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DELIVERABLE D6.4

Exploitation Plan

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**Deliverable review procedure:**

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* **Upfront** PM assigns a co-reviewer from the PMT group to cross check the deliverable
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* **Due date:** deliverable owner sends the final version of the deliverable to PM and co-reviewer.

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# Executive summary

This deliverable summarizes the exploitation results from the collaboration in 3D Pathology. Some products have already reached the market, but also longer term exploitation perspectives, standardization contributions and continued collaboration between partners are reported in the subsequent chapters.

# General introduction

## Scope

In this document we gathered the exploitation plans of all 3D Pathology partners based on the project results. This includes information on commercial aspects and business opportunities of new technologies developed during the project; these can relate to dedicated new commercial products as well as enhancement of existing products.

# Partners Individual Exploitation Plan

The following section contains an overview of the final exploitation plans of all partners in the 3D Pathology project.

## Philips

### Partner description

Already a world leader in imaging systems, radiology information systems (RIS), and picture archiving and communication systems (PACS), Philips has established the Digital Pathology venture to develop a sophisticated yet easy-to-use digital pathology solution designed around the needs of pathologists and that offers exceptional image quality. In 2007 Philips started a new business activity around this subject (Philips Digital Pathology Solutions), resulting in first sales in 2012. By digitizing the images that pathologists normally view through a microscope, Philips’ goal is to offer integrated solutions that help to enhance the operational efficiency and productivity of pathology departments. Other benefits include improved turnaround time for lab results.

Development within WP1 of the ITEA 3D Pathology project will result with a new scanner on the market capable of multi-layer bright field imaging. This product will set a new technological benchmark in the digital pathology solutions and increase usability range of our current scanning solution for the molecular histology.

Current Philips Ultra-Fast Scanner (UFS) is only FDA approved digital pathology solution for the primary diagnostics. This in combination with the new multilayer scanning technology will enable Philips to aim for major share of the fast-growing market.

### Obtained results

Philips developed a unique sensor to enable the next generation Digital Pathology 3D scanner. New sensor designed, produced, tested and showed very satisfactory performance results. Sensor integrated into the optical-mechanical unit that able to create images of a single microscope slide. The unit named Scanner Engine partly inspired by the existing UFS scanner and partly redesigned. Design and development effort resulted in a system with unique combination of hardware, electronics and software components working together. Advanced processing developed to make accurate scanner movements combined with multi-color illumination and automatic focusing. The system complexity requires iterative approach to the scanner realization. Philips development team together with another consortium partner – Prodrive Technologies tested many solutions before reaching desired performance. Tens of the Engine prototypes built and tested. Design evolved through three prototype iterations. Multilayer technology demonstrated and image quality confirmed to be superior to the UFS scanner. Next step is in manufacturing latest design solutions into a pilot batch and integrate into the new scanner.

### Perspectives, plans

New scanner introduction planned for the next year. It will be demonstrated and introduced to the pathology community in main pathology events of the year: USCAP and European Congress of Pathology.

Philips aims to expand its market share by offering integrated solutions for pathology departments. In three-four years, based on the widespread adoption of digital pathology, Philips is expecting at least 15% sales growth p.a. with 3D applications contributing for this digital pathology business, which is based in Best (NL). In addition to Philips in its role of system integrator, many suppliers of subsystems and components will benefit from additional sales generated as a result of 3Dpathology for other Dutch ecosystem partners/suppliers (i.e. those not belonging to the 3Dpathology consortium).

Philips is holding a leading position in digital pathology scanner solution for primary diagnostics. New scanner will increase market share and secure Philips position it this market sector.

