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VIRTUAL REALITY LAB

UNIVERSITY OF TWENTE.

Colophon

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**VIRTUAL
REALITY
LAB**

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CASE #01 DRIVING ASSIST

Imagine having an Integrated Driving Assistant, which provides aids to the car **driver** on every aspect related to the driving task. The Assistant helps the driver **choose** and maintain a safe speed, headway, and heading. It also takes care of **overtaking**, merging, and turning. It keeps a close watch on traffic signals and warns the **driver** of any obstacles. Moreover, it will guide the driver along the fastest, **cheapest**, or most comfortable route and constantly monitor the desired arrival time. It **will** inform and support the driver while taking their personal preferences and **purposes** into account. Driving is made more relaxed, safer and faster.

CHAPTER 1

INCEPTION

In 1978 the research group Production Technology started its research on Computer Aided Production Planning (CAPP). Systems developed in the eighties were ROUND for rotational parts and CUT for prismatic parts. To verify the output of these systems, graphic devices like plotters and displays were required; at those days rather exotic and expensive devices.

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 with 544, 192 or 384 words
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RD-11 RD-11T
 16K 16-bit words of 16K 16-bit words
 Single-Sided or Double-Sided
 Dual In-Line
 Quad-Sided Interface
 16K 16-bit words

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CRDS

CAD Research

The computers of those days at the University of Twente were the DECsystem 10 and PDP 11. In 1984 the rise of Knowledge Based Engineering (KBE) technology seemed to be an attractive opportunity to make CAPP systems more intelligent. The Fixes and Xplane expert system were developed on the Digital Equipment VAX station, one of the first generation networked graphic workstations. For educational purposes the Philikon CAD system was used. It was supplied to the group and supported by Hollandse Signaal Apparaten (HSA), a company producing defence equipment like radar and fire-control systems, being a subsidiary of Philips. These contacts with the CAD group of HSA were the basis of a long lasting cooperation. In 1987 a big project was granted by the Ministry of Economic Affairs and the PART system (Planning of Actions, Resources and Technology) was developed by a team of ten people over a period of four years. The prototype was finished in 1991

and ported to Silicon Graphics workstations, the fastest CAD equipment available. PART could interpret CAD models and extract manufacturing features for which it could allocate manufacturing methods and tools. It could then calculate cutting conditions and tool paths based on geometric configurations and manufacturing tolerances. PART was further developed into commercial software by an offspring company called C3, which was sponsored by Volkswagen and Control Data, the distributor of Silicon Graphics. They supplied additional workstations and their ICEM-DDN CAD system was used for student courses in surface modelling.

The commercialisation of PART was a big success for the research group on the one hand, but it blocked further research in the area of Computer Aided Process Planning for milled parts. However, a similar system for sheet metal parts was developed, which unfortunately was never commercialised.

Employment

The acquisition of projects during the years was successful and quite diverse in scope and volume. The T-Xchange team consists of about ten people of which half are on the Thales payroll and the others on the UT payroll. In 2008 the contract with Thales was renewed for a period of five years and undersigned by Rikus Eising, Dean of the Faculty of Engineering Technology and Andries Hummel, CTO of Thales Netherlands.

SURF, the collaborative organisation for ICT in Dutch higher education and research has sponsored several projects of the VR-Lab, among others the light path infrastructure for switched super high bandwidth connections to create ultra-low latency haptic environments.

In February 2011 the EU DG Infrastructure granted the Visionair project. The 18 partners connected their VR-Labs with a high bandwidth network to provide service to the academic and industrial community to enable cooperative work without the need to travel long distances.

The lab is now also intensively used by students. Special courses like Design with VR have been developed. Much attention has been given to keeping the VR tools up to date by active research and development. For example: A multi-touch wall and a virtual meeting table have recently been added to the inventory. Also the audio system has been substantially improved.

A second renewal of the contract for another five years has recently been signed by Ed Brinksma, Rector of the University and Gerben Edelijn, CEO of Thales Netherlands. It is still amazing to see the reaction of people when they enter the lab for the first time. WOW! Although it exists now for nearly eight years it has not lost its effect, on the contrary.

Virtual Reality

Product design gradually became a more prominent research area of the group and in 1998 a separate chair in Design Engineering was established. This chair received a starting grant of €150,000, which facilitated the investment in new computer graphics equipment and haptic devices. In the same year the foundation VR-Valley Twente was established, with the mission to make industry in the region aware of the existence and potential of Virtual Reality technology. The initiative was taken by Dick Arnold, the technical director of Thales Netherlands (the former Thomson-CSF/HSA), together with Ton Beune of the Development Agency East. One of the first projects the group was involved in together with Thales was MERTaC, an approach to improve the speed and efficiency of product development by early visualisation of design concepts in combination with customer feedback. The first VR dedicated equipment entered the laboratory in the form of a stereoscopic display, some head mounted devices and a tracking system.

Another VR-Valley project was AneuRx aiming at the development of training environments for surgeons, in particular for the application of vascular

stents in the aorta. For that project haptic setups were developed, which later were also used to practice open surgery. An offspring company under the name Vrest was founded in 2000.

In that year, the group was asked to investigate the possibility to start an educational programme in Industrial Design Engineering, which had to start in august 2001. A venue was found in the tower of the Horst building and there the first dedicated VR-Lab was established. The VR-Valley I project was coming to an end and the group was asked to foster the remaining equipment.

After renovation of the building the rapidly growing Industrial Design department moved to the Oosthorst that was converted from an experimentation hall into an education facility. Because of lack of lab space, a temporary solution was found in a shared VR-Lab facility together with the biomechanics group. In the meantime the renovation of the rest of the Horst building was on the brink of execution and it became clear that there was an opportunity to create substantially more floor space by putting an extra level in the Westhorst, one of the experimentation halls.

Digimap, een virtuele kaart van het Business & Sciencepark en de Campus van de Universiteit, waardoor het mogelijk wordt om nieuwe gebouwen optimaal in te passen binnen de bestaande ruimtelijke structuur. Jacob, het ontwikkelen van een virtueel

VR-Lab UTwente

The idea of creating a substantial VR-Lab was born and the target was to open the lab in 2005. A grant application was submitted under VR-Valley II to the Innovation Impulse Overijssel and the applicants received € 500.000,-. Additionally the University donated € 300.000,- and after the remodelling of the building finished in April 2005, construction of the lab's interior could start.

The look and feel should be spectacular. The Thales Effect Based Solutions method for multi-stakeholder decision making required an environment that stimulates creativity. The design of the technical infrastructure was done in close cooperation with Kees Nieuwenhuis (Thales Research & Technology) and ProSystems, the supplier of the equipment. The design of the furniture and control room was done by Robert Wendrich and Wouter Eggink. The lighting and audio design was a cooperation between Fred van Houten en Robert Wendrich.

