

Project Oriented Learning Environment (POLE)

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Summary

The presented work focuses on collaboration- experiences gathered with complex design and engineering projects, using the learning platform POLE- Europe. Within the POLE environment student-teams from different universities, disciplines and cultural backgrounds are assigned to real-world projects with clearly defined design - tasks, usually to be accomplished within one semester while working in a virtual environment for most of the time. The concept of POLE and the information and collaboration technology is described.

1 Introduction

Since 2000, the idea to build an active network of co-operating international universities to foster the use of modern information and collaboration technologies as well as project- and process-based learning in multi-disciplinary teams working on real projects has been strongly followed at the University of Applied Sciences Aargau. Starting with two pilot courses in 2000 and 2001 with the Stanford Process Based Learning Lab (Fruchter 1999) and in co-operation with the Center of Facility Engineering and Stanford Learning Lab, in 2002 POLE Europe was founded (Holliger and Breit 2001). Since then 7 courses have been held with students from 14 European universities: Aalborg Universitet, Bauhaus-Universität Weimar, Eidgenössische Technische Hochschule Zürich and Lausanne, Fachhochschule Trier, Politecnico di Milano, Hochschule für Gestaltung und Kunst, Zürich, Technical University Delft, Fachhochschule Zentralschweiz Luzern, ETSA Barcelona, University College London, NTNU Trondheim, Stanford University and University of applied Sciences Aargau. The following disciplines participated: architecture, urban development, civil and structural engineering, construction management, building process management, industrial design, economy, material sciences and social sciences.

The objectives are both to have an authentic learning experience and to show and verify that interdisciplinary work produces enhanced qualities due to the consideration and reflection of a broader spectrum of aspects of the problem. Course topics were: the planning of a campus hotel, the urban planning of the new campus area in Brugg-Windisch Switzerland, planning of the sports facility for a new university, sustainable development in companies. Currently the development of a new sports utility for snow, water and sand and a new tourist concept for the use of thermal springs in alpine environment are the themes. All projects have a real customer and are evaluated by an international jury of experts.

2 New challenges for the building industry

Usual practice when working on projects nowadays is to go about things in a linear manner, which for the building domain means that aspects such as architectural design and static calculation remain sequential processes. This equally applies to the design of infrastructures in buildings, which ever too often results in costly and inefficient installations. A crucial lesson to be drawn from the failures of current practices lays in the future development of much clearer concepts, which allow for buildings to be easy to maintain, yet also provide an approachable and practical concept to its future users. This in turn demands an integral and thorough study of

the perimeter in question, bearing in mind important issues such as life-cycle reflections. In order to cope with the rising complexity in the building domain, especially trained interdisciplinary teams may provide a valid alternative, provided they are willing to collaborate and sensitive towards their team members and the issues at stake. By applying iterative procedures, expert knowledge can be scrutinized and included within the process as a whole. This also helps in detecting potential contradictions and problems at a much earlier stage.

In this context, the question arises as to why collaboration between various disciplines is important already at an early conceptual level. The advantages are manifold: for example, multinational teams learn to improve communication skills, which may result in increased comprehensibility and better didactic skills later on. Interdisciplinary work and internationality on the other hand may also help to reduce costs, as the flow of information and skill becomes much more efficient, thus optimizing the resulting overall value.

The project team should therefore become a natural part of the process, the design of which ought to form an interwoven sequence within the life-cycle of a building. This does however not mean that the amount of time necessary for the design process could be cut, as this would result in an overall performance drop. What it really amounts to is a reallocation of work intensity in favour of the overall conceptual approach. Be that as it may, the expert knowledge within the team remains as important as ever, as only well-trained specialists within their own right can contribute to a substantial team effort. In a society governed by individualism and a waning emphasis on a socially oriented building culture, such statements appear more important than ever.

