A Tool for Preparing Trans-National Access to High Level Visualisation Facilities

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Abstract
VISIONAIR is a European infrastructure that grants selected researchers trans-national access (TNA) to high-level visualisation facilities and resources across Europe. A TNA, however, can only be efficient and effective for both parties if it is preceded by adequate preparation. Aligning requirements and assessing resource usage and working methods are essential here. Adequacy of these preparatory processes is not obvious, as the stakeholders are geographically scattered all over Europe and have their own backgrounds and interests. Therefore, supporting the underlying deliberations can yield huge benefits in preparing a TNA.

The preparation of TNA’s in VISIONAIR is, in many ways, similar to the construction of so-called Synthetic Environments (SE’s) that are used in product development. This publication describes the ability to prepare for TNA’s by applying the framework, working methods and rationale that is habitually employed in developing Synthetic Environments for a specific project-oriented purpose.

Keywords
Synthetic Environments, Visualisation, Roadmap

1 INTRODUCTION
In Europe, quite some facilities for high end visualisation purposes are situated. Visualisation is often defined as “the use of computer-supported, interactive, visual representations of data to amplify cognition” [1]. Some of the visualisation facilities specifically consider visualisation technology in relation to research purposes. They aim at the employment of visualisation technology in research projects, at the development of new technology, or on a combination these two.

Often these research directed facilities have their own divergent specialisations, ranging from ultra-high definition visualisation, scientific visualisation, collaborative environments to virtual reality. Regrettably, despite the many matching goals, little (structured) co-operation between these facilities has been established up to now. Frequently, specific visualisation tasks are not accommodated by the most suitable and competent facilities for those tasks, resulting in sub-optimal results for both researchers and facilitators.

To grant researchers from Europe access to high level visualisation facilities and resources that are most suitable for their purposes, a Vision Advanced Infrastructure for Research is created, also known as VISIONAIR [2]. The VISIONAIR infrastructure, which has over 25 members participating across Europe, intends to permit European researchers access to both physical facilities and virtual services suitable for their research project. Simultaneously, it has the aim to significantly enhance the attractiveness and visibility of the European Research Area (ERA).

To give the VISIONAIR infrastructure a stimulus, physical access of European researchers to the allied facilities is - under certain circumstances-funded by the European Commission. Based on the quality of the proposals and their match with VISIONAIR requirements, a selection of proposals is selected to be elaborated together with the facilities. One of the prerequisites is that a laboratory cannot host a project that has its origin in the same country. Consequently, the physical access of (a) researcher(s) to the facilities of one of the VISIONAIR partners for research purposes is called a Trans-National Access (TNA).

It goes without saying that adequate preparation is conditional for TNA’s to be efficient and effective for both visiting and hosting parties. Preparation is a challenge, as it, per definition, involves communication over some physical distance. Consequently, there is a distinct need to support stakeholders in the preparatory processes. This publication elaborates on the development of a tool that allows both visiting and hosting stakeholders of a TNA to streamline preparatory processes.

2 TRANS-NATIONAL ACCES AS A SYNTHETIC ENVIRONMENT
In its basics, a TNA is not a unique phenomenon. Many situations exist in which stakeholders from different backgrounds collaborate to achieve a specified and predefined conjoint goal.

In product development, so-called Synthetic Environments (SE’s) are an example of a setting in which such co-operations takes place. Given the way in which Synthetic Environments are
developed, established, used and evaluated, there is a clear similarity between these Synthetic Environments and TNA’s. Consequently, the preparatory processes of SE’s and TNA’s will prove to be analogous as well. Therefore, the tools and working methods used in (preparing) Synthetic Environments apply to TNA’s without abatement.

To better understand the backgrounds, requirements and criteria that allow for the equalisation of TNA’s and SE’s, the following sections elaborate on both topics.