Thales and the University signed a three year agreement to exploit the lab under the name T-Xchange (Technology Exchange) in a commercial way, acquiring orders from industry, government and organisations like Rijkswaterstaat, Deltares, Dutch

railways, etc. Besides that, T-Xchange should also participate as a partner in national and European subsidised research projects.

The official opening was on 25 November 2005, while the arriving guests were already drinking coffee in the lobby, the last big slab of glass was placed in the front control room window frame. The lab was ready just in time!

The official opening was performed by Arno Peels, the CEO of Thales Netherlands, Henk Zijm, the Rector of the University, Carry Abbenhues, Deputy of the province of Overijssel, and Fred van Houten, professor of Design Engineering. The opening act consisted of pouring a glass of champagne with four people each pulling on one of four strings. Some things which can easily be done alone may become quite complicated for a team!

In January 2006 the National Innovation Platform under chairmanship of Prime Minister Balkenende had one of its meetings in the lab. One of the many official national and international delegations that visit the lab. It has become one of the most prominent places to visit in the region.

3D Modelling Techniques

PART was based on 3D solid modelling and the group had gained ample experience in this field. Later, when Feature based solid modelling was entering the mainstream CAD world, the group developed feature based applications on commercial platforms like Catia and Unigraphics. For Fokker a feature based sheet metal application for rubber pressed parts was developed. After acquiring his PhD on the topic, the researcher worked for two years at Dassault Systemes to integrate it further into Catia. When Fokker became a subsidiary of DASA, a similar application was developed for the feature based construction of tooling for large carbon fibre reinforced parts for the Eurofighter and for commercial aircraft. Both applications ran on IBM RS/6000 workstations.

In the meantime the French company Thomson-CSF had acquired HSA from Philips and the new Dutch subsidiary became the first customer (and distributor) in the Netherlands of ProEngineer, a parametric feature based CAD system developed by Parametric Technology Corporation (PTC). At the University it was decided to use ProEngineer as a follow up for the 2D Philikon system. Parametric modelling became the trend in CAD for the early nineties and the group performed research and developed a ProEngineer application for parametric pump design for FlowServe as well as an integrated system for the configuration, sales, process

planning and production of large customer specific hydraulic cylinders for Rexroth/Hydraudyne. In the meantime constraint based modelling techniques were developed in the FROOM project (Features and Relations Based Object Oriented Modelling). The project concentrated on automatically deriving complete and consistent tolerance schemes from mating relations between parts. This formed the basis of development in the area of automatic product configuration: The What If system that could generate alternative part geometries on the basis of (explicit) mating relations and (implicit) material and production process properties. It was based on a commercial (e-commerce) product configuration toolbox.

In 1995, after 4 years of existence, the C3 company was sold to Tecnomatix, well known from their RobCad software for the automotive industry. They acquired C3 to extend their automotive portfolio and enter the power train market by incorporating machining operations in their product suite. The PART system was renamed and became Tecnomatix Machining Line Planner.

Ten years later Tecnomatix was bought by UGS and only two years later this company was acquired by Siemens PLM solutions. Machining Line Planner is now integrated in the NX CAM product suite under the name Feature Based Machining.

A photograph of three young men in a laboratory setting, looking down at a large, transparent table. The man in the center has curly hair and is wearing a white t-shirt with a graphic that says 'CLOSE TALKER' and a skull. The man on the left is wearing a light blue shirt. The man on the right is partially visible. The background shows industrial-style ceiling beams and lights. A dark, semi-transparent box containing text is overlaid on the lower left of the image.

CASE #02 EDUCATION

Students are challenged in their education to make optimal use of virtual reality tools, but also to develop new tools themselves. The VR-Lab is a real workshop for them. Not surprisingly student's projects were highly diverse and included, among other things, the development of a distance collaboration table, using motion capturing to review product use and the combination of physical objects and the virtual world. But also the development of new interaction scenarios and the use of emotion recognition for concept selection are part of student's projects.

CHAPTER 2

REALISATION

Late September 2004 the first ideas and fuzzy notions about the design and creation of a Virtual Reality Laboratory were surfacing. The initial plan was to divide one large room into multiple small research and development cubicles divided by curtains to create a patchwork of SME companies and prospective startups, as to create a symbiotic and synergetic working environment of domain specific activities and so lead to a dynamic and inspiring atmosphere.

However, this idea became quickly obsolete due to a change in perspective and the wish to make a high-tech state-of-the-art synthetic workspace that could flexibly be adapted to any kind of required or specified design environment. The envisioned VR-space had to become highly accessible by design, transcend a futuristic vision on technology, evoke surprise in styling and enhance the visual spectrum through a hybrid combination of real-world artefacts and virtual content systems.

The team that worked on the genesis of the initial plans was formed by Martijn Tideman, Ralph Klerkx, Wouter Eggink and directed by Robert Wendrich. They had to come up with a variety of scenarios, plans and lay-outs to create a number of different conceptual representations. Fitting the initial specifications and requirements, the concepts were visualised in 2D and 3D CAD drawings, scale models and design sketches. The first drafts of the VR-Lab were ready after a couple of months of intensive work by the team members, supported by regular meetings with the project stakeholders.

Fuzzy Front End

Like in any design project there were many wishes and demands at the start, changing over time through better insight and understanding in what really was needed and how to achieve the core goals. The hybrid design approach the team employed was to iterate fast and agile, as to come up with a maximum of possible solutions in short spurts of design activity. The team had a hard time to configure the right and best harmonised lay-out within the existing context and according to the requirements. To fulfil this task a rich and diverse combination of design and engineering techniques were used to come up with a final concept. This mode of working lead to a faster insight and understanding of the required design and engineering, the involved development and specific requirements needed for production. For instance cherry-pickers were used to give visual and ergonomic (anthropometric) clues about the space and location of certain furnishings. Furthermore, preliminary technical drawings were made to fine-tune plans, specify materials and dimensional information to request quotations from potential suppliers, contractors and manufacturers on estimated costs and production time.

From September 2004 until the end of March 2005 the team created five preliminary concept scenarios that all in all led to one more major overhaul in the month of August 2005. The final concept was accepted by all stakeholders mid-August 2005, after much deliberation and discussion. At that point there was only 3.5 month left for final design engineering, production and installation of the Virtual Reality Laboratory, as the opening of the VR-Lab was planned for December 1st, 2005, and all invitations being sent, there was no way back. In the following pages the final design engineering process is illustrated by on the spot photos and visualisations of all the different stages that were realised during this period of intense and hard work.

Floorplan and Layout VR Laboratory.

Early scale model VR-Lab.

