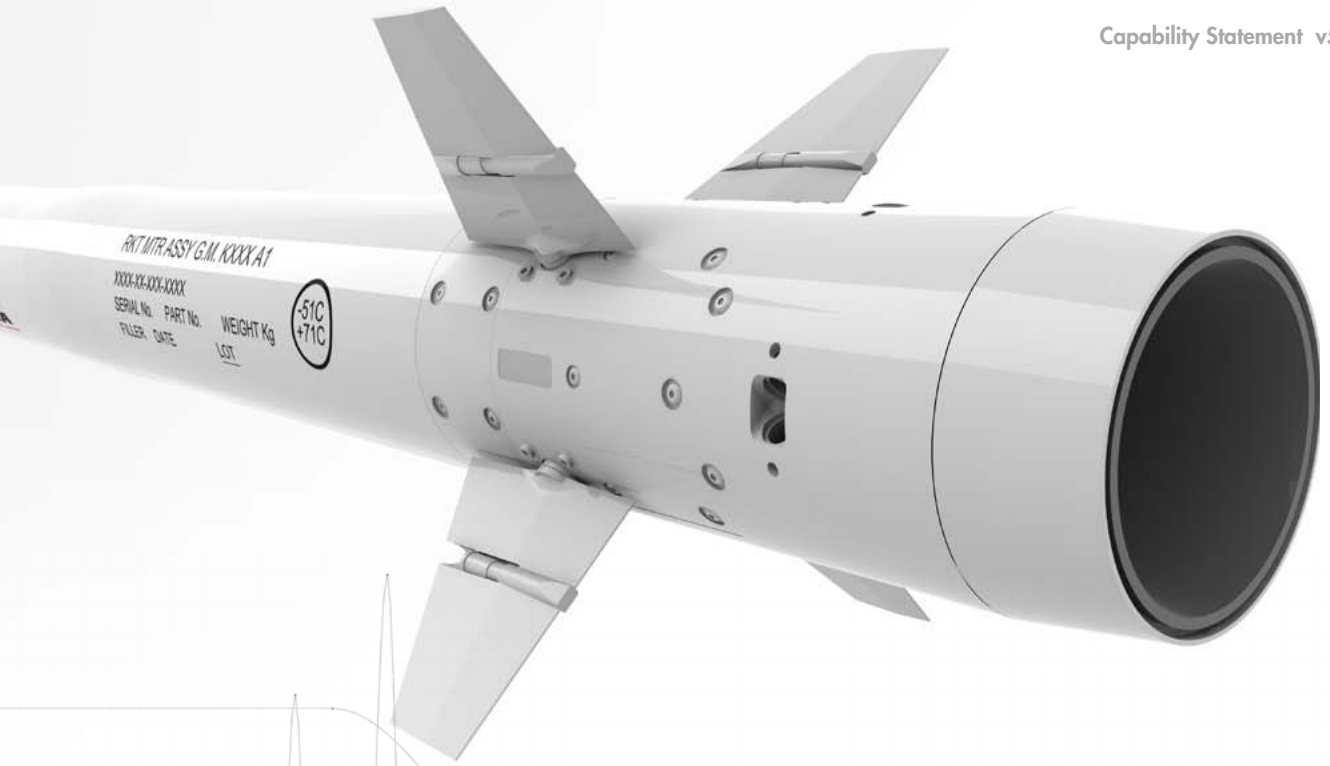

Defence*Imaging*

MISSION CRITICAL GRAPHICS

Defence Imaging is a specialist design consultancy offering high-quality 3D CGI graphics and design to the defence, marine, aerospace, transport and heavy engineering sectors.

At Defence Imaging we use our experience and expertise, coupled with cutting-edge technology, to realise concepts, unleash advanced visual effects and fulfil your project requirements.

As specialists in 3D graphics and visual effects, we are capable of creating still or animated visuals to various styles and complexity; Adapting to your requirements, we create imagery ranging from the photo-realistic to stylised. Our virtual cameras can film conceptual ideas in synthetic environments that are limited only by your imagination.