## Barco

### Partner description

Barco, a global technology company, designs and develops visualization solutions for a variety of selected professional markets: medical imaging, media & entertainment, infrastructure & utilities, traffic & transportation, education & security, and corporate AV. In these markets Barco offers user-friendly imaging products that optimize productivity and business efficiency. It’s innovative hard and software solutions integrate all aspects of the imaging chain, from image acquisition and processing to image distribution, management, and visualization. Barco has its own facilities for Sales & Marketing, Customer Support, R&D and Manufacturing in Europe, America and Asia-Pacific. The company (NYSE, Euronext Brussels: BAR) is active in more than 90 countries and employs 3.500 staff worldwide. In 2016 Barco posted a turnover of 1.102 billion Euro.

The Barco Healthcare division is the worldwide market leader in diagnostic medical display systems. Specifically for display systems for breast cancer screening, Barco has a worldwide market share of approximately 50%. Throughout the years, Barco has built a very strong expertise related to medical display systems, image processing and visualization.

### Obtained results

On the part of the visualization Barco learned a lot during the project on the technical requirements for a dedicated pathology display system. It includes the desired color behavior, response time, color management, … These requirements are been taken into account for the dedicated pathology Barco is developing.

Barco discovered while executing of the project that there is need for 2 different color calibrations. First of all there is a need for absolute color calibration in case of brightfield imaging. Color management has been implemented based on ICC profiles of the scanner (source profile) and display (destination profile) and successfully applied within a web browser with an average accuracy of 3,02 DeltaE2000 units.

Secondly there is also the clear need for a perceptual linear color calibration (similar to GSDF for grayscale images) in case of pathology images without real colors like fluorescence and mass spectrometry images. Also this calibration has been successfully implemented and is still part of ongoing standardization efforts.

Finally Barco also investigated how 10 bit pathology images can be represented correctly in a web browser, what is of nature limited to 8 bits.

### Perspectives, plans

Valorisation of the project outcome will be through the creation of a broader product offering for Barco. Barco plans to have display systems that address a variety of needs in the pathology lab, these are different product segments. The most basic segment needs calibrated, stable display systems for review, positioning of samples, and other non-diagnostic purposes. Barco already has products applicable to this segment, and evolution here will be covered here by the synergy and overlap with the radiology displays. The segment addressed by the 3DPathology project is the diagnostic segment. It is in this segment that the pathologist is working. The diagnostic display is a link between reality and the eyes and neural system of the pathologist. Despite an initial tendency to shop for the least expensive components, all medical professionals quickly come to realize the value of their time and the value of effective performance. To the extent that 3DPathology systems save time and increase effectiveness, the value of the display system portion is valorised by a higher price for the equipment sale.

Barco already has a robust channel to provide displays to the healthcare institutions. This consists of two parts, a first part that is a business to business sales channel, and a second part that is business development approach directly to the healthcare providers. The existing business to business sales channel does have some overlap with the sales channel needed to address the pathology labs within the healthcare community, and this will be augmented to include new partners that Barco will need to more completely cover this segment. New business development staff will be hired to specialize in approaching and educating the pathology labs. These staff will exist alongside similar staff currently creating awareness of the Barco surgery systems and radiology display systems inside healthcare institutions.

## PS-Tech

### Partner description

PS-Tech is specialized in professional 3D visualization solutions and optical tracking solutions. The company’s mission is to enable professionals to work with and analyze complex 3D and 4D data more efficiently and effectively.

PS-Tech was founded in 2005 as Personal Space Technologies B.V. and is a spin-off company of the Center for Mathematics and Computer Science (www.cwi.nl). The company is based in Amsterdam, the Netherlands.

The main markets are:

* medical visualization and navigation,
* simulation & training
* optical tracking and interaction.

Business areas range from medical, industrial design, training and simulation, serious gaming to the car industry.

PS-Tech’s systems are found in hospitals, industrial design environments, research institutes, museums and universities.

PS-Tech is recognized in Europe and the US as one of the world’s most innovative high-tech companies. In 2012 PS-Tech won the ‘Dutch Accenture Innovation Award’ for its C-Station™ in the category best new technology.

