

## 3D Procedure Authoring Tool

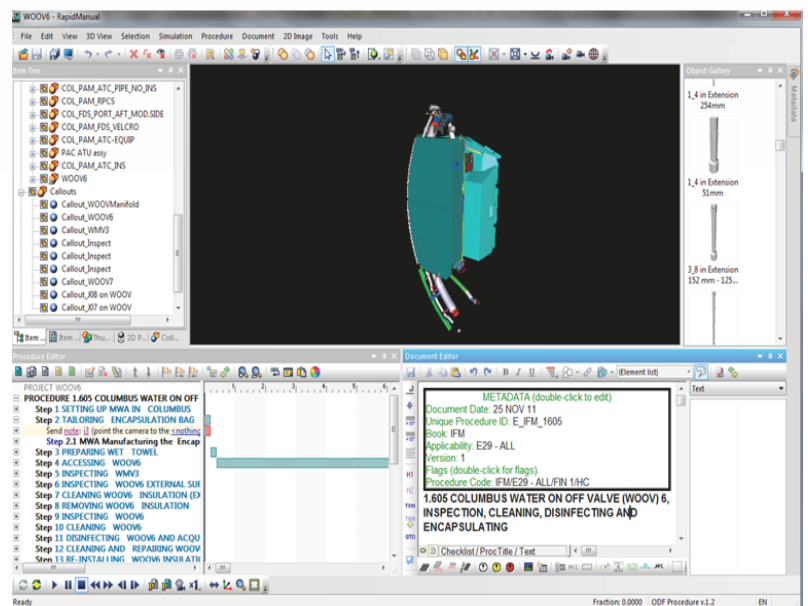
The European Space Agency (ESA) provides cooperation among European States in space research and technology and their space applications for exclusively peaceful purposes. ESA takes part in the International Space Station (ISS). Its astronauts have participated in space flight missions since the early 1980s. The following information is in respect of ESA ESTEC Contract – 4000103660: Authoring Environment for Interactive 3D Procedures. The contracting parties were Parallel Graphics Limited (IRL) and Skytek Limited (IRL).

### Background

The project aimed at improving the quality and performance of ISS crew operations and training. Training and mission operations are of crucial importance to the International Space Station and other similar sophisticated programs. The use of 3D Interactive procedures can bring benefits to operations and training, through improved understanding, minimizing the time required to train for a task and increasing knowledge retention.

For human space flight missions, task execution in the spacecraft and/or space station are mostly accomplished by the astronaut following a ground prepared and validated crew procedure. Today on the International Space Station procedures are XML and PDF documents, with pictures and illustrations interspersed where operationally beneficial. The procedures are accessed by crew members through a graphical user interface provided via a custom built interactive procedure viewer (iPV – international procedure viewer) deployed on laptops within the ISS.

The full 3D PAT authoring application is shown below including the 3D Window that is used for highlighting and previewing the animations.



3D PAT Authoring Interface

Procedures today are developed in a prescriptive way that enables a step-by-step procedure execution. With the new 3D PAT a fully interactive 3D view or virtual reality view of the procedure can be delivered to the astronaut. During training and or to rehearse an activity, the astronaut can always do a walk-through including interactive 3D of the procedure prior to the scheduled activity execution. To enhance the preparation/rehearsal phase it is possible to play a virtual-reality clip showing what has to be done, and how.

### 3D PAT Development

3D PAT has three primary areas of functionality:

- Importation of source data
- Authoring the Document Procedure and Creating Animations
- Publishing and Delivery

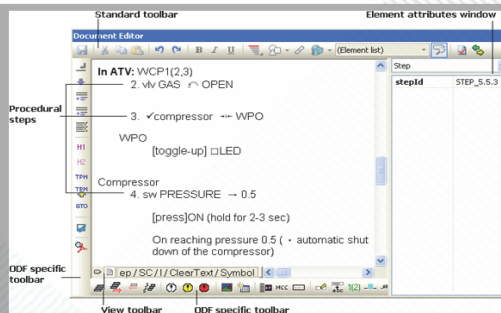


Figure: Document Editor

### Authoring & Animations

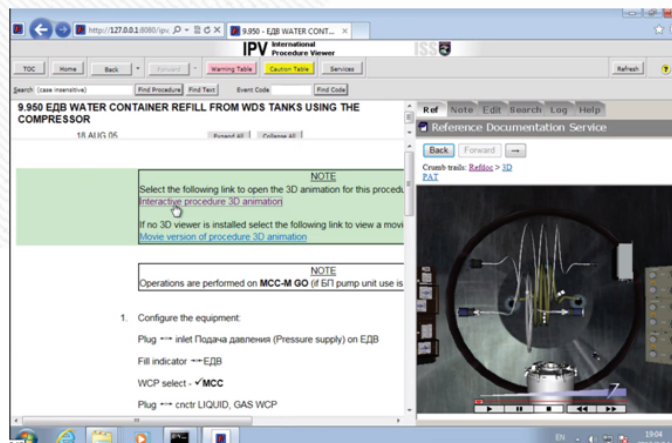
The 3D PAT authoring interface includes two primary areas of functionality:

- Document Editor for ODF authoring
- Procedure Editor for Animation creation



## 3D iPV implementation

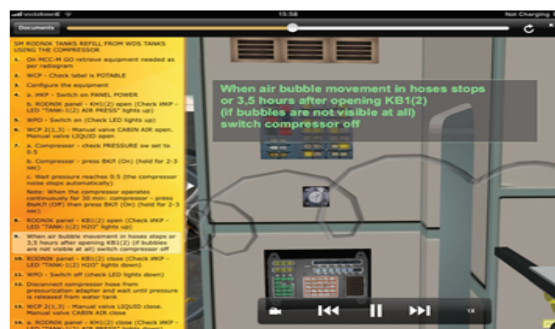
When the procedure is published and accessed via the iPV system, the user will click on the defined hyperlink to launch the reference documentation service and display the 3D model via the installed Cortona viewer. Once the model is displayed the user will have the capabilities to synchronise the 3D animations with procedure steps. The synchronisation can be controlled from either direct procedure navigation or from 3D model animation playback. When synchronisation is controlled through procedure step navigation, whenever a step is selected that has an animation linked to it, the linked animation is automatically displayed and played. When synchronisation is controlled from the 3D model viewer, when the complete animation sequence is played the active step within the ODF procedure is automatically updated to reflect the relevant step to the animation being currently viewed.



**IPV with 3D animation displayed**

## Mobile Device Testing

Since the commencement of the contract several platforms have emerged and been extended including iOS and Android. The main focus was on the iOS due to stability of the platform hardware and the decision during the project to bring an iPad on board of the ISS. The testing was performed on the Cortona3D iOS App.



**ODF derived procedure on iPad**

In addition, for the Android platform a beta of a Java-based viewer was developed and tested. While the Java-based viewer performed equally well as the native viewer when tested on a PC, the results varied on Android platforms. One of the issues with the Android platform is the wide variety of hardware with many different specifications. In tests the Java-based viewer was very dependent on the specification of the test machine. A possible future enhancement could be to extend the native Java ODF viewer integrated with the Cortona3D Java viewer which both can be ported to mobile devices.

## Research: Collision Detection, Physics Simulation and Augmented Reality

The goal was to research how real-life factors such as collision between objects and other physics parameters could be simulated in 3D Virtual environments to give a more realistic view to the users performing the task or procedure.

We have considered Physics Simulation and Haptic Devices, Digital Mannequins Animation and Augmented Reality.

Our research has shown that presented use cases are quite viable and with proper development can be used in real training scenarios.