3 The POLE concept

3.1 The learning system

University students are nowadays increasingly challenged within their specific core disciplines. In addition however, they are also supposed to develop skills in order to apply this particular knowledge in practice. This ideally goes hand in hand with a sense of maturity of the individuals' characters vis-à-vis the social, cultural, and economical environment. The practical application of theoretical knowledge can thus only be implemented successfully if these three basic elements are taken into account.

In addition to university students' disciplinary knowledge, the ability to work efficiently within multicultural environments has become increasingly important. This realization has led to a more proactive stance by universities with regards to networking and offering joint courses, which is where POLE Europe, i.e. Project Oriented Learning Environment, is actively involved in. In the course of this new collaboration, the complementary aspect has gained in importance. An example for this is the liaising between strongly research-oriented and more practically oriented universities with the common goal of being able to implement results effectively and time specifically. In this process, the POLE course puts particular emphasis on improved cultural know-how, which is reflected in the international composition of the POLE teams.

POLE Europe sees itself as a learning system cooperating with foreign universities. It does so within a reflexive context that takes into account the various cultures involved. This results in the creation of new solutions regarding teaching and learning methods. The students are at the core of this concept, and are given the opportunity to develop process oriented expert knowledge through interdisciplinary teamwork. Simultaneously, they learn how to work independently and deal with current problem cases through the use of modern information and communication tools.

3.2 Teamwork

The teams themselves mainly organize processes within POLE Europe. The courses also increasingly tend to amalgamate various lines of work in order to give way to new, holistic, and interdisciplinary perspectives. This concept makes for a comprehensive platform giving students the opportunity to develop their full potential.

The teamwork in the POLE Europe courses allows the students to broaden their specific professional skills, and gives them the opportunity to develop competencies that are necessary in order to adapt to a continuously changing work environment. The courses also provide students with means to evaluate and substantiate their team and communication skills.

Professionals from relevant industries form an essential part of POLE Europe. Their participation contributes a high degree of practical knowledge, linking professional practice and academic education. This exchange allows for a rapid transfer of knowledge and technology and acts as a motivating factor for the participating students. In remolding the landscape of university teaching and learning, POLE also intends to provide an impact concerning decision-making and creation of practical work processes. In association with university teaching staff, industry mentors are therefore instrumental in contributing expert knowledge and regular feedbacks to the teams.

Through collaboration in interdisciplinary teams guided by process management students (1), students from various fields of expertise are given the opportunity to understand the individual processes involved and acknowledge their relation to the social, economical, and political dimensions.

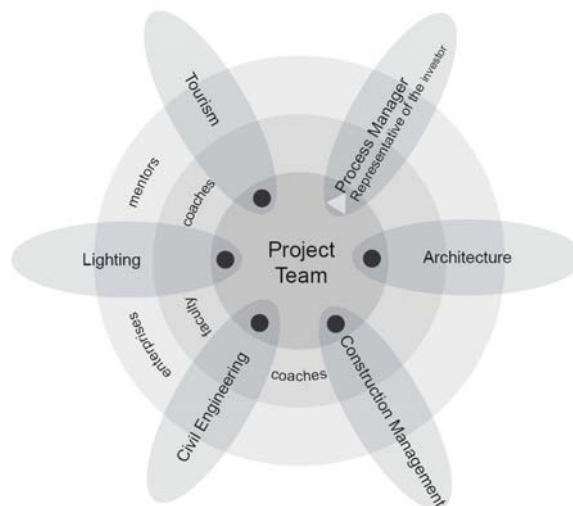


Figure 1: The Pole- Team- Concept

3.3 Organization of courses

A POLE course starts with a kick-off week where all students come together in Switzerland. They get a thorough introduction into the program assignment, visit the site and meet important stakeholders such as the future owner, representatives of the local government or specialists and experts. The students introduce themselves and prepare a summery statement about their intention and goals to participate in the project. After that, the team building process takes place.