PS-Tech, as an SME (10 staff), has the strategic policy to collaborate with those partners (scientific and commercial) that add most value to both technology and product development. In that respect there are collaborations within the Netherlands and Europe. PS-Tech has obtained several research grants and is part of European consortia.

For more information, visit the PS-Tech websites at www.ps-tech.com or www.ps-medtech.com.

### Obtained results

PS-Tech’s visualization technology allows for interactive visualization of volumetric (pathology) images and has 10 plus years’ experience in 3D workstations.

PS-Tech used its 3D workstation (C-Station, combined with Vesalius3D rendering engine) in the project to provide users with a means to quickly review the problem areas in the analyzed pathology data sets. Through the intuitive 3D interaction and the data displayed in 3D, users gain better insights in the patient’s specific problems.

Within the 3D pathology project PS-Tech built several tools into the medical visualization package Vesalius3D. Most notable are the following:

* New types of data can be visualized: Brightfield Microscopy (AMC), OCT data (AMC), Mass spectrometry data (M4I) and Particle accelerator-CT (Korean partners).
* Much larger datasets can now be visualized in 3D (up to 1.3GB per slice).
* Different modalities can be compared and visualized simultaneously.
* 3D Navigation using standard interfaces was developed for remote interaction and visualization. This 3D navigation through standard interfaces also enables the full interactive capabilities of the Vesalius3D package when it is on a PC or laptop instead of on a C-Station. This improvement has already been incorporated in Vesalius3D.
* Demonstrator of volumetric zooming functionality allowing users to zoom to reveal the full resolution of the datasets in 3D. The zooming functionality will be implemented in a future release of Vesalius3D.
* High resolution lighting has been implemented to provide a better overview of the data’s 3D structure. This improvement has already been incorporated in Vesalius3D.
* Masking technology was created that allows users to extract data from volumes. This improvement has been incorporated in Vesalius3D.
* Interactive remote visualization. Tests were done for remote visualization and interaction on Ipads, Smart phones and laptops. These systems lack the required capacity for storing huge amounts of volumetric data and they lack GPU processing power to display the visualizations. Through the implementation of 3D Navigation using standard interfaces, it is now possible to connect with a C-Station and control Vesalius3D remotely.
* Together with AMC and M4I technology was developed to successfully visualize the 3D data from 3D microscopy and Mass Spec data. A demonstrator was created allowing Visualization of specific Mass spec scans out of the huge quantity of data generated by M4I.
* In the final demonstrator PS-Tech was able to visualize aligned mass spec and brightfield data.
* A new segmentation/extraction module for volumetric datasets, enabling geometrization for 3D printing of extracted/segmented parts was incorporated into Vesalius3D.
* New technology was created to be able to visualize data using high resolution lighting.
* Rest interface technology was created to be able to link third party results to Vesalius3D.

### Perspectives, plans

The technologies developed within the 3D pathology project as well as the insights obtained drive new developments at PS-Tech. Many of the results have already been included in the new releases of Vesalius3D. Most notably masking, 3D navigation and color data visualization. Other results are further used in research projects and are expected to find their way into releases in the next two years. Furthermore PS-Tech is thanks to 3D pathology planning to develop:

* 64-bit Volumetric rendering needed for visualization of even larger data sets.
* Simultaneous navigation and visualization through multiple views. In effect, be able to position virtual cameras inside volumes and navigate them at will.
* High speed zooming functionality through very large 3D datasets.
* Enhance the masking and extraction tools to be able to semi automate extraction processes.
* Work with partners to combine 3D visualization and navigation with deep learning tools.
* Implement the Vesalius3D technologies in a cloud environment.
* Provide SAAS and PAAS solutions based on Vesalius3D.
* Continue the working relationships with the partners within the 3D pathology project.