The space of 245 m² in potential floor surface and 14700 m³ in volume for the prospective VR-Lab was analysed, measured and planned for a complete makeover, using traditional and high-tech tools. The envisaged space at the Faculty of Engineering Technology was shaped like a huge, regular 'shoebox' and constructed with steel support columns, beams and trusses (open web

steel joists) supporting the lightweight corrugated roofing system. The floor was made of pre-stressed concrete floor slabs and finished with a screed layer.

The whole steel construction was coated in red paint. The outer walls consisted out of a combination of panelling and glass panes fitted in an aluminium framing system.

Future Space of the Virtual Lab - WH225.

Digital photography and scale models with 3D printed furnishings were used to create fast and speedy lay-outs in conjunction with 3-dimensional visualisations and renderings in 3D Studio Max to support the planning and decision-making process.

Rondscher 6m x 4m
Katheder met TFT scherm
Mobiele werkstations (2 pers.)
Cubicles met regieconsoles

Virtual Reality Laboratory
Interior design / Planning
Westhorst - Hal 4
Enschede

design: robert wendrich
date: 01 - 03 - 2005

schacht

Coffeecorner

Scale: 1 : 100
march 2005

Rondscher 6m x 4m
Katheder met TFT scherm
Mobiele werkstations (2 pers.)
Cubicles met regieconsoles

Virtual Reality Laboratory
Interior design / Planning
Westhorst - Hal 4
Enschede

design: robert wendrich
date: 01 - 03 - 2005

schacht

Coffeecorner

Carpet
Scale: 1 : 100
Scenario: Presentation & Work
Egg chairs- 3316

Opbergruimte

Rondscher 6m x 4m
Katheder met TFT scherm
Mobiele werkstations (2 pers.)
Cubicles met regieconsoles

Virtual Reality Laboratory
Interior design / Planning
Westhorst - Hal 4
Enschede

design: robert wendrich
date: 01 - 03 - 2005

schacht

Coffeecorner

Carpet
Scale: 1 : 100
Scenario: Gaming
Egg chairs- 3316

Opbergruimte

Rondscher 6m x 4m
Katheder met TFT scherm
Mobiele werkstations (2 pers.)
Cubicles met regieconsoles

Virtual Reality Laboratory
Interior design / Planning
Westhorst - Hal 4
Enschede

design: robert wendrich
date: 01 - 03 - 2005

schacht

Coffeecorner

Carpet
Scale: 1 : 100
Scenario: Crisis
Egg chairs- 3316

Four Concepts of Scenario-based Gaming Environments to illustrate
the flexibility and adaptability of the Future VR-Lab.

Digital photography and scale models with 3D printed furnishings were used to create fast and speedy lay-outs in conjunction with 3-dimensional visualisations and renderings in 3D Studio Max to support the planning and decision-making process.

Iteration #4 March 31st, 2005.

The final concept was arrived at after much deliberation and debate between the stakeholders in the early weeks of August 2005. The ultimate design of the VR-Lab consisted of a projection area with a radius of 8.8 meters located in the South-East corner, equipped with a 3.5 meter high curved screen.

The tiered theatre seating arrangement is modular and mobile to enhance flexibility and adaptation of the laboratory lay-out to different settings. A total of 30 Vitra conference chairs are implemented for seating with 12 fixed chairs on the podium. The floor between the curved screen and the podium

is made from layered float glass to create visually appealing space and distance. In addition a custom designed lectern has been added to complete the presentation area.

Diagonally in the opposite North-West corner of the laboratory the Director's Room is located, containing all necessary control instruments and mixing panels for the Matrix computer system, the DMX lighting system and audio-visual equipment. In the North-East and South-West corners of the VR-Lab two semi-fixed Gaming Station areas are situated. Each Gaming Station is configured out of two mobile gaming tables, one horizontal pro-

jection table and eight Aeron office chairs, styled to specification. Above this set-up, a projector wing is fixed to the ceiling of the hall, supplied with three RGB-projectors, which allow for three-channel projection on three screen panels.

The trio-projection screen has been fitted with a Yamaha 3D directional audio speaker set. The gaming tables come equipped with eight Tablet-PC's, individual audio headsets and network ports. Furthermore, three custom designed Mobile Workstations are part of the VR-Lab lay-out, that can be arranged in any configuration to fit every possible required scenario.

3D Sketches and Tangible scale model of VR-Lab

Design and Styling for the VR-Lab was inspired by SF-Movies like '2001, A Space Odyssey' and other futuristic designs. The final concepts are illustrated above in sketches and 3D renderings. The ideation phase of the design process was completed on August 15th, 2005.

VERDIEPT
SISTEEM
PLATFORM

TERUGLIGGENDE
DAKRAND AFW.

Design & Engineering

Almost all the hardware, special furnishings and gear were custom designed for the VR-Lab following the design guidelines and according to the requirements and specifications of the final design concept. The designs were transformed from basic concepts to production ready products in close cooperation with manufacturers and suppliers. There were a dozen production companies and suppliers and about twenty sub-contracting companies involved during the design engineering and production process.

In this last stretch of the project Robert Wendrich acted as principal designer and project-leader for the realisation and execution of the VR-Lab project. In order to speed up the design engineering and production process he cooperated directly and intensively with the engineering departments of the various production companies to ensure optimisation in design direction and rapid progression of the evolving steps in realizing the various requested products.

Communication lines were short and straight forward, decisions were often made at hi-speed, often by direct communication with one of the principal stakeholders in the project, Professor Fred van Houten. While production and final delivery times within Industry are normally four to eight weeks from date of final approved production drawings, in this project lead times were much shorter, thanks to the enthusiasm, willingness and cooperation of the suppliers. Especially the design and engineering of the Director's Control

Room (DCR) was a rather ambitious task.

The final design for the construction of the DCR was to use steel and glass, as this part of the VR-Lab was considered as the 'pièce de résistance'. It involved a feat of engineering technology and several suppliers and partners to accomplish this. All the calculations needed to assemble the DCR in the VR-lab had to be done before any final go for production of the DCR could be given, as the calculation of the load bearing, strength and stress that the existing flooring construction in the building had to support due to the anticipated weight of the DCR was difficult to estimate, and so this was a real engineering endeavour.

Since there was no time to lose, main supervisor and chief designer Robert Wendrich finally attracted Arie J. Ottink, as the a clear headed construction engineer that was desperately needed to fix the job. Ottink made a very simple but extremely effective plan that solved all engineering problems, and so effectively eradicated previous doubts. After this the final 'Go' was given both to steel construction company Voortman to produce the DCR and to float glass supplier Eikelkamp who had all the time been in close communication with the design team to come up with proper specifications for the steel construction parts and the glass panels of the DCR.

Needless to say that all this had to be accomplished in so little time, and under such great pressure, that all the suppliers had to be kept on their toes to deliver on time.

Various Technical Drawings and 3D Representations of Furnishing Parts.

The Design, Development and Production of the Director's Control Room.