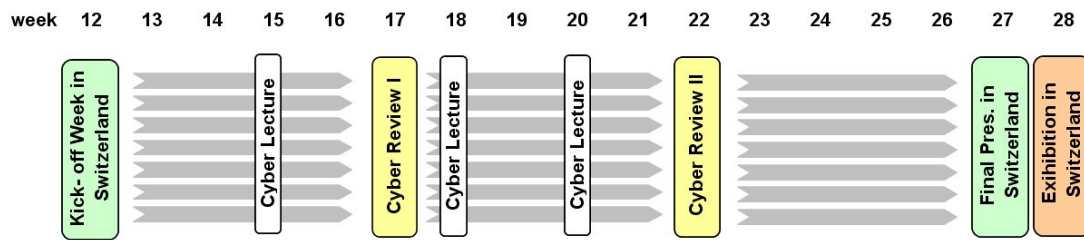


Figure 2: Organization of the courses

The new teams define their set of goals for the project and plan the necessary processes with the help of a process wall (8). At the end of the week, a review with faculty, mentors and owner representatives gives all teams the opportunity to present their work and discuss the proceeding. The kick-off week also includes a two-day introduction into the POLE information and collaboration technology (ICT) as well as hands-on sessions.

The intensive work and the process of becoming acquainted with each other is very important for next phase of distributed team work, where the students co-operate from their home universities via the internet-based ICT. At two cyber reviews, the teams present their current state of work and discuss with faculty, mentors and the owner representatives how to proceed. There are three cyber lectures on ICT, 3D and 4D modeling and collaboration. At the end of a POLE Europe course all students meet again in Switzerland for the final presentation and the assessment of their work by an international jury. Additional presentations may be organized for investors or other groups of stakeholders. The results will be shown in a public exhibition. As part of the requirements of the assignment, students have to create a project web page, which shows the objective, the possible and chosen solutions in an interlinked fashion. This enables the user of the page to learn about the interdisciplinary decision processes of the team.

3.4 Assessment and Grading

An international jury composed of one representative per discipline, and two representatives from the POLE Europe faculty, assess the performance and teamwork and provides a written statement. The home universities are exclusively responsible for the grading of performances of their students and the awarding of ECTS credit points.

4 The ICT concept

As part of the POLE concept, we use currently available software applications. Nemetschek Fides and Partners in Wallisellen, Switzerland is our ICT partner, who provides the academical licenses for the Lotus Internet portal software, Allplan and Cinema 4D. The partnership includes both sponsorship and mutual learning. We receive support in designing and customizing the portal features to our needs and for maintaining the portal availability and share our experiences in using the software in a highly interdisciplinary, international and competitive environment. Thus, software providers can prepare for future releases of their software. Pole participants are not primarily "technology" driven. This shifts the focus to the question, how do processes have to change to make new ICT a success and what changes need to be done with the ICT to support new promising processes.

Pole participants collaborate over the Internet. Per requirement, students from foreign universities need 24 hours per day access to the Internet with a connection of at least 256 kBits/s

and suitable IT support for set up and security issues (firewall settings). A speaker phone with unlimited international access for conference calls is also necessary.

