

## WEB BASED VIRTUAL REALITY

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### ABSTRACT

*During the development of products and processes and for the sales of products and services, Virtual Reality (VR) in combination with Internet offers unique possibilities to improve the dialogue between different stakeholders. What is needed to let anyone - without geographical limitations - test a VR application is that the VR file first is transformed to distribution format. The next step is to import the transformed VR file to a Content Management System that has a VR-module. When the web application of the compressed VR application is arranged to suite the lay-out and style of the web pages of the company it can be released on the public web site of the company so that the visitors on the web pages can use the VR application on any internet connected computer. If that home page also has a chat function the company can get fast, good and free of charge information on how e.g. the potential users and/or customers judge the solutions. Thus the use of expensive traditional information collection and analysing methods - as QFD - could to a large extent be removed when the new possibilities with publishing the VR application on a home page are cultivated.*

### KEYWORDS

VR, Virtual Reality, Web, Internet.

### 1. INTRODUCTION

Virtual Reality (VR) is a tool which, today, is mainly used by experts in the performance of mechanical engineering and industrial design. VR has especially found its use in the automotive industry. An illustrative example of the use of VR in the automotive industry was the development of a new rack, which is a steel pallet to carry sheet steel parts, windows, engines, etc from their production plant into the assembly line of the automobile maker. The rack project, which took place 1998, was manned and managed by consultant company Prosolvias Research & Technology AB (from 1999 Frontec Research & Technology AB) for Weibulls AB. Weibulls AB wanted to be a rack supplier to Volvo and the objective was to develop a “superior” rack that could be

presented not as a prototype but as a VR application to the managers of Volvo. The reason for using VR was to save time and money, compared to building a prototype, and to impress the Volvo managers with the new technology. Prosolvias got the order as it used the principles of Dynamic Product Development (e.g. Ottosson 1996, Ottosson 2004, Axeborn et al. 2004) meaning reduced development time and customer involvement. The project leader at Prosolvias was the author Holmdahl.

When the development team had reached the situation that a CAD model existed of the rack, it was transformed to VR-files and loaded onto the computer controlling the cave at Prosolvias. At that point 8-10 production engineers and purchasers from Volvo were invited to the cave. Wearing shutter glasses they moved around the VR-model. One purchaser was told to look inside one of the pillars. Doing so he could see what it looked like on the inside, then he was told to bend down and watch from below and was impressed by actually seeing what the rack looked like from that angle. The purchaser was now asked to step into the rack, and tread air in an attempt to step up onto the rack, so complete was the illusion at that instant. A moment later the purchaser said that this was enough information for him to make a purchase decision.

Lately BMW has made public a new project building, which seems to have much the same VR equipment that Prosolvias had. Thus BMW's project building has two VR-studios with power walls and a cave (Shamanesh-Banks 2005).

Besides being used for illustrative purposes in automotive design VR is also useful for making simulations, for the study of user behaviour, to train personal skills (Ottosson 2002, Emerson et al. 2005), and other activities as e.g. reducing burning pain of patients through the VR program SnowWorld ([www.snowworld.com](http://www.snowworld.com)). It is also possible to use existing VR applications to improve the dialogue between different stakeholders during the development of the products and production processes as well as for the marketing and sales of products and services. Stakeholders are e.g. users, customers, product developers, marketers, service people, etc.

In this paper we will focus on what is needed for the use of already existing VR files as web applications with the aim of spreading the use of VR applications to a wider group of people than engineers and designers. A natural way to reach more stakeholders is by taking advantage of the Internet and the development of so called Content Management Systems for the administration of web pages with VR applications.

## **2. INVESTIGATION**

The information collected for this paper is observations and dialogues with development people at Tervix AB in Sweden, and to some extent with people from former Prosolvias AB now working in e.g. EON Reality AB and Opticore AB, as well as own tests and change suggestions of the different editions of the web module that August - October 2004 was developed by Mr Markus Axelsson at Tervix AB. Thus the research has been Insider Action Research in the two positions as observers and team members (e.g. Björk 2003).