## Target Holding B.V.

### Partner description

Target Holding is a SME with a 30 fte workforce, specializing in 'Big Data' Analytics, amongst others the classification of unstructured data, applied to time series based (sensor) data mining for trends & forecasting as well as natural language processing. ITEA-3D pathology together with the ongoing ITEA-Medolution project (both, however, for totally different aspects) enables us to succesfully focus on image analytics as a third field. To connect and gain benefits from complex medical data sets is one field of interest content-wise, next to energy (smart grids), smart industry and vehicle / traffic- related problems.

Target Holding uses pattern recognition and machine learning techniques on extremely large (Terabytes to Petabytes range) data sets. This requires innovative technologies to achieve acceptable performance. In addition, we do create the appropriate computing infrastructure and data bases as well as web or App interfaces ourselves as needed.

Target Holding delivers specialized and customized Artificial Intelligence-services to large international companies with extremely large datasets, but on the other hand side also to highly specialized SMEs. The common point being the need to extract valuable information from complex, unstructured datasets, their assets, in order to enable or improve their business models.

Target Holding holds an ISO 27001 certification for data security management and certainly works up to all legal stadards, e.g. the European GDPR.

### Obtained results

A) Target Holding set up and made available to the partners the data storage and exchange infrastructure for internal project usage, once the originally intended french contribution had been cancelled. We developed a secure data storage structure within our redundant datacentres in Groningen, that allowed to upload, store and exchange (i.e. download) extremely large volume 3D images, i.e. high resolution Brightfield 2D image stacks, lower resolution multi-channel Mass Spectrometry Images and eventually X-ray images, through a Virtual Private Network connection. A separate partition was created in order to host the Philips Image Management System, enabling the manipulation and viewing of images in different modalities by all partners.

All images had been provided fully anonymized for our project aims, however, we could show that the infrastructure setup as such can safely serve as a blueprint for a 3D-digital pathology system. Depending on legal constraints, it could be used inside a hospital only, or give secure access to experts (pathologists) from anywhere outside as well.

B) Pathology samples are prepared as a series of wafer-thin 2D slices from a volume of tissue material, in order to allow for slice-by-slice surfacial inspection, by optical or molecular (e.g. mass spec imaging) methods, and to detect progression and changes across the volume. Genuine 3D imaging and measurement methods, depicting the whole volume without slicing in a useful way for pathologists, are still to be developed for the application, e.g. X-ray setups. The ultra-thin slices are susceptible to rotation, stretching and distortion during handling and measurement.

Target Holding developed automated algorithms to apply to the innovative Maastricht University multi-channel Mass Spectrometry Images (MSI), in order to reconstruct the full 3D volume data from the (distorted) measurements of the stack of 2D slices. As compared to e.g. the Brightfield images, the spatial resolution is less good, while there are thousands of kinds of molecules detected. Those might or might not carry important information for both the reconstruction and the analysis by the pathologist. Ther e are no clear cell structures visible to guide the reconstruction. These 3D volume MSI images can then be combined in a defined way with the Brightfield 3D data (AMC) and eventually X-ray data or any other modalties.

### Perspectives, plans

3D imaging is becoming more and more important in many different fields, for deeper insight into structures and processes, and in combination with modern 3D viewing techniques. Still, many methods actually rely on a series of 2D images, followed by a reconstruction of the 3D volume dataset. However, as long as the material under inspection might be subject to deformation, rotation or any other relative movement (internal or relative to the analysis instrument) before or during analysis, the 2D images cannot be put together in a straight forward way. For those cases we can supply algorithms for a structure-sensitive reconstruction.

The very first instance to apply to should be the MSI-technique itself. As the method will leave the experimental research stage, become mature and be rolled out for routine applications, there will be a need for our algorithms in all life sciences-related applications. This should become a part of the mass spec producers' proposition and data analysis package in Mass Spec Imaging, to be developed and maintained in the future in close cooperation.

Aside from the (re-)combination of different slices we gained a lot of experience in image handling and analysis that will be applied in different customer cases.