Most of the steel furnishings produced for the VR-Lab were made by van Keulen Industries, and their flexibility, quality of work and outstanding manufacturing equipment too proved to be a perfect match for this project. In close cooperation with them, the bulk of the requested custom products and parts were produced within four to six weeks. Due to the meticulous design and engineering work by Eddy Heling and Robert Wendrich all the goods were produced without any fault or deficiency. This saved a lot of aggravation and time during assembly and installation, and consequently resulted in a perfect fit of all additional custom made parts and components from other suppliers. It illustrated again that proper communication in design engineering is the most important aspect

of all design engineering processes, to make sure that partners and/or stakeholders are continually in sync during the whole course of a project.

Another remarkable aspect was the design and construction of the HUMBOLDT[®] lectern, a custom designed artefact that seamlessly fitted with the overall futuristic styling of the VR-Lab. The design was based on the metaphor 'a penguin embracing a human being'. The ideal material that was used to create this special piece of furniture was Corian[®] a solid surface material made from acrylic resin. The outstanding quality of this material for this particular purpose consists of its intrinsic property that virtually any form can be made from it, the only limitation being the designer's designer. After

several trials and errors in thermo-forming the desired shape, supplier Cora Techniek came up with a solution, using a perfect hybrid match between manual skills and high tech material, enabling the creation of an exquisite product, exactly according to the design specifications.

The complete design and production of the VR-matrix system was realised by Pro Systems, who were responsible for the implementation of all the visual-audio and control systems. They were responsible for the Ixfinity curved screen in one of the corners of the VR-Lab premises, allowing dual christie projectors to create high-performance projections, that is high-resolution, high-brightness and high-contrast - if required: moving - images, combined with 3D sound.

Schematic diagrams showing the complex installation of the VR-Lab Matrix system for the control of data-sets, simulation, visualisation and representation of virtual content.

Installation & Assembly

Basically the VR-Lab contains two major components of installation and assembly, planned to be simultaneously implemented, in order to deliver full completion in time. The first tangible part contains the hardware, fixtures and furnishings that actually represent the VR-Lab environment. This specific interior design conveys the high-end futuristic approach that is suited for this synthetic virtual reality environment.

Secondly, the virtual complement to this consists of the software and virtual reality matrix infra-structure that together form the wired inner workings and 'technological soul' of the laboratory realm. The entire computational and visualisation system was designed, build and executed by Pro Systems according to the requirements and specifications of the design team in connection with the various stakeholders. The plethora of cables, wires and abundance in in- and outputs machines were installed, engineered and configured to facilitate the interaction and representation of virtual content and simulations in support of the collaborative design and gaming scenarios.

The installation and assembly of the VR-Matrix took over eight weeks to complete with several system testing intervals in between. After the opening of the VR-Lab a number of iterations and major changes were implemented to complete this hi-tech virtual reality facility.

Most of the furnishings and fixtures were delivered in parts to the VR-Lab to be assembled on

location. This approach was necessary for a number of reasons to simplify logistics, space limitations on the premise, limited storage facilities and to facilitate the gathering of different intermediate components from various suppliers and sub-suppliers for final assembly into products or furnishings. The streamlining in planning and organisation of the various assemblies was executed and fulfilled in close cooperation with the various suppliers and work crews. Despite the fact that the installation of the Director Control Room was a real challenge, the crew from Voortman in conjunction with Schooten staalbouw installed the steel construction in less than four days. This is the more remarkable when it is realised that the complete steel structure was delivered as some sort of huge LEGO-kit.

Practically, the construction started by positioning and fixating the two tubular steel columns, followed by adding the roof structure, the floor structure and the two spiral staircases on both sides of the DC room. Afterwards, the grid flooring behind the room was installed to create a mezzanine entrance and storage area. Directly following the assembly of the DCR, glass supplier Eikelkamp fitted the non-tempered float glass panels for the walls, sliding door and the layered float glass flooring. At the same time, the podium was also fitted with layered float glass floor panels. This operation took one full day and actually was finished one hour before the grand opening of the VR-Lab.

Assembly and Installation of VR-Lab Components and Furnishings.

Layered glass floor of the Director Control Room.

Final Realisation

After roughly 60 weeks of design engineering processing, production, assembly and installation, the final result was a stunning combination of a well-balanced research laboratory environment in its overall appearance, interior design and extraordinary technical complexity. The envisioned Virtual Reality Laboratory in the Faculty of Engineering Technology at the University of Twente became instantly an icon of timeless design, hi-tech progress and futuristic advancement.

The design and styling of the VR Laboratory in conjunction with the high-end technology was a perfect symbiosis of high-tech and human touch. The genesis and realisation of the VR-Lab emerged through a harmonious mixture of collaborative design engineering teamwork and individual design management direction. The overall decision-making process evolved throughout the complete design creation process and lead to a very inter-

esting, complex and mindful design project.

A few months after the opening the Dutch Innovation Platform, a think-tank established by the Dutch Government, used the VR-Lab as its conference venue. Former PM of the Netherlands, and Chairman of the DIP, Mr. J.P. Balkenende and delegates assembled in the VR-Lab to discuss their policy and strategy on Innovation and the positioning of the Netherlands with respect to these issues in Europe. Since then, a large number of large and SME-sized companies, research institutes, and governmental organisations used the VR-Lab for their purposes and needs.

The VR-Lab proved to be a perfect environment to facilitate and support several start-ups and hi-tech entrepreneurs in their early stages of existence as a stimulating workplace and inspirational research venue.

HUMBOLDT® Lectern.

Director Control Room.

and Ambiance Shots VR-Lab.

LED RGB Colour Schemes.

Scenery and Ambiance Shots VR-Lab.

CASE #03 INTERACTIVE TABLE

Touchscreen tables have been used in several use cases to facilitate collaborative design reviews of future room layouts, such as hospital rooms or office environments. Design reviews often use 3D digital models to illustrate the future situation. In order for future users (in our cases hospital staff or office employees) to participate in these reviews, an intuitive interface is required to modify and interact with the 3D model. To achieve this, 3D room models can be linked to the Surface table, allowing participants to modify the layout by moving around tangible objects on the table. For instance, miniature chairs and beds were used to change the layout of a hospital room. This interaction is not only very intuitive but also supports collaboration within the design review; everyone can participate in creating the new room layout without elaborate instructions.

Interact & Moderate

After a sound preparation, the Lab has changed from a rather gloomy room to an environment that appeals to the commitment and creativity of all stakeholders involved in a project. When the participants enter the Lab for a session, they are immediately brought in the synthetic environment dedicated to 'their' context and 'their' problem. With the help of skilled moderators, the stakeholders are introduced to the abstract reality that will help them to better get to the core of the problem.