## **3. BACKGROUND**

Mr Lars Persson at Tervix AB had worked for Prosolvias AB in Gothenburg, which developed software for VR. In May 2004 he occasionally met with Mr Dan Lejerskär, who was the president of Prosolvias AB before it was split into different companies in

1999. When the meeting took place Mr Lejerskär acted as adviser to one of the companies from former Prosolvia AB called EON Reality ([www.eonreality.com](http://www.eonreality.com)). EON produces VR software for large companies within different industrial branches.

During the short meeting between Mr Persson and Mr Lejerskär the idea arose that companies, having invested in VR applications for their product development, should also use the applications as web applications. As Tervix AB had developed a content management system a VR module could be created to make it easy for the customers of EON to make web applications.

Mr Lejerskär was positive to the development idea of such a module as it could extend the commercial possibilities with the EON software. However, he did not want to order such a work without an order from one of EON's customers.

To test the idea without having an order Tervix AB asked for a simple VR-application from EON and got one to work on.

#### **4. CONTENT MANAGEMENT SYSTEMS**

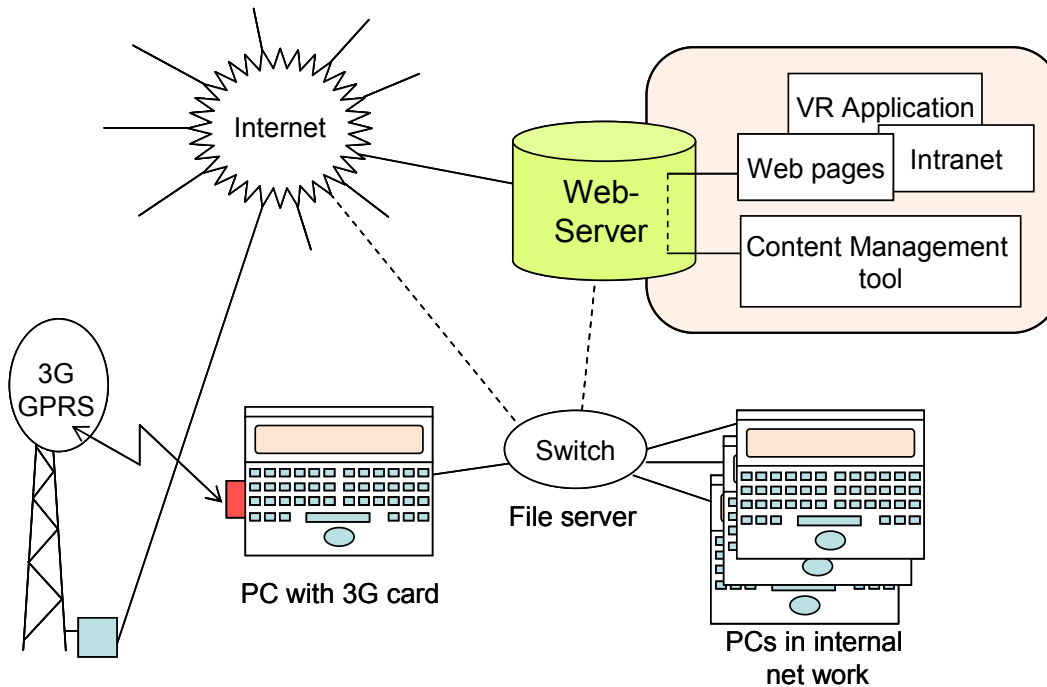
For the handling of the content on web pages, content management systems (often abbreviated as CMS) have been developed by different companies over the last few years. The situation of having expensive content management systems for large organisations has, since 2002, drastically changed to having well functioning content management systems that cost only a fraction of the prices paid in 2002.

Content management systems are developed for the users to work with the web pages without them having programming knowledge (e.g. HTML programming). With the new systems it is easy to work on the web pages e.g. to change text, add new text, pictures, videos, banners, calendars, forms, etc.