Another growing market and application area is the combination of different modalities, e.g. visible, ultra-violet and infrared (thermographic) images, in order to make use of more information than from visible spectrum alone. We think of industrial applications of visible inspection in production lines. This falls into our thematic field of Smart Industry.

We will start up a first proof-of-concept together with a highly specialized company in optical (infrared) product inspection in june 2018. This should lead to the inclusion of our Artificial Intelligence (Machine Learning Algorithms) into their analysis tools under licence or other contractual conditions.

## Prodrive Technologies B.V.

### Partner description

Prodrive Technologies develop and produce electronic, mechatronic and optical products and systems with an exceptional price-performance ratio. We can do this because we have smart ways of optimizing, integrating and robotizing, and because we produce everything we need in-house, in the Netherlands. Technology solutions of Prodrive Technologies are:

* Digital Processing / Computing solutions.
* Video / camera Technology.
* Motion Control / Drives.
* Mechanics / Electromechanics.
* Power Electronics.
* Software.
* Electronic systems.
* Mechatronics.

The Technology solutions developed and produced by Prodrive Technologies are applied by our customers (worldwide) in several business areas: Semiconductor, Medical, Professional, Multimedia & Consumer, Defense, Traffic & Infrastructure, Renewable Energy, Industrial, Automotive, Agro-cultural, Building automation, Defense and Security / surveillance.

Prodrive Technologies is a fast growing company and won several awards like: “Financieel Dagblad Gazellen Award” (fastest growing company), many (including last year) “Dutch Industrial Suppliers Awards” (awarded by many industrial companies in the Netherlands, our customers). Due to the fast growing character, Prodrive Technologies generates a lot of employment in Research / Development as well as manufacturing in the Netherlands.

Prodrive Technologies cooperate with several universities and delivers and finance part time education employees and PhD students on several areas. A cooperation with a customer did result in a new joint venture acting in a specific business area.

For more information, visit the Prodrive Technologies websites at [www.prodrive-technologies.com](http://www.prodrive-technologies.com)

### Obtained results

Prodrive Technologies developed the 3D camera that accommodates the unique sensor developed by Philips and new image processing to smooth out the sensor artefacts. A lot of research was required to get these artefacts clear and to find image processing solutions to smooth these artefacts out. The computing hardware performance in the camera was increased (more than doubled) during the project to accommodate the required image processing.

A new illumination unit (light source) is developed to produce a homogeneous triple color sequence. The light intensity of the light source is huge to create enough light on the sensor pixels to get a sharp (low noise) image. Several trials and adaptations are made to get the best final result. Prodrive Technologies closely cooperated with Philips Digital Pathology, Philips Research and other parties to realise the desired performance. Many prototypes are build and qualified and redesigned resulting in an image quality superior to competing scanners. The next step is bringing the new scanner technology into manufacturing and market delivery phase.

### Perspectives, plans

The next step for Prodrive Technologies is finalizing the scan engine design and the production tools to start volume production at Prodrive Technologies in the Netherlands and regular delivery next year. In parallel the 3D functionality will be improved and will be released next year. Prodrive Technologies will support Philips to increase market share and secure Philips position in the Pathology market. After finalizing the 3D functionality, Prodrive Technologies expects to resell the 3D camera and parts of the scan engine technology in other application areas.