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- *Glossary of Terms* - *Pages 11,12*

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www.defenceimaging.com

3D VISUALS

3D ANIMATION

VISUAL EFFECTS / CGI

DESIGN DEVELOPMENT

CONCEPT DESIGN

TECHNICAL GRAPHICS

CONSULTANCY

PROFILE

Formed in 2005 by Rob Carter and James Malloch, Defence Imaging has quickly established itself as one of the foremost creative 3D CG companies in the UK. Catering directly for more engineering based clients, we integrate seamlessly with marketing, research and tech teams and span the divide to produce complex CG visuals that are compelling, accurate and accessible.

The DI team of professionals will deliver the cutting-edge design and digital art demanded in today's competitive environment. Our technical and creative experience will allow you to realise your concepts and fulfil project requirements using the industry's most powerful and creative tools. We will ensure the seamless integration of our digital content into your established work-flows and accurately communicate project progress at all design stages.

Now dealing directly with many major 'blue chip' clients, Defence Imaging is the industry's choice for professional digital graphics and a selection of our satisfied clients are listed below.

DI offices located within the historic Rougemont Castle, Exeter, Devon.

- Airbus
- Atkins
- Atlas Elektronik
- BMT Defence Services
- BMT Nigel Gee
- Bombardier
- BVT Surface Fleet
- BMT Nigel Gee
- Carlton Communications
- De La Rue
- Discovery Channel
- Dubai Metro (RTA)
- Dyson
- EADS (Defence & Security)
- Honda Europe
- Houlder
- Iturri SA
- Karrimor SF
- Kongsberg
- London City Airport
- London Underground (TFL)
- MOD (UK)
- MBDA - Missile Systems
- Red Bull
- Rothenburger
- Shell
- Sony CEE
- TATA Steel

HOW TO COMMISSION

We always offer a free initial consultation and after we have fully understood the client's brief, will usually quote for the work within 24 hours. For more complex projects that require large amounts of planning, we may require longer.

Depending on the type of job, there are generally ways of helping us in the early stages that will smooth the production processes significantly and ultimately have an impact on the final costs.

Alterations during a project

Changes after the final render are not encouraged although we understand they can sometimes be required. We will make every effort to plan thoroughly prior to rendering to reduce the chance of alterations at a later stage. If minor changes are needed (such as a logo or surface treatment) we will endeavour to make them as quickly as possible and without incurring extra cost. In most circumstances this can be achieved. If the change is more fundamental such as a change of geometry or animation, then a full re-render would probably be required.

Included in the price (agreed at the outset) is one set of amendments identified by the client. We will act on these changes and re-submit the project to the client for evaluation. We will endeavour to complete these alterations to the satisfaction of the client but any new changes required after this stage are subject to additional costs at our hourly rate.

At defence imaging we use production pipeline management protocols used by all the top CG post-production houses. The final output stage known as compositing (or 'comping') is where a number of 'passes' or 'shots' are layered and effects applied. This has a distinct advantage in that we have a great deal more control over the final look of the image/s. It also means we can make certain alterations without any re-rendering.

We will always keep the client fully informed about the financial and time implications of any changes requested during production.

Pricing information

We can either quote fixed prices for a job or work flexibly on a daily or hourly rate. Also, wherever possible, we will 'tune' any project quality or style to fit an available budget.

Any changes to the project by the client that are outside the remit of the initial/agreed brief will be charged at our hourly rate (please enquire for details). We always seek agreement on what constitutes 'changes'.

Special conditions for 3D production

An essential aspect of pre-rendered 3D is the rendering time required to output images from the 3D software. The render time (per frame) is highly variable and dependent upon a multitude of variables including scene/model complexity, special effects, output resolutions and quality required.

As part of our service, we include the price of rendering within the quote. Under exceptional circumstances we may need to charge for additional rendering time at £20 per render-farm/hour (over and above the included CPU time allocation). Generally is is highly unusual for us to charge extra for rendering but we reserve the right to have that option.

We will always contact the client in this instance to seek agreement on any additional costs.

Additional

At Defence Imaging we specialise in 3D computer graphics but we also have a great deal of experience in most fields of design. If in doubt about how to go about anything design related, please get in touch and we'll try to find a solution.

For additional information on any of the topics raised in this document, please contact Defence Imaging or consult the Glossary Of Terms (at the end) which explains the meanings of some of the terms used.