Technically, a content management system is placed on a web server in parallel with the public web page. Thus, the content management system is computer independent as long as an Internet connection exists to the PC/Lap top in use. With 3G connections the user today is rather independent of geographical location to make changes of the web pages with the help of the content management system used.

To note is that the home page/start page can be the gate for other web based systems such as an Intranet. For only internal use this means that the office is moved to the web so that one has access to different information and can produce and share information over any Internet connected computer as long as one has log-in codes.

Figure 2 shows, in principle, how different pieces are connected to each other when web based solutions are used for information and communication. When someone authorised wants to change the content of a web page named e.g. [www.page.com](http://www.page.com), he/she opens the content management tool that has the address [www.page.com/webadmin](http://www.page.com/webadmin). Now he/she can work on the web pages in the content management system and look at it only on his/her computer. When he/she is satisfied he/she can store the changes on the web server meaning that the edited web pages are then public. Thus, the content management tool is stored on its own address on the chosen web server on which the public web pages are also stored.



**Fig. 2:** The web system offers the possibility to work from any computer sharing information

## 5. Combining VR and Content Management Systems

With the rapid development of the Information and Communication Technology (ICT) first Internet and then the World Wide Web (www) have been widely used, which means a new possibility to use VR over the web. A few of the benefits from combining VR and the web are given here.

When a new product concept is developed combining VR and the web different ideas can be tested and judged faster using web technology than would otherwise be the case. The problem of getting important people assembled frequently and with short notice in the early important and creative stages of concept development can be minimised using web applications and e-meetings (Holmdahl et al 2005). When and if market and QFD investigations are needed (e.g. Guinta & Praizler 1993, Kim 1997-98, Moscowitz & Kim 1997, Shillito 1994) they can, through the use of the web, be done faster and cheaper when VR and the web are combined.

On a detailed level of product and process development the combination of VR and the web can be used to keep the whole development team and the steering board as well as management of the company well informed about the progress. This is possible if development projects use the daily-build methodology. During the workday CAD-models are manipulated and stored away. At the end of the day these models are put together into that day's build, thereby forming a representation of the project status at that time. By annotations (test results, etc) (e.g. Boujut 2003) and colour coding parts, it is possible to show stages of readiness of parts and systems. By making this digital mock-up available through VR over the web, it is possible for management to follow and guide a project's development regardless of geographical position and in a true gate-less fashion.

Virtually they can log in on the intranet through the web page to see the new virtual product as they did in former days by walking through the room where the models/mock ups were built. The static decision systems – as stage-gate-systems – developed for the traditional way of development in large companies can, with high speed information and communication systems, be complemented with and partly exchanged for dynamic systems as Dynamic Product Development – DPD (e.g. Ottosson 2004). VR presentations over the web that are updated when changes have been done on the products means that input can be fed back e.g. from the management soon after the publishing of the new editions of the VR presentation. A situation more adapted and flexible for decision-making can thus be achieved even for larger companies through the use of VR as a web application.

Situations adapted and flexible for decision-making is what makes development efficient in micro and small enterprises and, to some extent, for medium sized enterprises. The lack of situation-adapted and flexible decision making in large companies manifested by stage-gate systems (e.g. Cooper 2002) means inefficient product development. A recent comparison investigation showed that Time to Market for a new web idea management portal was 1/3 for the DPD case compared to the Stage-gate case (Ottosson 2004-b). Another investigation (Elfving 2004) showed that small Swedish companies worked close to the DPD principles. An important reason and advantage for using dynamic principles is that management is close to the product developers and, particularly in small companies, they can see and feel the development on an everyday basis, which is extremely important early in the development process when as much as 75 % of the total costs for the development is fixed (e.g. Breing & Flemming 1993, Vajna & Burchardt 1998). VR applications made available over the web should create closer contact between the management and the product developers.