The skill in moderating a project is to foresee adequately what tools and methods will contribute the most to the successful execution of a project. This includes an assessment of the type and amount of preparation that is required. While employing the prepared scenarios and gaming approaches, the stakeholders start to explore the problem and its context. Usually, ample time is spent on adequate phrasing of the problem; more often than not, participants are actually prevented from jumping to possible solutions too early. The reason for this is that every suggested solution brings along its own details, particularities and consequences, all concealing the essence of the actual problem.

With many different techniques, ranging from mind-mapping, via collages to classification, the participants conjointly formulate a basis from which the search for an optimal solution can start. The solidity of this basis justifies the efforts spent on it; it allows the participants to focus on developing solutions, without having to revisit the starting points.

While developing different concepts for a solution, the participants are supported by the prepared simulations and gaming approaches. Obviously, such interactions only buttress the activities of the participants, without influencing them.

When a session is in full swing, the stakeholders, the moderators and all technology involved in the process and the controls of the Lab environment are inextricably bound up with each other. The atmosphere in the Lab is a factor that should not be underrated. It can allow people to focus, to shift attention, and even to - cautiously - pull people out of their comfort zone.

Conducted, guided and facilitated by the moderator(s) the group can effectively work towards a set of solutions that seamlessly fits the requirement specification, or exceeds that mark.

Prepare

While discussing the demarcated problem area as well as the initial ideas for solution paths, the scope of the project is set. This scope is instrumental in delimiting the 'wanderings' of participants in meetings. This involves preparing for example 3D models, environments, animations, but also simulation/probability models and a controllable set of premises that underlie the interactions in the synthetic environment. It goes without saying that the translations that convert ideas into environments that allow for purposeful interaction are at the heart of the craftsmanship of the researchers working in the Lab.

Moreover, there is quite some expertise involved in integrating the environment with its setting and a well-balanced combination of the hard- and software with the working methods to be used. For researchers, the challenge is to support and facilitate the process as functional and effective as possible, avoiding at the same time to implicitly hide a solution in the approach.

In preparing for a session, or an entire trajectory, quite some effort is spent in bringing the Lab to life in an adequate manner. Often, creating, converting and assembling 3D models are important, as can be the realisation of libraries of 3D models that have a dynamic role in the session. All other resources used might require programming, data sets or training. With the employment of such resources, the hard- and software can be tailored in such a way as to exhibit the behaviour that actualises the environment in which clients, users and all other stakeholders can realistically investigate different perspectives on the problem area, which is supposed to bring forward the various alternative solutions. Even more, the course of a session is planned, based on scenarios, simulation models and serious gaming approaches. All in all, having a session in the Lab can resemble an iceberg: the part that is visible floats on all the preparatory efforts involved in a session, which are hidden from sight during the session itself.

Plan

Understanding a problem is the major prerequisite for obtaining a good solution. Before moulding a synthetic environment, there is a considerable challenge for the prospective user of the lab to make the problem field where the Lab will be employed transparent. The problem statement itself does not need to be fully elaborated. Often, conjointly determining what the actual problem is, creates more added value during early sessions in the Lab than anything else. Besides, more often than not, the real problem appears to be hidden behind the articulated problem statement. Even worse, with an explicit, yet improper problem statement, the wrong problem will be solved.

In other words, any session should rather focus on starting from a problem area. This area should challenge all participants to see the common responsibility, while stressing the variety in viewpoints and perspectives involved. Therefore, the problem area should be demarcated, thus avoiding inclusion of too many details or dimensions. Additionally, there should be a clear problem owner, who is capable of assessing the adequacy of the problem statement and its evolution, of being instrumental in selecting the right stakeholders and of evaluating the outcome of the sessions. Moreover, he will need to judge the level of abstraction as well as the desired (level of) the outcome of the project. During sessions, it is essential that the problem owner does not have ascendancy on the course of the interactions.

Toolbox

The experts that employ the Lab are people that think in terms of the project as brought along by the prospective user of the Lab. Whether a project definition is correct and complete is initially not even relevant; it is the structure and breadth of a problem statement that appeals to the possibilities of the Lab and the feasibility to use it. It is the proficiency of the creative expert that identifies the way in which a preliminary problem statement can be connected to the way in which the hardware in the lab can come to life. Resembling a sculptor who already sees the statue in a block of marble, the expert is trained to recognise the basics of a solution in the initial problem itself.

However, in a high-tech environment like the Lab, one can not rely on sheer intuition. It takes experience, knowledge and the ability to associate, but foremost a well-considered approach to adequately address the integration of stakeholders, problem formulations, solutions approaches, hardware, software and especially working methods. For an experienced user, the Lab encompasses a wealth of opportunities, captured in its hard- and software, in the evoked possible futures and mainly in the determination of the combination of resources and approaches that will render a maximum of added value for the client in the most flexible and efficient manner.

Here, the Lab becomes a versatile toolbox, providing many tools with great potential. Yet, it takes knowledge and expertise to select the appropriate tools for any specific job and quite some craftsmanship in applying them in a purposeful manner.

Synthetic Environment

Consequently, it's all about establishing a synthetic environment that is able to create an alternative reality in which - through simulation - imaginary worlds, objects and characters can be experienced that are impossible to realise and experience in non-virtual reality. Virtual reality allows the creation of new objects, spaces, interactions without the need for their actual construction, thereby providing the possibility to experience products even in the very early stages of the design process.

By employing high-end simulation techniques, design information is made explicit and verifiable. Through a personalised interface, all actors can be enabled to directly influence design information and directly assess the consequences of their decisions. By allowing stakeholders to experience products in the very early stages of the design process, insight in stakeholder requirements and communication within the design team as well as with stakeholders is improved and design quality is enhanced.

Overall, synthetic environments support product design processes by offering a demonstrative environment that facilitates the experience of future products by stakeholders in a wide range of (use) scenarios, enabling an identification of the needs and wishes of stakeholders with regard to the product design.

CHAPTER 3

WORKING METHODS

Every time someone enters the Lab to prepare for a new meeting or session, it is literally a step in the dark. Every time, it is the sensation of exchanging the familiar surroundings of the University for the slightly alienating environment of the Lab. When the door has fallen shut, there's darkness, somehow emphasised by the minimal lights and monotonous hum of many pieces of equipment, acquiescently anticipating deployment.

Pressing the light switch brings a cold pale-blue light to the Lab. At this point, quite some imaginative power is required to fathom the possibilities that are implicit in the Lab and are inherent to its plans. Any passer-by would see an expressionless and passive collection of apparatus, with a hint of underlying coherence at most. It takes a creative mind to envisage the way in which such an environment can facilitate, stimulate, capture and challenge the interactions between a variety of different people from different backgrounds while identifying and pursuing common goals. Such a creative mind is required to see through the manifestation of the hardware in the Lab and bringing that hardware to life in a purposeful and appropriate setting.