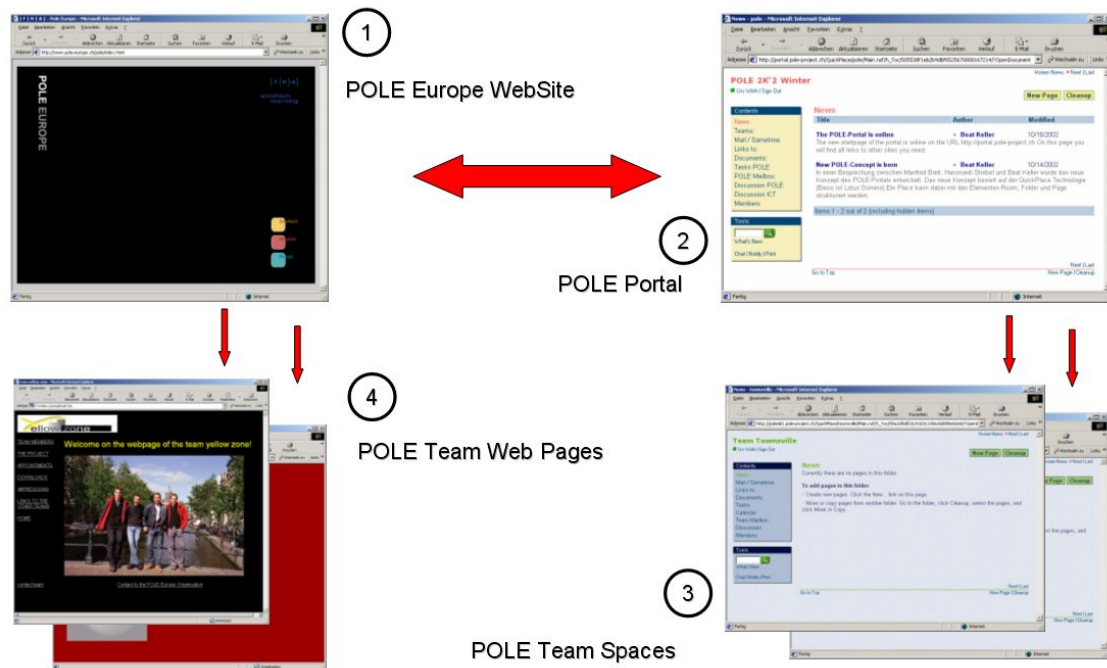


Figure 3: Access to POLE ICT via the <http://www.pole-europe.ch>

To simplify the access to the POLE ICT environment, all information spaces can be reached via the POLE webpage. The POLE webpage is public and offers information about the current courses, has an archive of past courses and links to team web pages and to the POLE portal, which is only accessible for participants. The POLE portal is the main information server and is built up with the following applications: Lotus Quickplace, Mail and Notes. The Portal is a shared information space and meeting place for all POLE participants. There is one common place for all participants and a private one for each team.

4.1 Asynchronous Collaboration

Asynchronous collaboration is the mode of work where participants work on shared information at different times. Participants upload information and attach Meta data (version, purpose, author, etc.), which let the other team member know what to do with it.

The portal has the following features:

- News: serves as a bulletin board
- Document server: storing and retrieving documents and shared computer models
- Tasks: a Gantt chart like tool for team process planning and assigning of tasks
- Team Mailbox: a place to store mail, which is important to the team
- Discussion forum