VR also provides us with a greater range of opportunities when presenting information. Whilst one is normally limited to diagrams and different colours allowing for simultaneous presentation of one or two variables, VR by its 3D capability and the possibility to include motion (lines and surfaces can blink, vibrate, change colour, etc) strongly increases the possibility to present and understand economical and other data (Rase 2002). By the use of a HMD (Head Mounted Displays) it is possible to literally walk among the data.

As the production of new products becomes more and more separated from product development and when cheaper production possibilities are made available in e.g. the former Soviet states and Asia, communication becomes a problem. By using VR-applications over the web the understanding gap can be reduced as well as the transfer cost from one production situation to another. The new technology with IP-telephony (IP=Internet Protocol) and e-meetings increase the possibilities with web based VR.

VR as a communication tool can also be valuable in the marketing and selling of standard products and turn-key-products (e.g. Thierauf 1995). E.g. customers can virtually test different colours, features and modules for a product before purchase. If a distributor has access to web-based VR in his show room he can e.g. have only one or a few specimen of the product instead of having many for the customers to make their choices, as, for example:

A motorcycle dealer in an area of few people and far away from a large city can, in general, not afford to buy many motorcycles for show to potential customers. With a VR-application downloaded in his computer he can buy only one standard motorcycle,

which the potential customers can ride to get the right feeling of the vehicle. Then he can let the customer try different colours and different equipment on the VR-application. In so doing the customer should find it easy to order a motorcycle with the desired colour and equipment.

Far better than downloading a VR application on one computer via e.g CDs, would be if the producer – or marketer – of the motorcycles were to provide web based VR applications. In so doing, the producer/marketer can easily make changes as often as he wants. The customer can in his home or anywhere where there is an Internet connection use the web VR application.

VR as a tool for simulation has shown to be of special interest for complicated and/or expensive systems when engineers have to take lots of information / many signals into consideration (Ottoosson 2002). If e.g. a new layout of a factory and or a production line is to be implemented, the material flow can easily be visualised for different alternatives. With web-based VR, many people can give their input and test different possible solutions in a way that, for economic reasons and due to time constraints, would not be possible without VR. Bottlenecks in production can easily be simulated and the viewer can study in detail any part of the production line. The use of Internet makes it possible to communicate with people around the simulations independent of their location.

A bonus effect of the use of web-based VR is that it makes it possible to increase the trust of a company (Hallberg 2002) – to build the “Trust mark” of the company or organisation (Webber 2000, Lagergren 2003). In a time when we have a surplus of information and products, building up the Trust mark becomes more and more important. [Note that Trust mark is a much wider term then Brand or Trade Mark.]

#### **4. THE TEST SET UP**

The simple VR-application EON Reality supplied was a T-shirt application that could be turned around and which could be changed in different ways by the test persons. For Tervix to work on the file EON converted it to an “.edz” file, which is their distribution format of the VR files used “typically at the end of the project phase, when the 3D simulation has been debugged and tested out thoroughly” ([www.eonreality.com/products/EON4\\_0\\_Features.htm](http://www.eonreality.com/products/EON4_0_Features.htm)). That file was sent over the Internet to Tervix.

Having got the file Tervix created a suitable lay-out with suitable commands in JavaScript, buttons and colours. When that had been done the application was placed as an object on a web page, which was edited with the content management system Tervix WebPublisher 3.0. Thus the VR module developed could be treated in much the same way as a picture archive or a video archive but with its own commands. A screen dump of the web page is seen in figure 3.



**Fig. 3:** A screen dump of the web page with the VR application

The prototype of the VR module was evaluated by different people at EON and general opinion was very positive. However, so far (February 2005) EON has not received any orders which is why no commercial VR application has been developed by Tervix. Another reason is that EON's customers are engineers and designers in large companies e.g. within the automotive industry and they have very little interest in spreading the work they have done outside their profession. EON in turn has enough to do to sell their VR products to the engineers and designers which is why no priority is given to the sale of additional products to other market segments. Also larger companies have their own content management systems and rules/organisations for web publishing that are difficult to change.