3 TRANS-NATIONAL ACCESS

3.1 Stakeholder collaboration in TNA’s

The Trans-National Access of researchers to visualisation facilities is an expensive undertaking; it e.g. includes costs for travel and accommodation, rental of facilities and tools, and support from experts on site. The actual visit should therefore be as effective and efficient as possible; this requires a thorough and streamlined overall process. This also aims at rendering collaboration self-evident and at incorporating unanticipated issues as a matter of course. Clearly it involves the well-considered use of hardware, technologies and working methods.

Adequate collaboration in the preparation of a TNA is hampered by the physical distance between the stakeholders involved. The different backgrounds of stakeholders also do not simplify this process. Applicants, for example, are most familiar with the research goals that are aimed for and the occasions for considering the employment of high-level visualisation technologies in the research process. However, due to the unfamiliarity with the exact possibilities of using the technology in a certain laboratory, facilities might be under- or overrated by applicants. The host of a facility, who often is an expert in the field of visualisation technology, runs the risk of overrating the significance of technical specifications in defining solutions, losing sight of the initial goals of the visualisation. Moreover, a host can easily misinterpret the intent of an applicant.

3.2 Facilities and working methods

The facilities that are offered by VISIONAIR vary from individual visualisation tools, via dedicated custom build solutions, to fully equipped Virtual Reality Laboratories (e.g. [3]) that allow for a wide range of solutions. Therefore, it might initially be difficult for an applicant to assess what facilitator will provide the most suitable solution package in relation to the research interests. Although a VISIONAIR resource map is published [4] that gives an overview of the specific technologies and models available at the various facilities, applicants run the risk of making incorrect assessments of technology required. This is partly due to the fact that the applicant needs an adequate combination of facilities, resources and working methods.

This not necessarily is a problem if switching facilities -based on progressive understanding that is gained during the preparation activities for a certain facility- would be easy and would not require a lot of rework. However, because of the variety of original working methods present at the different facilities and the lack of a common framework, the preparation process might need to be restarted from the beginning. More conformity in the preparation of TNA’s would prevent this re-doing of work.

3.3 Facilitating the preparation of TNA’s

To streamline activities in preparing TNA’s it would be beneficial to have some collective approaches that facilitate the process. The approach should ideally support stakeholders from many different backgrounds and locations to work as efficient and effective as possible. It should enable them to formalise a plan of execution that can be carried out at the time a facility is actually visited.

Considering the variety of stakeholders, project proposals, facilities, and current approaches, it is, however, difficult to foresee all potentially required processes and interactions. Therefore, it would be inefficient and undesirable to support the development process by some kind of method that merely prescribes (a set of) processes. Moreover, any imposed collective method will harm (or favour) at least some of the individual strengths already present at the facilities.

4 SYNTHETIC ENVIRONMENTS

4.1 Stakeholder collaboration in SE’s

During product development cycles, an initial and evolving set of requirements is translated into an adequate solution: the required product. Many stakeholders have influences on different levels of the cycle. This cycle actually is an amalgamation of activities, resulting in a network of influences, decisions and assumptions that together shape the end-result. In this, the available capacity and capability of resources play significant roles.

Synthetic Environments are used to bring together all influences on product development cycles, while achieving synthesis between information, resources and control mechanisms to reach an adequate solution (product).

Generally speaking, a Synthetic Environment can be described as any deliberately constructed artificial environment that gives more insight in the real and natural environment; allowing an operator to navigate or interact as if in the real world. As a Synthetic Environment simulates a real world situation, its construction is usually based on virtual and augmented reality technologies.

It is obvious that the development of a Synthetic Environment also requires extensive preparation before its use can actually provide significant results in product development cycles. This preparation
often is a consultation process between the client (e.g. a SME conducting design processes) and the host of the facility that realises the Synthetic Environment.

4.2 Virtual reality technology in SE’s

The virtual reality (actually being a combination of ‘virtual’ and ‘real’ reality) that is used in SE’s allows for the engendering of new objects, spaces and interactions. It does not need actual construction, thus providing the possibility to experience these objects, spaces and interactions even in the very early stages of the design process.