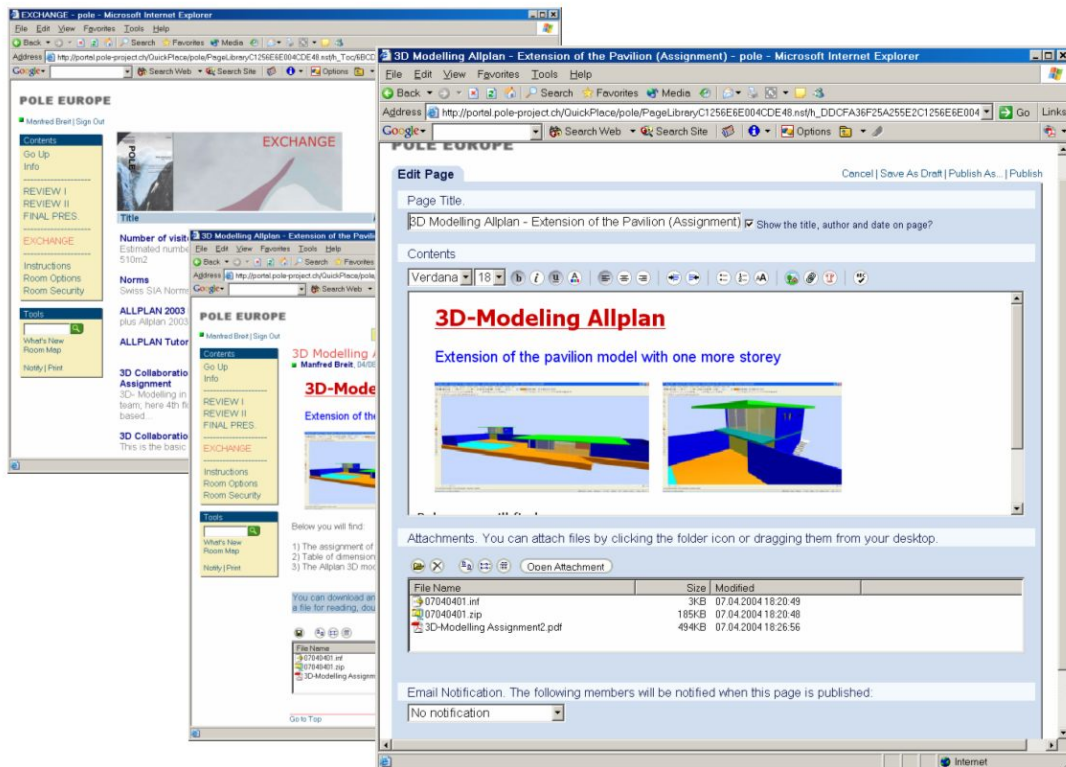


Figure 4: Exchange document folder, document with attachments and editing mode

To store documents in a discussion-forum-like fashion, has been proved as very useful. Students can respond to submitted proposals and comment on it. The handling of the system is as easy as writing e-mails. Author of documents who are currently online are denoted by a little green dot and can be contacted direct via chat or messaging tool.

The asynchronous working mode is a tough learning process for all participants, because they are not used to provide most of the information electronically and pro active within the team process. Only after a certain project progress, this extra work pays off.

4.2 Shared interdisciplinary Models

Most of the documents are output of computer applications, such as drawings, pictures, portable documents (pdf), Powerpoint slides, etc. With the current course we introduce collaboration on shared 3D models. Modeled solutions are explicit. Possible spacial design – engineering conflicts can be detected at an early stage. Thus helping to increase the quality of the work. The databases are stored on the Portal (4) and the version can be denoted as "check out" to show the other participants the status of the work. This mimiks distributed concurrent design and engineering. The 3D models have been organized to discipline specific file sets (a kind of layer structure in Allplan).

4.3 Synchronous Collaboration

Team meet on a regular basis in Cyberspace to discuss problems or to take decisions. In so-called Sametime Meeting (5) participants can share applications, draw annotations on a whiteboard at the same time or upload presentations for shared redlining. The meeting can be scheduled. One important feature is the recording of the meeting which is especially useful if a team member is not available for a meeting. We observed that meeting minutes become even more important in Cyber meetings than in ordinary ones.