## SIVECO Romania

### Partner description

SIVECO Romania SA ([www.siveco.ro](http://www.siveco.ro), <http://rd.siveco.ro>) is a private shareholder company, established in 1992. During its twenty two years of existence, SIVECO Romania SA has become one of the most important Romanian providers and software integrators of ERM L&M (Enterprise Resource Management License and Maintenance), eLearning, eGovernment, eHealth, eAgriculture, eCustoms solutions and turnkey projects acting both on the internal and international markets. Moreover, SIVECO has gained a solid reputation on international markets by developing successful projects together with several international companies, collaboration that has blossomed into genuine partnership over the years.
We can provide all services on the whole life cycle of the information projects: analysis of users requirements, design, development, testing, implementation, end-users training and technical assistance, system maintenance. We have developed and currently are running some of the largest and most complex, national-wide information systems in Romania, in different domains: Education, Agriculture, Health Insurance, Customs, Nuclear, Social Security. Our staff contains over 1.000 highly educated IT specialists covering all stages of projects development: analysts, business consultants, system architects, programmers for different platforms, implementers, testers, DBAs, data analysts, accredited trainers. SIVECO has developed and implemented solutions for improving the management of the health insurance funds and for increasing the quality of medical and pharmaceutical services. SIVECO Romania develops complex solutions aimed at improving the quality of services for citizens and administration, by introducing IT tools nationwide. These systems are integrated into the Health Insurance IT Platform (PIAS), managed by the National Health Insurance House (CNAS).
Also, SIVECO Romania SA offers a new approach in computer based education for both educational and enterprise sectors, by leveraging the power and flexibility of its etraining solutions. Our successful references include very complex projects, as for example, the introduction of the AeL eLearning platform in the Romanian pre-university education; providing an integrated information system for large national companies, etc.
SIVECO Romania SA is involved as technological partner in many European Projects.

### Obtained results

**Mobile viewer** for pre-visualization and manipulation of medical images (SIVECO), which will give the pathologists, clinicians and researchers the possibility to:

* Rapid pre-viewing of 2D/3D Pathology high-resolution datasets. This volume can be moved, rotated, zoomed, etc.;
* Fast performance and accessibility from everywhere;
* Intuitive and interactive user interface;
* Flexibility with both high and low-level control;
* Fast integration on different platforms;
* Accessible for any mobile device regardless of the device’s performance: PC, laptops, mobile devices.
* Interactive remote visualization of multi-modal 3D image data
* Highresolution rendering of large pathology images.
* It can display very large-sized images.
* Possibility to load a different 3D model and to select the number of tiles, number of layers and can set the distance between the layers.
* Increased speed on loading the images.
* Browse through interesting and rare cases from different networks;
* Facilitate academic/research networking and collaborations;
* Integration with a web portal for storing, manipulating, viewing and analysis of pathology images.

### Perspectives, plans

**The Mobile viewer** developed by SIVECO and also **Web-based viewer** developed by Altfactor are both dedicated technologies bundled for the 3DPathology project. Both viewers are de –novo development, starting from Zero. The products can easily be exploited outside the project, in the medical domain. A particular innovation for the Romanian market is the rapid pre-viewing of 2D/3D Pathology high-resolution datasets. This volume can be moved, rotated, zoomed. Accessible for desktop applications but also for any mobile device, regardless of the device’s performance: PC, laptops, mobile devices, the products are a very innovative way of using a viewer technology in the Romanian medical field. The products are exploitable in various medical settings. In this respect, SIVECO, along with Altfactor, intends to initiate discussions and possible collaborations with Romanian hospitals (Spitalul de Urgenta Sf. Apostol Andrei Galati) and Pathological Institutes.

Also SIVECO intends to continue the collaborating with Altfactor for future collaboration, improvements and developments for their products.

### Exploitable prospects

* **New markets** Digital pathology & scientific visualization users.
* **Large data:** Ability to deal with big data and render details is extremely important for medical 3D imaging as well.
* **Customers**  Romanian hospitals, researchers or the digital pathology departments and educational institutions with interest in the 3D structures of the images
* **Market access**

At the Romanian consortium level, together with Altfactor, we established in accessing new e-Health markets, where technologies such as 3D, mobile or web-based applications and big data can be applied and exploited.

SIVECO will exploit the knowledge gained in this project by creating new business opportunities on medical e-learning market, improving SIVECO software solutions and training processes. An important focus will be to enhance the company’s e-learning portfolio of software products and solutions dedicated to medical staff, pathologists, and medical researchers.