Advances in VR hardware and software industry have made much technology affordable to ordinary users. However, only a ‘clever’ application of the technology, with adequate attention for working methods, makes the technology profitable. Reality shows that many users apparently have trouble identifying and interpreting benchmarks for defining such a ‘clever’ application; despite its promises, VR technology is currently not exploited to its full extent. The concept Synthetic Environments tries to solve this problem by employing working methods that support the exploitation.

4.3 Development of SE’s

Although manifestations and established advantages of Synthetic Environments are case specific (they depend on the strengths and weaknesses encountered in a company’s development process), Synthetic Environments do have generic characteristics. They allow for:

- realistic experience of virtual interaction, ensuring validity of decisions in the real world.
- simulated effects in a familiar context to stimulate stakeholders to develop a realistic mental image of a future product or situation.
- congruent mental images of the future of a product or situation, facilitating negotiations about the consequences of their characteristics.

In recognising the significance of these generic characteristics, it is possible to establish a ‘blueprint’ of how Synthetic Environments are efficiently and effectively developed and used [5]. This blueprint (see figure 1) is currently used as a guideline in the consultative process between the visitor and the host of a SE. The perspective of the blueprint focuses on the host, and his role as a consultant.

5 Synthetic Environments in Visionair

As the corresponding characteristics of respectively TNA’s and SE’s indicate, treating a TNA as a synthetic environment is instrumental in selecting resources and preparing for their effective usage with the appropriate stakeholders. This makes it reasonable to apply working methods for constructing Synthetic Environments in the preparation of TNA’s.

The long-distance communication and collaboration in the development of Synthetic Environments has not been a real issue until now. Therefore, the way in communication is arranged might require attention. Moreover, the information that is available on the construction of SE’s is primarily accessible for the host of the SE; the information has not yet been formalised for use by stakeholders with different backgrounds.

To make working methods for SE’s employable for application in VISIONAIR, the approach needs to be adjusted to also meet the requirements specified in the context of TNA’s (see section 3.3). Obviously, the improvements for TNA’s will also benefit the approach for SE’s.

The following sections introduce a tool that enables VISIONAIR stakeholders to employ SE knowledge in the context of TNA’s.

6 A ROADMAP FOR CONSTRUCTING SE’S

6.1 Roadmap Approach

An approach that can employ the fundamentals defined in the previous sections is the so-called Roadmap approach [6]. Roadmaps use descriptions of processes and process steps to access and structure information. At the same time, individual information entities give guidance in understanding the suitability of processes steps in the overall process. Consequently, the roadmap concept can provide an extremely flexible way of supporting stakeholders during their collaboration.

As a roadmap offers a common framework for multiple stakeholders, and can even explicitly amalgamate and employ existing working methods present at the different facilities, the roadmap concept is chosen as basis for the tool.

6.2 Roadmap Structure

To develop the roadmap, it is, in the first place, required to identify an appropriate information structure. This structure must be suitable to capture the entire information content that is used for, and result of, the development of a SE. It should, for this purpose, be able to adequately subdivide the entire
information storage into sub-repositories that make information easily retrievable for all stakeholders involved. Inspiration for the structure is found in the blueprint in section 4.3. The result of translating this structure in a roadmap for all stakeholders is shown in figure 2.

In essence, the structure of the roadmap for Synthetic Environments in VISIONAIR consists of 'checklist' items that guide users in their process of developing and establishing a Synthetic Environment. The items are listed below:

A Occasion for considering SE’s in the process
B Opportunities for introducing a SE in the process
C Stated Purpose
D Requirement Specification for SE
E Basic Construction Variants
F Effects of Variants
G Definition of SE
H Prototype Implementation of SE in the process
I Comparison with reference projects
J Documentation for implementation SE

6.3 Roadmap Content

6.3.1 Library function

The different items in the roadmap indicate the information that is required to meticulously underpin the decisions that are made during the construction of a Synthetic Environment. Also the considerations on whether or not to use a SE in the development or research process are included.