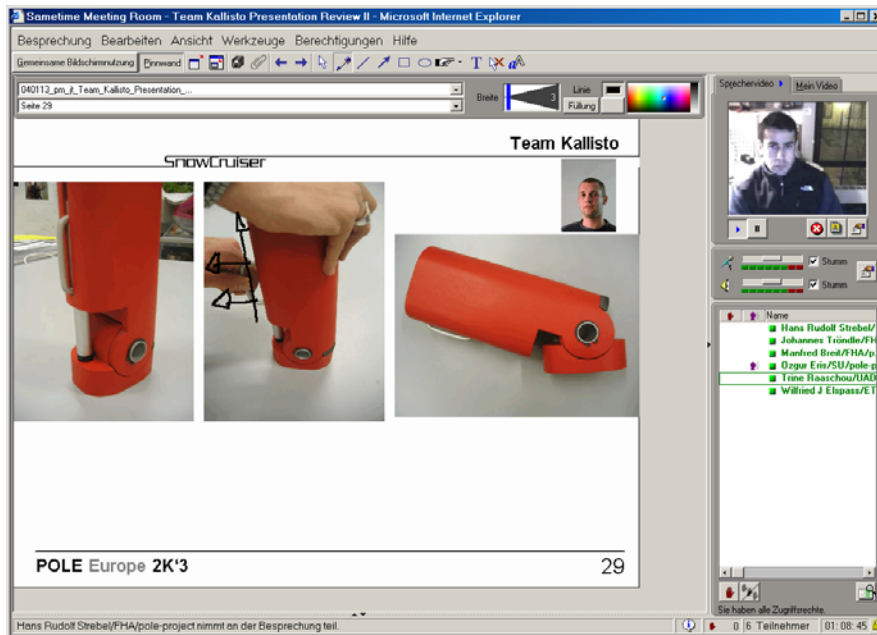


Figure 5: Sametime Whiteboard, Meeting: Aargau, Alborg, Trondheim, Stanford, Zurich

4.4 Review Sessions

Review session with design teams are especially challenging, because they need visual communication to a very high degree. The currently available communication systems in this respect often hinder their own purpose. We try to cope with these shortcomings with the following means:

- Multiple IP-based cameras, displayed in SimuView - an own developed application, which distributes multiple camera views over the Internet
- Sametime
- Telephone conference

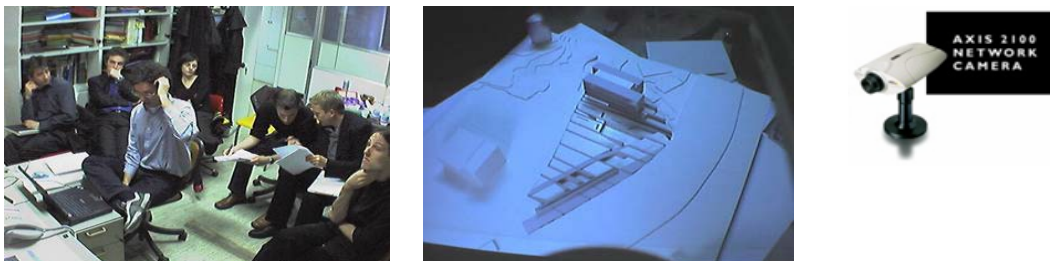


Figure 6: Review Session in distributed Teams: here architects in Milano

4.5 i-Room

The i-Room consists of three rear projected SmartBoards with a touch sensitive screen. Every SmartBoard is connected to a PC running Windows XP a fourth PC acts as server. Only the SmartBoards alone work as enhanced blackboard where the advantages of explaining a problem while writing on a blackboard can be combined with computer applications. Furthermore we installed the Stanford i-Room OS and CIFE's i-Room-to-go, which support information sharing to a much higher degree. The advanced i-Room applications are still in an experimental phase.

Students learn to use the i-Room during the kick-off week. Thus the i-Room environment is the center of information sharing during the reviews and the final presentation.



Figure 7: Final Presentation using physical and virtual models in the i-Room environment

4.6 Storyboard, initial Process design, team building process

The initial task of the new build team is to define their goals and to design the necessary processes at the story board. It shows that the work with cardboards, pencil and paper seems to be the right ingredience to foster the team building process. The resulting process plan is a very valuable executive function if it is used as a vivid co-operation document. We use SMART Ideas from SMART Technologies to combine graphical sketches with hyperlinked information. Currently we are beta-testing new capturing methods to transform the process wall information directly into SMART Ideas.