Our Capability Statement is always being updated. Please visit our website regularly to obtain the latest version.

ASSETS FOR GRAPHICS PRODUCTION

3D production checklist:

Modelling & Surfacing
We construct models and environments in virtual 3D space using industry-standard computer applications. This process can be very time consuming but can be significantly sped up if the client can supply us with existing CAD models. We can import most 3D model file-types into our systems but prefer IGES and/or DXF.

For high quality rendering or close-up shots, we may need to enhance the CAD model with bevels and fillets, etc. This increase in model complexity will have an impact later on with rendering times and will also take time to edit.

If no CAD model exists, we will have to either create the model from scratch or source it from a 3rd party (eg. online 3D model resellers). Where the client cannot supply us with a CAD model, we would appreciate the best possible reference material to help us create the geometry (eg. General Assembly drawings (GAs), photographs, elevation drawings).

*Please be aware that creating a 3D model from scratch using reference material is time consuming and not as accurate as using an existing CAD model. Wherever possible please make all efforts to supply 3D CAD data as this will speed up this stage of production and keep costs to a minimum.

Model Texturing
With certain 3D projects, we may require logos and decals to be applied to the 3D models in the scene. It is important that the graphics we use for these 'textures' are as high-resolution as possible. This ensures the graphics are crisp and clear when we render the final output.

We can accept almost any type of graphics file but ideally vector based artwork is best as it has a small file size and we can convert it to a bitmap image at our preferred resolution. We work with Adobe Illustrator but can convert vector artwork from most other major commercial illustration packages.

For bitmap images, the next best thing is a file with no compression applied. As a general rule, the bigger the size of file (in memory terms) the better. Finally, JPEG, GIF, PNG files are satisfactory but be aware they are compressed and so quality will be compromised.

2D production checklist:

Reference & support material
2D graphics and design is generally a simpler process than 3D production. Apart from a high level of communication between us and the client, there are some very useful things that can be supplied to us at the start of a project that will significantly speed up the design process.

- An accurate and clear brief
- Quality photographic material (if externally supplied)
- Finished copywriting (if externally supplied)
- Corporate design guidelines
- Relevant fonts (TrueType/PostScript, etc)
- Relevant corporate literature already in production (for reference)

We have significant experience in graphic design and print production and can take a 2D graphics project from initial concepts right through to delivery of printed material.

Our print customers include: Airbus, Dyson, UK MoD, Dubai RTA, BMT Defence Services Ltd, HM Coastguard and EMAP.

3D production checklist:

Modelling & Surfacing
We construct models and environments in virtual 3D space using industry-standard computer applications. This process can be very time consuming but can be significantly sped up if the client can supply us with existing CAD models. We can import most 3D model file-types into our systems but prefer IGES and/or DXF.

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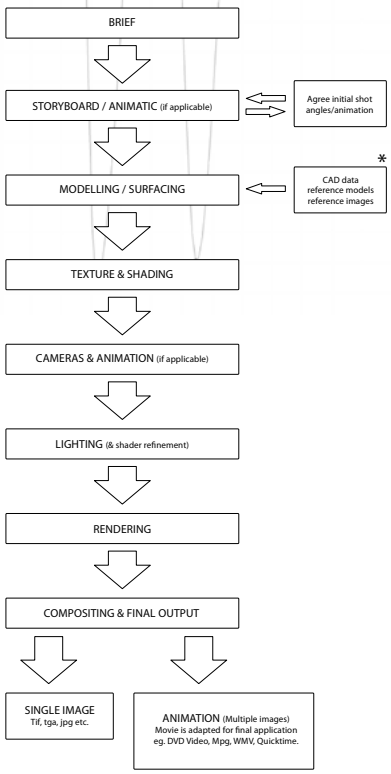
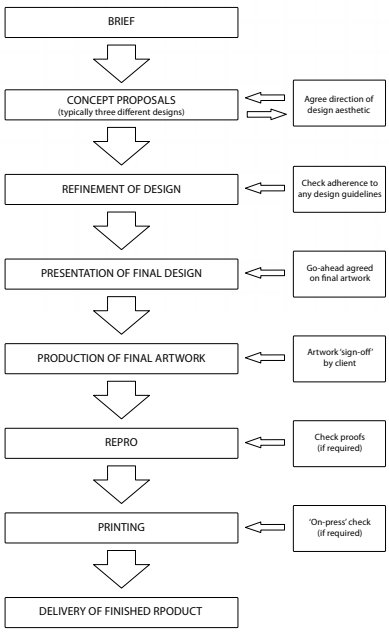
Typical 3D Production Pipeline