Each element of the roadmap is provided with a description of the interest of acquiring the information. Moreover, approaches to generate that information are suggested. As often more than one approach can be used to generate the same (type of) information, stakeholders are free to choose any approach that appears useful; they are definitely not restricted to using approaches offered by the roadmap. In fact, the roadmap is never finished, nor complete; the roadmap benefits from regular updating to allow new approaches (e.g. the approaches and or tools developed during the VISIONAIR project) to become part of the content.

6.3.2 Communication function

When using the roadmap to structure considerations and decisions during the establishment of a SE, it is helpful to employ the roadmap structure to capture the information content as well. To support users in this documentation effort, a mind-map is provided that acts as a digital 'workbook'. By attaching rationale, decisions, e.g. in documents, to this mind-map, users are able to efficiently capture their work.

In order to make the roadmap easily accessible for all VISIONAIR partners as well as (prospective) visitors to the VISIONAIR facilities, the roadmap is published on a website. A depiction of the proof-of-concept of the website is shown in figure 3.

Currently, the first version of the roadmap is ready and available for use by VISIONAIR partners and TNA applicants.

Figure 3 - The web-based implementation of the roadmap.

7 SCENARIO FOR PREPARING A TNA

To give an indication of how the roadmap is used in preparing a TNA, a scenario is presented below. The scenario merely shows one specific situation; as the roadmap is developed to allow for extremely flexible use this is definitely not the only way of using the roadmap.

7.1 Scenario

Tom is a Greek researcher; he sees added value in using virtual reality and visualisation techniques for better exploring the data he has gathered. This is why he answered the VISIONAIR project call; he submits a proposal depicting his project, the visualisation and interaction needs, and the reason why he proposes to visit the Dutch site. Tom prepared an excellent proposal, so he receives a notification that his project is selected. This means that Tom can now contact the host of the proposed site, and that he can start preparing his visit. The host, Peter, invites Tom to use the Roadmap for constructing Synthetic Environments.

When Tom visits the web-roadmap application he finds out that a TNA can be considered to be a Synthetic Environment. By navigating the different
blocks of the roadmap he finds out what information he needs to gather in order to be well-prepared.

In block A he is recommended to establish his occasion for considering a synthetic environment. As Tom already wrote this occasion in his proposal, this step allows him to check the validity of his underpinning. He can quickly document his occasion in the mind-map that is provided with the roadmap. The mind-map has the same structure as the roadmap and can therefore be used as a kind of workbook. From this workbook, the content of block B follows effortlessly. In block C, Tom needs to carefully formulate the “stated purpose” of the visualisation. To find an appropriate manner to document the stated purpose, he reads more about the approaches that are suggested to specify requirements on the stated purpose. This information helps him to write down his stated purpose in the mind-map.

Subsequently, one of the approaches in block D shows how to use Scenario Based Requirement Specifications, and another how to write these scenarios in a coherent manner. After adding the scenario based requirements specifications to the mind map, Tom discusses the intermediate mind-map with Peter. He hopes that Peter has some idea of the construction variants that can be used for realising the scenario.

Based on Tom’s workbook content, Peter acquires a much more clear indication of the project. As Peter is quite experienced in the field, and can quickly retrieve captured content of similar projects via the database in block I of the roadmap, he can easily come up with solutions. He uses the scenario to define rough descriptions of three different solution variants that are possible on his site. He adds the variants to the mind-map.

The preferred variant has to meet Tom’s strategic research/development process. To assess this, Tom makes an updated version of his process definition and planning. Based on the availability of the proposed solutions and the check with other relevant blocks in the roadmap, Tom and Peter conjointly select the solution that fits best in the time schedule and process planning. They document a detailed plan of constructing and using the SE in the mind-map. Consequently, they have a well-considered plan of approach for implementing the Synthetic Environment in the research project. Now, Tom and Peter know what to prepare before the visit so they can use the time during the visit as efficient and effective as possible. They are confident in their plan and look forward to the actual TNA.

8 TESTS AND EVALUATION

8.1 Test organisation

The first purpose of testing the roadmap approach is to assess whether it offers guidance in the preparation of divergent scenarios for preparing TNA’s. Moreover, such assessments allow for the improvement of the roadmap concept.