## Altfactor

### Partner description

ALTFACTOR is a Romanian SME company that develops custom educational and multimedia applications for computer-assisted interaction and training. The company focused mainly on ICT, acquiring solid competences in this sector and oriented towards eLearning and web-based multimedia interactivity, a dynamic sector that gives the opportunity to put to the best use both acquired expertise and the approach based on quality and innovation. The company has created educational content for off-the-shelf products and custom-tailored training suites alike. Also, during the implementation of different European project, ALTFACTOR developed different applications which integrate 3D visualization, simulation and AR technologies.

The expertise areas are in 2D/3D animation, modelling & simulation, VR/AR, web and mobile applications development, e-Learning, SDK documentation, sensors and communication systems. The company profile covers applied pedagogy and instructional design, 2D/3D graphics and animation, 2D/3D modelling & simulation, multimedia development (programming), standardization, web development. Also, we have expertise in SmartTV and mobile application development. The company is committed to research in the field of adaptable software solutions which can increase user satisfaction and is designing and developing tools and applications based on this philosophy.

The new visualization and interactive techniques, such as Virtual Reality and Augmented Reality together with the educational purpose use of IoT (Internet of Things) are research fields that ALTFACTOR tackles to develop its products and services range into ones that will offer users an efficient and modern instructive experience.

ALTFACTOR was involved as technological partner in many R&D projects: TWIRL - Twinning virtual World (on-line) Information with Real world (off- line) data sources, GUARANTEE - A Guardian Angel for the Extended Home Environment, 3D Pathology - Developing 3D Digital Pathology with Spectroscopy and CITISIM - Smart City 3D simulation and monitoring platform, Wearable IoT Network Solution for Work Safety in Hazardous Industrial Environments - Wins@Hi, and Enhanced Affective Wellbeing based on Emotion Technologies for adapting IoT spaces - EmoSpaces.

### Obtained results

The 2D-3D viewer - VISPAT, used to present medical data from pathology field, is a web tool built on top of the most used technologies, currently available for image representation 2D or 3D. For example, among these technologies, complex libraries like openseadragon, Three.js, X3dom, Caman.js, DZI (deep zoom images) it can be mentioned. The result is a fast, flexible image viewer capable of displaying whole slide images (several GB uncompressed) using dynamic colour transforms, that aims to fill an existing gap on the market, where most of the existing tools are desktop based, impossible to be used outside office.

This tool gives to pathologists, clinicians and researchers several working possibilities: rapid pre-viewing of the pathology medical images and data, fast performance and accessibility from everywhere, intuitive and interactive user interface, flexibility with both high and low-level control, fast integration on different platforms, accessible for a range of devices like PC, laptops, mobile devices. Besides displaying extra-large 2D images (by using tiling approach), the viewer offers also the possibility to pan and zoom the selected images. In 3D mode, the viewer displays 3D surfaces built as stacked images with the possibility of zooming in or out, rotating the model and applying different effects. The forementioned effects, like brightness, contrast, colorize, dilation, erosion, exposure, gamma, grayscale, invert or vibrance can be applied to every image (slice) defining a model and for any zoom level, being effective both in 2D and 3D mode.

VISPAT viewer offers the possibility to visualise images thumbnails and to switch from 2D to 3D mode based on the current zooming level. This approach can be used as a magnifier tool for 3D mode. Also, the web viewer offers the possibility to determine the distance between two selected points, no matter the zooming level of the image. Another characteristic of the web viewer is that offers also the possibility to use the common, standardized, DICOM files for obtaining 3D views, enhanced through different functionalities like cutting planes, setting light/opacity factors, transparencies and transfer functions.