Typical 2D Production Pipeline



3D ANIMATION & VISUAL EFFECTS

As specialists in 3D graphics and visual effects, we are capable of creating still or animated visuals to various styles and complexity; Adapting to your requirements, we create imagery ranging from the photo-realistic to stylised. Our virtual cameras can film conceptual ideas in synthetic environments that are limited only by your imagination.

Used increasingly to enhance all types of marketing material, 3D graphics are now considered to be an almost essential component of modern video or graphics production.

Video sequences that would cost hundreds of thousands to produce using traditional cameras can be done for a fraction of the price as a 3D CG simulation. Being able to 'fly' cameras anywhere in a virtual environment also offers boundless opportunities.

NOTE: We can import/translate existing CAD data or construct scenes based on supplied or researched information.

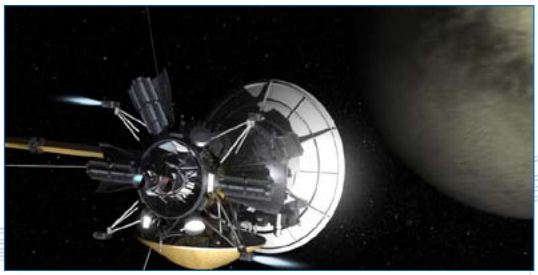
Primary applications:

- *Visualisation of concepts & existing designs/systems;*
- *Promotional videos & illustrations*
- *Training*
- *Real-time/interactive 3D for web & simulation*
- *Stereo-graphics for projection or realtime applications*
- *Technical illustration (stills/animation)*
- *Virtual 'fly-throughs'*
- *Post-production*
- *Visual effects (VFX)*
- *Bid support*

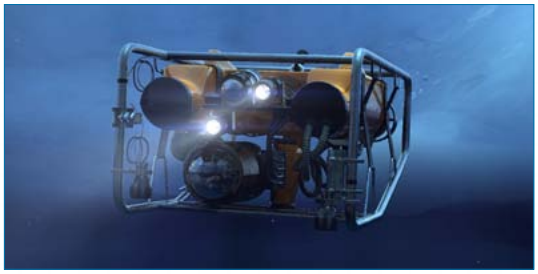
Early Rider 'Spherevelo' Product Animation

BMT Defence Services - Concept ship

BMT Defence Services - Vidar submarine concept



Discovery Channel - Cassini Huygens Probe



ROV

Shell - Ferrari F1 car

MBDA - CAMM Air Defence System

REAL-TIME 3D

The team at DI. have produced 'in-game' 3D graphics for Sony, Carlton, SEGA and LEGO. Using knowledge gained in the production of cutting-edge graphics for computer entertainment markets, we can now offer those skills to our clients.

Defence Imaging is currently evaluating a number of real-time 3D products; Along with 3D PDFs by Adobe, Blaze3D by Holomatix now offer superb quality interactive 3D visuals to all.

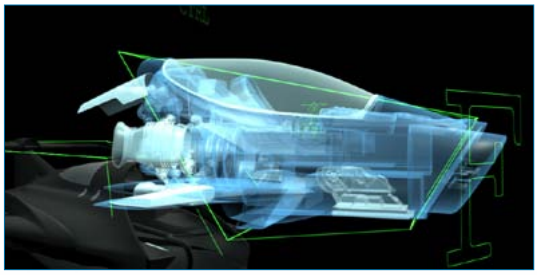
Using a combination of HDR lighting and global reflections, the results are perfect for any web or offline applications where you need to show products and allow the user to manipulate them using the mouse, track-pad or touchscreen.

Click on the HK demo to the right.