Act & Evaluate

As with almost all projects, a session or complete trajectory in the Lab suffers from a considerable risk: achieving a great solution is one, but adequately capturing its specific characteristics before the project is over, is a different matter. In other words, not only in the early phase of a session it is essential to record evolutions in - for example - a mind-map; it is especially in the conclusion that the added value of a session can be fathomed and secured.

It is important to allow all participants to maintain the conjoint understanding and the resulting solutions paths that have been established. Here, the moderator has a great responsibility in making sure that the participants address the focal points that have been essential in the session. Realising an effective summary while doing justice to all perspectives involved is a shared responsibility that will usually require quite some effort and attention - to say the least. Experience has indicated that there is another essential reason for adequately

capturing the result of a session: after the end of a session, its result has to be separated from the environment in which it came into being. Towards the end of the session, all participants have to retreat more or less from the synthetic environment with all its possibilities for interaction and simulation. After the session, the solution should have been formalised in such a way that it can inherently and autonomously survive, without the aid of the environment.

In other words, the Lab purposefully disintegrates again into a set of independent tools with individual capabilities that no longer belong to that temporary and goal-oriented synthetic environment that - in the hands of the craftsmen - could engender the required added value. That is, if the problem owner has achieved a breakthrough in the project. Only then, the lights in the Lab turn to cold pale-blue again; to allow the stakeholders to step back into the 'real world', but also to allow for the preparations for a new session or project to start.

CASE #04

VICTAR (VIRTUAL COMPETENCE TRAINING AREA)

Vrest Medical was among the first users of the Virtual Reality Laboratory at the University of Twente. Vrest Medical develops the ViCTAR (Virtual Competence Training Area) a groundbreaking generic simulation platform for medical professionals. ViCTAR is the world's first simulator with real-time dynamic volumetric models allowing 'open' surgery to be possible in a simulator. With a DICOM module patient data retrieved from CT and MRI scans is converted to dynamic patient models. Therefore a large variety of anatomical models has become available.

To learn the medical professional what to see and what to feel ViCTAR comprises stereoscopic view and haptic feedback. Furthermore ViCTAR comprises a learning and assessment area in which tasks are being provided and where one is learned how to decide in the medical profession. Using the ViCTAR surgeons will face a novel procedure in the operating room better prepared and with more confidence. For patient benefits!

CHAPTER 4

LAB EMPLOYMENT

The VR-Lab and its contents allow for divergent virtual experiences. In realising the synthetic environments in which these experiences can be gained, it is important to secure that the Lab itself does not become the subject of observation. Ideally the Lab should be concealed behind its practicability, that is: the research projects that it enables; it should not be perceived as a display of tools. In order to become context instead of physical environment 'an Sich', it is essential that it is in some sense chameleonic, that is: it should be able to merge in any desired scenario it is employed for, and in this way to become as invisible as possible itself.

Only when its physical dominance dissolves after users have entered, and the behaviour of the people present can still be purposefully influenced by its atmosphere, possibilities are 'virtually' endless. To realise this ambition in divergent situations, obviously some clever thinking is required, both on the performance and functioning of tools and the methodology for employing these. Many researchers and students, in various projects and educational settings, contribute to lab-related research projects. Considering this from an academic perspective, a rather different kind of scenario for lab employment is revealed, in which the physical lab and its contents explicitly do become the point of focus.

Atmosphere

The atmosphere in a synthetic environment offers freedom for fantasy and allows to break away from the dominance of the physical architecture. It affects visitors from the moment they come in, influencing their general mood, the way they feel and how they behave. From the control room in the Lab, an appropriate atmosphere can be created and adapted to almost any scenario. By operating all audio-visual equipment and adjusting lighting from this room, changes can be made without visitors being prepared. The lifted position of the control room allows for observation of the entire Lab, enabling permanent control.

In creating a desired atmosphere, the lighting in the Lab can energise people, and make them feel comfortable or excited. The colour and intensity of the light and the changes therein are important instruments in this. By directing and shaping the light, almost any wall can be transformed into a screen. The applied settings create distinct areas that are suitable for employing creative activities, significant meetings or relaxation. Obviously a total different lighting is required for lab-related research purposes; the simulation of natural daylight reveals the technical details of equipment available. Sounds created in the Lab can either be aligned with visual stimuli or purposefully distinct from what the eye perceives. Although flaws in the syn-

chronisation of (moving) image and sound is normally perceived as extremely annoying, synthetic environments seize this opportunity to illustrate that things may not be what they seem. As guests have comfort zones for distances, proximity, altitude and depth, sound can help to influence the perception of what feels 'near' and what 'far'. The possibilities of directed sound and anti-sound allow for a whole range of interesting effects in group dynamics. For instance, providing different stakeholders with different messages without being noticed this by themselves, is technically feasible. Creating the appropriate atmosphere is intended to encourage people to behave in a manner that is in line with the premises of a scenario. In each situation it is important to account for the degree of realism that is needed - or, in other situations, has to be avoided - to increase the chances for useful results.

The far-reaching implementation of a fairy-like environment, like for example an Arcadian landscape or a castle setting, in a surrealist scenario might be able to resolve and ultimately push forward a bogged down process due to its refreshing effects on visitors. However, when a serious discussion on complex data is required, a spectacular environment may turn out to be a disastrous mismatch, by distracting participants from their target.

Industry

A visit to the Lab is a great experience, even for experts in the field. It, however, is obvious that the time and resources invested in this visit and the preparations for it, should be repaid somehow. The aims for using the Lab are various, even when merely simple industry visits are considered.

The synchronisation of stakeholder perception (inside or across the borders of an organisation), the visualisation of possible future scenarios, complex multiple stakeholders decision making, collective idea generation or impressing/overawing clients, are among the targets.

In relatively simple scenarios it is possible to reach the goals by employing the functionalities of individual tools and techniques. The targets of uncomplicated mind-mapping or brainstorm sessions usually benefit from the availability of multiple large screens and the possibility to apply multi-user data input on the spot.

Sometimes, however, a more overall experience is required to extricate stakeholders from their daily situation, to make them think beyond their usual boundaries or to make them realise the complexity of a situation. By pulling attendant stakeholders out of their comfort zones, their stress levels can be slightly raised, resulting in enhanced levels of concentration, focus and alertness. This high state of preparedness makes it possible to get the best out of a scenario and to make real progress towards the targets that are set.

So-called 'Serious Games' are potent means to create settings in which existing roles and conditions

are not taken for granted anymore. As serious games entertain stakeholders, while at the same time having been designed for the investigation of difficult situations, they provide an inspiring mix of seriousness and fun. Serious games are ideal to discuss complex topics and issues, while simultaneously they actively involve, challenge, motivate and reward the player-participants with game elements.