### Perspectives, plans

Nowadays, the field of digital pathology is growing in Romania. More and more doctors and medical institutions adopt clinical investigation procedures using digital pathology tools and techniques. Although there is an increase in the acquisition of digital pathology equipment, the general degree of knowledge that pathologists have on tools and techniques used in digital pathology is still low. Therefore, the first domain in which the company expect to exploit the outcomes of the gained experience from the 3D Pathology project is the field of eLearning, the core of the company’s profile. A set of e-courses, addressed to the pathologists, can be developed to improve their experience and expertise in applying various methods of investigation used in digital pathology and their combination. These e-courses can be developed based on the images visualization features that VISPAT offers. The strategy is to design the e-courses either for promotional purposes, as a free, simplified version of a course, deployed on a Learning Management System (LMS) or for commercial purpose, through different types of contracts with hospitals, clinics and private practices. The e-courses can be included in a more complex software package, including the player itself. This is possible because VISPAT is web-based player (and can be included in an LMS) and can visualize 2D-3D medical images (TIFF, DICOM etc.), too.

It is worth mentioning that because most of the digital pathology imaging software from the market are desktop-based applications, impossible to use outside office, there is a gap in the market that VISPAT viewer will be able to successfully fill. This will give the possibility to the “out-of-office pathologists” to view medical images using a specialized tool like VISPAT.

Another domain in which the experience gained from 3D Pathology project will be used is the field of three-dimensional visualizations, like Virtual Reality (VR) using Head Mounted Display headsets. Until now, the VR devices were neither developed nor accessible to the public and most of the devices/tools were 2D. The developed viewer VISPAT, as well as the gained experience from the 3D Pathology project implementation, represent a solid foundation for the development of new VR applications, that could ensure a total immersion and superior presence of the pathologists, that can analyse and diagnose more efficiently. Stating September 2018, we will begin the in-depth development of a VR-compliant VISPAT viewer. The 3D Pathology project provided valuable professional training for the Altfactor’s team and enabled them to substantially broaden their command of Big Data, Image Processing and 2D/3D visualisation technologies.

## Xavis

### Partner description

XAVIS is established based on field experience accumulated in manufacture of X-ray, machine vision, and software for Factory Automation (FA) equipment with highly qualified employees. By automating the assembly & testing lines, it is willing to provide various effects such as quality improvement, quality security, and labor-cost reduction, etc. Business area includes: 1. Automatic X-ray testing Equipment, 2. Vision system & software of FA Equipment, 3. Development of the operational software of FA system, 4. Automation equipments for assembly & testing in productive lines of electronic products, (cellular phone, LCD, semi-conductor, digital TV, etc), 5. Automation equipment related to testing in productive lines of mechanical products (automobiles, etc).

### Obtained results

Developed animal in vivo imaging for the biomedical market.

Supporting Academia Sinica and POSTECH in the project activities.

### Perspectives, plans

Entering into International Indusrial on biotechnology TXM market.

X-Ray microscopy instrumentation, viewers, and testers - Asia market.

## BioMaTek

### Partner description

Bio Materials Analysis Technology Inc. (Bio Ma-tek) carries the “R&D partner for high-tech industry” spirit in its sole investor Ma-tek. To address the ever demanding needs on the physical and chemical characterization of nano materials in biological systems, Bio Ma-tek rolls out an array of bio-EM sample preparation and image analysis services and a comprehensive list of analytical services following the recommendations in TR13014.

Vision: To become a leading brand in nano- bio- sample preparation and analysis.

Business model: Focus on core technology, Leverage external resources, Deliver proficient and adequate services.

Positioning: Solution provider for nano- biomaterial characterization and analysis.

Service scope: Nano- Biomaterials in Foods, Cosmetics, Medical materials, Drugs, Vaccines, Biological tissues and etc.; Provide proficient and adequate sample preparation, analysis, consultation and contract services.

### Obtained results

Development of 3D TEM imaging protocol, conducting 3D imaging services for murine organs.

Supporting Academia Sinica in the project activities.

### Perspectives, plans

Academic and industrial needs on TEM 3D imaging services for biological samples (cells and tissues).

Collaborate with major industrial partners to develop automated x-ray and electron microscopy imaging equipments.