## 5. CONCLUSIONS

Recently it was stated that: "Virtual Reality is perceived to provide the most complete understanding of the future product, but it is also the least used product representation."

(Engelbrektsson & Söderman 2004). In the same paper it was also found that “methods for analysing customer information (e.g. Quality Function Deployment) are among the least used methods”. One reason for that is maybe that “there is a limit in reflecting all customers’ needs into a design by only optimizing geometrical dimensions” (Yuang et al 2003).

The test reported here, although very simple, showed that by combining a content management system and a VR file transformed as a compressed VR file, the VR application can be used as an ordinary web application. This in turn means that more people can be involved e.g. in the decision-making process of a new product design, a new production line, or simply the purchase of a product. If the possibilities to chat over the web page are used a fast market investigation at virtually no costs can be done instead of the heavy to use and costly method of Quality Function Deployment and other methods for collecting and analysing customer opinions about a product.

The step from having engineers and designers as the only users of a VR application to letting anyone, without geographical restraints use it opens up new dimensions in decision taking not only in industry but also in society as a whole, where web based VR, for example in urban planning could help deepen democratic decision-making. What is needed for that step is to simply develop and add a VR-module to an ordinary content management system.

The sequence from having an ordinary VR file to the publishing of it on a web page is:

1. Compress the VR file
2. Import the VR file to a CM system with a web module
3. Publish the VR file on a web page

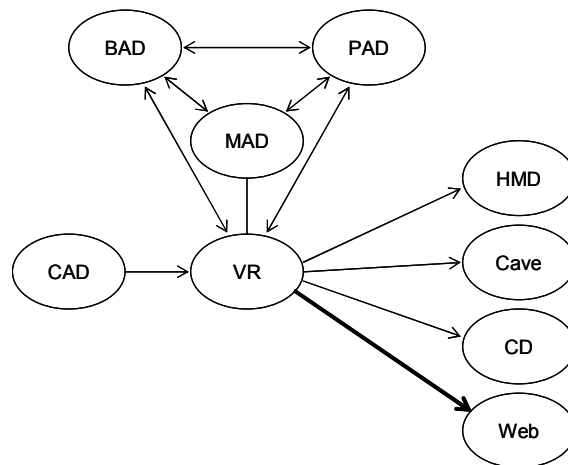
Seen from a commercial perspective it was a mistake by Tervix to invest time and money in making the VR web module, as EON’s customers are large companies that already have content management systems. Seen from a research perspective it was an interesting project as it showed a new possibility that can be of commercial interest in the future especially when VR will be used also in micro and small companies.

Based on investigations of the term VR in the academic journals, books and commercial material from companies selling VR programs in combination with their own work in the field of VR, the following definition of VR has been proposed (Ottosson 1998 & 2002):

"VR means that an individual encounters ‘synthesised’ experiences created by computers and performed in such a way that the experiences to some degree are experienced as real experiences by the user. The individual will through uncontrolled and controlled reactions in real time influence the computer generated VR."

Both papers had as focus the product development process and the relations between VR and other tools and methods to bring forward new products. Input for a VR presentation according to the papers is BAD (Brain Aided Design), PAD (Pencil Aided Design), MAD (Model Aided Design) and CAD (Computer Aided Design) (Ottosson 1998-b). The presentation of the VR can be done with HDM (Head Mounted Displays), Cave, CD and Web as well as combinations of them. With the development of the Information and Communication Technology (ICT) since the papers were written figure 3 in paper (Ottosson 2002) today should have been drawn as figure 1 shows.





**Fig. 1:** Input for a VR presentation is BAD (Brain Aided Design), PAD (Pencil Aided Design), MAD (Model Aided Design) and CAD (Computer Aided Design) (Ottosson 1998-b). The user of the VR files can use different presentation forms as HDM (Head Mounted Displays), Cave, CD and Web as well as combinations of them. The focus of this paper is the use of Internet as presentation tool on web pages.

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