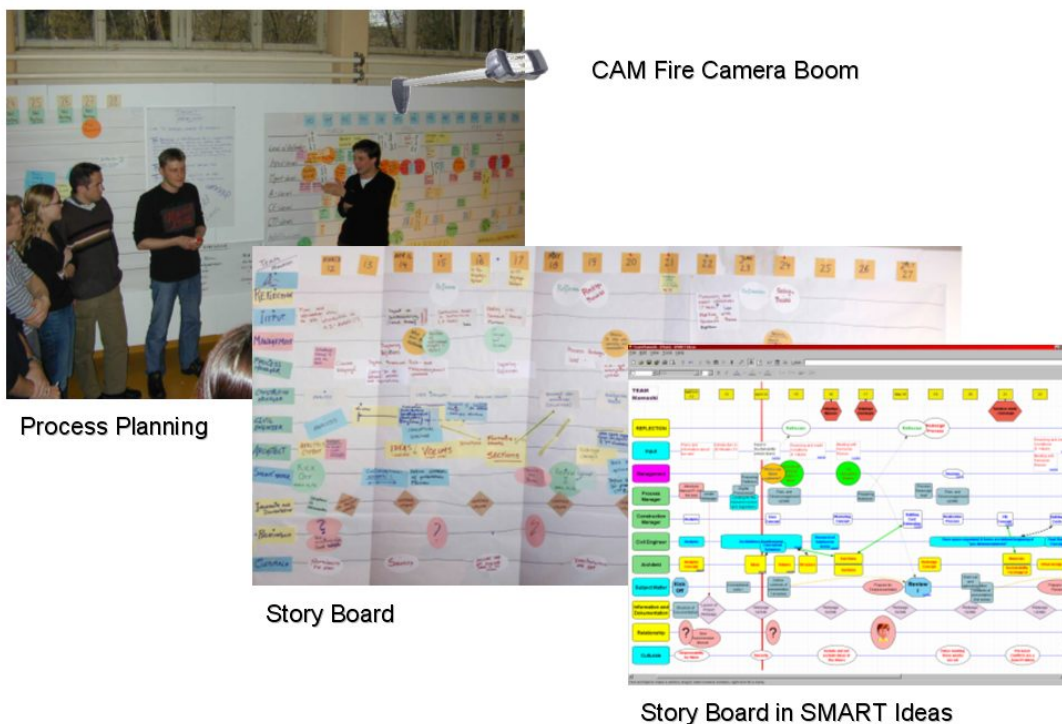


Figure 8: Transforming the Story Board into an team document with executive functions

5 The deployment of disciplinary IT-Tools

We encourage our students to take advantage of design and engineering modeling software. In the current course we started to include collaboration with 3D building models. We teach modelling in the following fields:

- 3D modeling
- 4D visualisation and animation of the architecture and structure
- 4D modelling and visualization of the processes



Figure 9: Landscape architecture, Scene from a 4D animation, Team Dianopolis

6 Research and development

POLE Europe as a learning system is also an ideal testbed for new processes and technologies. Currently we are engaged in the following R&D fields:

- Libraries for Advanced Knowledge Environments: Knowledge capturing and re-use
- 4D Technologies: computer aided process design for the whole life-cycle of buildings
- Assessment of interdisciplinary teamwork

7 Conclusion

The POLE project is been coached by Prof. Dr. Larry Leifer, Lecturer and founding director of the Stanford Learning Lab. As conclusion we cite a passage of his evaluation report:

The scope of the POLE Europe 2k'2 experimentis impressive. I am not aware of a comparable "experiment". The Project Oriented Learning Environment (POLE) curriculumis on the cutting edge of highly distributed, multidisciplinary, team based learning. The combination of disciplines, diversity of universities and richness of the immersive teambuilding experience at

the University of Applied Sciences Aargau are notable on any scale. The level of individual performance responsibility during the dispersed team phase is especially notable and requires a high degree of mature, autonomous behaviour. POLE is also notable for the sophistication and wealth of information and communication technology (ICT) that has been deployed in support of distributed coordination and creative collaboration. POLE Europe 2k'2 serves as an excellent test-bed for the development of a tightly coupled working model for a sustainable relationship between industry and academia across regional borders. In summary: The POLE experiment should definitely be continued.

8 Endnotes

The POLE project has received financial support from Swiss Virtual Campus, and is currently a development project of the University of Applied Sciences Aargau. POLE has also received donation from industry sponsors. The authors want to express their gratitude and thank for the support.

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