solution supports a real, a virtual, or both types of fair events in parallel.

6.3. User reaction

During MITE 2001, selected exhibitors and professional visitors were invited for individual interviews on the FAIRWIS system. The interviews were based on a system walkthrough with qualitative evaluation.

All interview partners emphasized their need for concise information, before, during, and after the fair event. Especially information availability at the earliest point of time and permanent update in order to prepare the fair attendance was valued most. Having a common environment, in which information and communication come together, was appreciated. Both groups called the internal messaging system one of the most useful features.

Also of great value for both user groups is the exhibitor catalogue. Exhibitors cherish it surviving the real fair event, opening the door wide for longer promotion. A virtual fair related to a real fair was considered a very interesting and inventive way of promoting companies exhibiting at the fair. The exhibitor catalogue structure provides targeted addressing and links in the catalogue directing interested users to the exhibitor's home page speed up the information gathering process and facilitate establishing contacts. The personalized program feature supports professional visitors in planning their fair attendance during the preparation phase.

All exhibitors were positive about the on-line booking of stands and services, they considered this electronic service as easier compared to the traditional process.

6.4. Usability evaluation

Usability is a fundamental quality factor of any interactive system. Usability experts applying the well-known usability evaluation technique called heuristic inspection have evaluated successive versions of the prototype. Heuristic evaluation [12][13] prescribes having a small set of experts inspecting the system, evaluating it against a list of usability principles — the heuristics. The usability criteria adopted comprise ease of access, orientation mechanisms, efficient search facilities, and efficient organization for multi-step indexes. Usability evaluation findings led to redesigns in the software development process. Minor concerns were changed within short period of time.

7. Conclusions and future work

From the scientific point of view the work performed in the above outlined R&D project has paved the ground for an integrated model, which supports the efficient evolutionary design and development of Web-based application solutions for sustaining business processes related to the trading of intangible goods. We described how an integrated multi-domain model is producing an advanced Web-based computational environment, offering a common platform for the activities of all the user groups involved in the trade fair business.

From the software development point of view the work carried out so far represents a starting point for an integrated framework of components, providing a highly participatory design and development environment for implementing such systems in an evolutionary way at a significantly lower cost on the one hand and with much higher support for business process reengineering and integration of domain knowledge in the form of business intelligence, i.e., competitive advantage on the other hand.

The application examples demonstrate that the adopted model, from a business process standpoint, permits a smooth migration and integration between real and virtual instances of the same trade fair, in which real events and face-to-face interaction are not eliminated but supported and finally integrated in a timeless and spaceless business process, in which the real events will represent concrete milestones in continuously running virtual fairs.

8. Acknowledgement

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