As described before, the roadmap structure for preparing TNA’s has been implemented in a web based application. With this application, the use of the roadmap structure has been evaluated in a number of case studies, elaborating upon several different scenarios and aspects. The studies aimed at answering the following questions:

- Does the roadmap provide guidance through the (yet) unfamiliar design process of a Synthetic Environment?
- Can information on the development of a Synthetic Environment be adequately accessed via the roadmap structure?
- Is the roadmap suitable for the ‘applicant’ as well as for the ‘host’?
- Does the roadmap adequately support over-distance communication?
- Can the roadmap for constructing Synthetic Environments incorporate all VISIONAIR tools where applicable?

To be able to answer these questions, the case studies addressed various research projects in which Synthetic Environments are employed, using the roadmap as a facilitator. The participants of the case study, however, were not always asked to actually perform all the actions that are needed to be able to come up with a Synthetic Environment. Instead, they were asked to indicate what information would be required, what actions they would like to perform, and in which sequence they would perform these actions to be able to arrive at a satisfactory definition of a SE.

8.2 Test with VISIONAIR partners

An example of a case study that has been performed is the test that was conducted during the VISIONAIR General Assembly at the University of Twente. The test with VISIONAIR partners was arranged in the Virtual Reality Laboratory of the University of Twente. Aim of the test was, first of all, to familiarise the various partners with the proposed roadmap approach. This was done by allowing them use the roadmap in a small case study in which they created a plan for implementation of a Synthetic Environment in a research process.

During the workshop, the partners had to take into account both the customer and supplier of the facility. Therefore, the group was split up in two smaller groups, each representing one of the two roles. The groups had to collaborate on how a SE could be implemented in an effective manner, and what the SE should look like.

The roadmap was used by both groups to support the collaboration and to help both groups to conjointly prepare a proposal. The information that was gathered during the workshop was indeed documented in the mind-map that was provided with
the roadmap. This document could -after gathering enough information- be used as the final proposal.

Simultaneously, participants considered some questions on the appropriateness of the Roadmap structure, the applicability of approaches/tools/templates and the capturing and exploitation of best practices. Additionally, they indicated what approaches they would like to add to the content, and how they would suggest to disseminate the Roadmap approach in VISIONAIR.

8.2.1 Evaluation
Following the case study, the questions were discussed in an evaluation session. In general, the impression of the roadmap structure was positive. Even, the roadmap does show considerable overlap with the TNA application form that is used for selecting proposals. This clearly stresses the relation between the formal TNA organisation in VISIONAIR and the roadmap.

The VISIONAIR partners indicated to have found useful new approaches in the map. Also the inclusion of some tools directly developed for VISIONAIR was appreciated. Partners immediately became enthusiastic to make some of their own approaches available to other partners via the roadmap.

Considering the existing learning curve of the roadmap, it was indicated that it would be helpful to have a number of ‘example’ projects that illustrate the usage of the roadmap. It is expected that such examples (captured in block I of the roadmap) will enable applicants to reduce the time required for learning to use the roadmap.

Currently, the mind-map is send via e-mail when important new information is added. It is, however, recommended to use some kind of document synchronisation system for synchronising the information in the mind-map.

In general, disadvantages and critical remarks mainly addressed the quality of the implementation of the roadmap, and not the roadmap itself. This is caused by the proof-of-concept quality of the implementation; in further developments, such points for improvement can easily be integrated.

9 CONCLUDING REMARKS
By taking advantage of the similarities between (establishing) Synthetic Environments and TNA's in the VISIONAIR context, a new complexion can be put on preparing TNA's. The experience gained with the blueprint structure for establishing SE’s has resulted in the development of a roadmap that, with slight modifications, proved to be applicable for TNA’s.

The current status is that initial validation has been performed, and ideas for future elaboration have been formulated. These ideas focus on the ease-of-use, on the capturing of experience and on the dissemination of knowledge in a wider community. Also the quality of the implementation will be addressed, before the roadmap becomes an inherent tool for (at least) the VISIONAIR community.

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11 REFERENCES

12 BIOGRAPHY
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