As people usually imitate each other when they are largely free to act as they please, individual assignment are great means to prevent unintended 'group thinking'. Although the realisation of group thinking can be the goal of a visit, the desire for harmony in a group might also override a realistic appraisal of alternatives or lead to serious blockades in a creative process. This is problematic when for example the development of new product ideas is pursued. By using role playing elements in a serious game it is possible to explicitly confront players with the aberrant feelings of other stakeholders and to make them consider effects of decisions from different perspectives.

Additionally, serious games can focus attention on formerly underexposed aspects by filtering out some of the more obvious aspects. Players can experiment with the situation and discover new relations without being restrained by constantly seeing trouble ahead. In this way serious games help visitors to achieve the understanding, awareness and behavioural changes that are often desired.

Research

The location and the nature of the Virtual Reality Lab makes it a real hot-spot for researchers. The Lab not only offers a perfect opportunity for use in many different research projects; the techniques, tools and methods that are available are also a source of research themselves. Researchers employed at the University of Twente as well as scientists from Europe and the rest of the world apply not only to use but also to investigate the possibilities of the Lab. As the Lab is part of a European funded infrastructure that grants researchers access to high level visualisation facilities, emphasis can be put on the excellence of proposals instead of the research budget available. The research for which the Lab is employed is related to a wide area of fields including - but not limited to - engineering, medical science, nanotechnology, chemistry, physics, behavioural sciences and biology.

By testing ideas or findings in truly immersive environments, researchers can employ the lab to gain results without the need to prematurely invest in real - not virtual - test environments. Early stage visualisation of solutions benefits research on the interiors of ante-, peri-, and neo-natal care departments, on crime prevention through environmental design or the design of in-car lane-change systems. By virtually representing an interior or environment in (close to) real size, initial tests can be done without the need to actually build physical prototypes. changes in e.g. colours or shapes can be realised real-time, and their effects can be discussed immediately.

The equipment of the Lab helps researchers to identify and analyse aspects that are difficult to study with the naked eye in the physical world. For

example, by using motion capturing techniques in combination with sensor data and visualisation techniques, (human)movements can be captured and analysed. Based on the findings, work situations can be adapted to become more safe and healthy, the ergonomics of a packaging can be improved or equipment for training surgeons can be developed.

The examples mentioned above, only describe a few of the large amount of research purposes the Lab is employed for. The available technology is updated regularly and new combinations of technology can support almost any sort of research one can think of. This, however, is at the same time one of the major traps to avoid. Sometimes the attractiveness of the Lab, and the desire to spend some time in there, inclines to distract from actual research questions; apart from that some research questions might not always really need a synthetic environment to be solved.

Some researchers however are the lucky ones. Research on the Lab, it's technology and suitable working methods, requires frequent visitation, and is therefore mainly done by researchers of the faculty of Engineering Technology. These researchers among others concentrate on the development of computer generated worlds to interact with, the visualisation of possible futures, the involvement of future users in design processes, distributed cooperative design support, the use of virtual reality in training simulators, and the future technology of future technology of minimal invasive surgery. It is obvious that their results can be used for implementation in other scenarios for employment almost immediately.

Education

In the curriculum of Industrial Design Engineering (IDE) many of the functionalities of the Lab are used in beneficial ways as well. In the BSc.-programme, the visualisation possibilities of the Lab not only allow for clear explanation of difficult topics during lectures; the available technology is a welcome source of support in project based teaching too.

During project based teaching at IDE, students work on realistic engineering problems in group-based projects. In these, students groups act as design teams, independently shaping their own product development processes. User investigation, on the spot virtual representation of products, evaluation of ergonomics in product use, and user tests are examples of steps that are often required in such processes. In these the techniques and tools available in the VR-Lab have proven to be a great help for students.

The MSc.-traject of Industrial Design Engineering goes one step further than merely using the available equipment, as it introduces students to lab-

related research topics. In one of the courses on virtual reality, students work on finding a suitable virtual support tool for a chosen phase or activity in a product development process. The term 'virtual reality' includes all kinds of digital tools varying from a simple display to a full-blown 3D environment. Students are allowed to use or develop any virtual support they can think of and are even not limited to the equipment that is available in the VR-Lab. The requirement that the virtual tools should support, and not obstruct its users is one of the main challenges for students. Covering users with heavy head mounted devices or other equipment, and telling them to 'act normally' is not considered to be a very realistic scenario. Making students realise and test their solution, prevents them from developing solutions that are not really suitable in practice. The open-minded approach of students towards the development of virtual reality tools, makes their results very much refreshing and useful for further development and use in one of the other scenarios of lab employment.

CASE #05 LICHTPAD (DYNAMIC LIGHTPATH)

Large public areas require a sophisticated safety approach, which should handle questions like how do you get a better overview of the situation concerning public safety, and what information should ultimately go from the operational level tot the policy-makers who need to get the situation under control? In the serious game of the Twente soccer stadium a combination is made between camera images in and around the stadium as well as a 3D simulation. This game is used to plan and execute a real training session and to support the decision making process by the policy-makers.

CHAPTER 5

FUTURE REALITY

As the employment of the VR-Lab relies on flexible, modular and interchangeable combinations of hard- and software, new technology can easily be included in the toolbox of the Lab. This not only directly allows the quality of virtual experiences to improve with new developments, it also widens the scope of solutions that can be created.

In the everlasting race to keep up with new developments it is important not to become too greedy; the most incredible tools are often dedicated to the most specific problems. Next to the fact that the relevance of these dedicated solutions is low in a lab that has a wide range of stakeholders, the life cycle of such tools is often relatively short. Additionally, when they become outdated, this often means that the entire set of software and hardware constituting a tool is written off and that the substitutes cannot be dedicated to other purposes. Consequently it is the aim to focus on the acquisition of relatively small, standardised and general sub-modules that can be employed to tackle any dedicated demand. Obviously the acquisition is guided by some trends/topics that can be seen internally and externally, including distance collaboration & virtual presence, information sharing, holographic visualisations, unconscious user input, and of course the faster execution of old logic.

Distance collaboration and virtual presence

Communication and collaboration between people will be facilitated and supported by continually improving technologies. Imagine having a conversation together with a few discussion partners that are actually present at several different locations, as if they are in the same room. In the future this will become part of daily life, allowing people to work together across the globe, whenever needed or wanted, without any travelling issues, planning problems or high costs.

The future scenario of distance collaboration goes far beyond the abilities of current video conferencing systems, which only partly display participants on a framed monitor, in a different size, in a different environment. Where the size of a virtual representation is currently not always matched with its size in reality, future collaboration systems will visualise your virtual discussion partners as if they are actually sitting around the same table. By only projecting the real-size person him- or herself, without his/her 'real' environment, distraction from other surroundings is limited and the person will perfectly be placed into the shared environment. As the arms and hands of your partners are also visualised, even the smallest gesticulation can be received. Using a large touch screen as a conference table, which can be operated from every location, participants will have the opportunity to discuss any 'item' that comes to table. And, maybe, one day it even becomes possible to touch each other.

Information sharing

The processing of complex information in a simple and especially easy way, is a topic that remains important, and continuously needs upgrading. A situation in which it does not matter anymore with what device and on what location what type of information is gathered or shared, is not that far away. We are rapidly heading a situation in which the user isn't bothered anymore with the technical details and organisational factors of (re)using and sharing information.

The future work space, for example, has a giant touch screen (possibly concealed as a discussion table) that recognises the information devices you bring, like your mobile phone, tablet pc, or memory stick. It allows you to wireless push the information from your device to the table and to share it with the other people that are present (in person or virtually). Networking technologies also make sending files to others, and the duplication of files on multiple devices superfluous. Working with a central data source, 'cloud', provides access to your personal files on every location and with multiple devices.

To easily find the information you desire in the ever increasing amount of information that is available, intelligent filters guide your way. Based on your personal profile, they make a pre-selection of information that seems of interest for you. By also representing the selected information in a way that fits your personal needs, time to understand and interpret the information is drastically decreased. A production- and a maintenance employee, looking at the same set of information, might see entirely different things, being a production plan and maintenance manual respectively. And maybe, future information tools are even able to provide you with information, you weren't about to search for yet.

Holographic visualisation and interaction

Virtual reality is becoming to seem increasingly real. In a synthetic environment, where always a combination of real reality and virtual reality is made (in professional terms called 'augmented reality'), the boundary is starting to become more and more indefinite. In this trend, it is obvious that head mounted devices and other disruptive devices are a stage passé; the possibility to act as free and normal as possible is an important condition for an experience to feel 'real'.

The developments in holographic visualisation and interaction are definitely contributing to this experience. Holograms, which are three dimensional objects that can be perceived without the need for computer screens or additional eye ware, will allow stakeholders to walk 360 degrees around a visualisation. Where most of us still consider holograms to be a great creative idea of the human mind but only possible in movies, this conception has definitely become antiquated; holographic displays are already being realised. The challenge is already far beyond the visualisation part; current research focuses on making it possible to touch holographic visualisations and to interact with them.

User recognition and unconscious input

In an ideal situation Virtual Reality tools automatically recognise their user and fluently interpret the user input from the body language that is told; no log-in passwords are required and the input is done so naturally that it is almost done unconsciously, and obviously without any unintended results. In fact you might even already have used technology that is considered a predecessor of the technology in this scenario. Gesture recognition is already widely used in the gaming industry, represented in devices like the Wii, Kinetic, Leap motion and others.

Where Virtual Reality used to be something very exclusive and expensive, it is nowadays used in everyday situations by the man in the street. The fact that most people are not aware of using such high end technology is quite an accomplishment. When people are unaware of the technology as such, this usually means that a tool is functioning quite well.

The adoption of VR technology in the mass gaming industry, which is talking about high figures, has led to an enormous boost in developments that also benefit the employment of the VR-Lab. As the strength of the VR-Lab is characterised by the smart combination of tools and working methods that are used to reach a certain goal, each technology improvement is not only make it possible to create experiences of higher quality; also the range of solutions that can be created is extended.

Effortless preparation

Creating new tools for developers is often done combining multiple techniques and tools into a workable new setting or product. Due to the improved possibilities in connecting devices ('hand shaking') and the coherence between them, it will be easier to quickly generate new configurations. This allows for a faster and more flexible integration of new technologies in existing design processes and decreases preparation time for the use of a solution. Decreasing preparation time will provide users with the possibility to apply VR simply and quickly as a real tool to achieve a goal, and not to see the use of VR as a goal in itself. Where current VR solutions only work optimally if all the conditions and characteristics of the use situation seamlessly fit with the method proposed by the manufacturer, new VR solutions will be more based on the need and demands of the user. These new configurations can be created and tested faster and with lower costs and therefore lower risk. This makes Virtual Reality more accessible and affordable for small and medium-sized enterprises. Furthermore increasing possibilities of flexible configuration of different VR-components will permit the reuse of individual VR items in different projects, allowing a more efficient use of the equipment.

Real-time and all-embracing

To make an experience as real as possible, future synthetic environments need to stimulate all the human senses in a desired extent and way. On the other hand, the environments should be able to interpret and quickly react upon the smallest reactions that a user shows. This requires quite some computer calculation capacity and speed, especially when multiple users and even distance collaboration is concerned. It requires the connection between different locations in and outside the Lab to be extremely fast. The continuous improving (wireless) network capabilities allow for data access and communication possibilities without any noticeable delay.

Knowing what you exactly need at a moment when dedicated solutions are not yet at hand, is a field in which designers are working daily. The tricky points are that knowing what will be useful in the process cannot be predicted completely on forehand, and that some techniques unexpectedly

appear to be a success, along the way. The same applies to the development and/or implementation of new tools in the design process itself. From a management perspective it should, at the beginning of a project, be clear what the added value of a specific tool will be. But with the use of new techniques the possible results and advantages of usage are hard to predict. Supporting potential users to find and implement the most appropriate configuration of virtual tools in the proposed process is essential. This includes uncovering the goals that VR should help the user to achieve. By providing the designer insight in the possibilities, consequences and properties of VR tools, it will enable them to make a solid choice in the wide range of available tools. In addition, it is also possible to simulate and compare the use and outcome of different configurations, or to review already tried configurations based on the outcome of a particular tool in a previous completed project.

CASE #06

VISIONAIR (VISION ADVANCED INFRASTRUCTURE FOR RESEARCH)

Visionair is an acronym for 'VISION Advanced Infrastructure for Research'. Visionair calls for the creation of a European infrastructure for high level visualisation facilities that are open to research communities across Europe and around the world. By integrating existing facilities, Visionair aims to create a world-class research infrastructure for conducting state-of-the-art research in visualisation, thus significantly enhancing the attractiveness and visibility of the European Research Area (ERA).

Outlook

The past ten years have offered an exciting experience. Getting the opportunity to create a brand new lab from scratch has resulted in a big challenge in many aspects; it had to look spectacular, it had to be functional. It had to be flexible, it had to be secure. But in particular it had to be the home of contemporary design tools. There were constructional and financial constraints and the business model had to prove itself.

Looking back we consider the experiment to be successful as the collaboration with Thales in the joint venture T-Xchange has been renewed for the second period of five years. This provides a good perspective to look forward. The Lab will be continuously updated and new equipment and software will be installed. Students will use the Lab intensively, both in the Bachelor's and Master's programmes. Many new companies and governmental agencies will become customers and think and talk about future problems and solutions together with scientists and engineers.

The future is already there; we just have to make it happen in the proper way. The VR-Lab will contribute to that in the years to come.

VIRTUAL REALITY LAB

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