Primary applications:

- *Web-based presentations & product catalogues*
- *Product development visualisation tool*
- *Offline presentations*

MP5 - Click image to open demo



Future cockpit concept

ROV - Click image to open demo

SIMULATION GRAPHICS

Our primary role in this field is the production of optimised 3D assets for use in simulated or synthetic environments. The skill with any realtime 3D system is being able to display rich computer generated content with a minimum computational 'cost'. As the computers behind the simulation will mostly be concentrating on mathematical accuracy of the environment, physics model and data, the 3D assets that visually define that environment need to add realism without overloading the processors and reducing 'frame-rates'.

Our skills are well proven in creating 3D assets and we also know useful games-development 'tricks' for adding extra realism at no processing cost. We also offer consultancy concerning the introduction of special effects such as depth-fogging, particles, bump-mapping, specular and reflection mapping, HDR lighting, collision modelling, LOD modelling and lighting models to custom 3D engines. Preparing a 3D model for life inside a realtime 3D engine is an art in itself and at DI we can help you achieve unparalleled realism with a minimal 'footprint'.

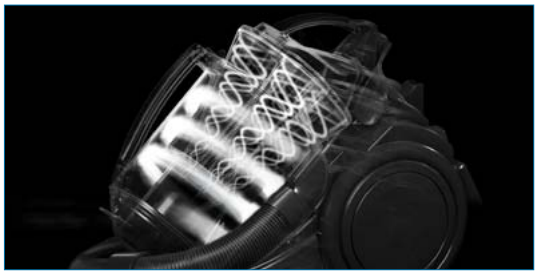
With the increasing convergence between commercial simulation and computer game technology, the level of interaction now achievable within a synthetic environment is considerable. HDR lighting, reflections, fluids, particles, weather, dynamics and bump mapping all go to create engaging worlds to build and then explore; the importance of delivering realism has never been greater.

Primary applications:

- *Training & simulation systems*

Dyson airflow filtration animation

Honda under-deck airflow animation



Dyson vortex flow animation

STEREO 3D

Stereo Imaging for both stills and video has been around for many years but increasingly sophisticated active and passive 3D systems are now in existence. Defence Imaging has recently been working with the passive projected 3D system by Cyviz (Cyviz.com).

To create the illusion of 'real' 3D in space, the Cyviz system uses the same computer generated object/scene 'shot' from two slightly different angles. With the user wearing polarised glasses, the system then splices the two projected images together to form a single '3D' image. The same system is used to create the 3D scenes at an Imax cinema or on the 3D amusement park rides often found at the large US film studios.

We have the ability to create full pre-rendered movie style 3D footage or fully interactive stereo 3D where the user can manipulate the object in 3D space using a mouse or track-pad. This system is especially used by the oil exploration and energy industries.

Primary applications:

- *Exhibitions*
- *Presentations*
- *Training*

Rear projection 3D system

Presentation using stereo 3D content

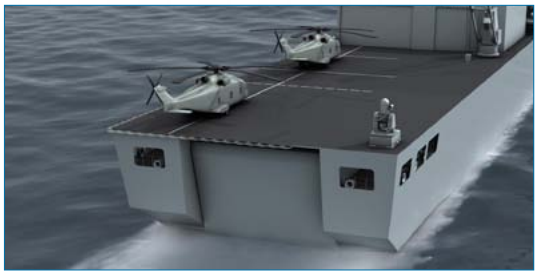
VIRTUAL 'WALK-THROUGHS'

Most often used by architects to help visualise a new building interior, virtual walk-throughs are also becoming increasingly popular as a presentation and training tool. Defence Imaging will use their 3D skills to build any environment and with the appropriate software, allow users to navigate and study it.

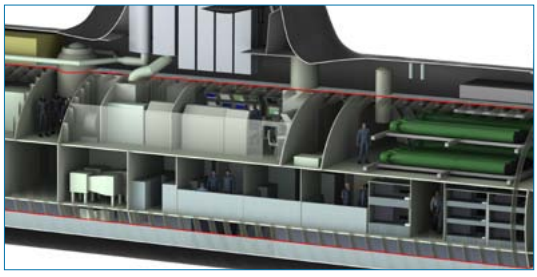
Primary applications:

- *Pre-visualisation*
- *Sales & promotions*
- *Environment familiarity scenarios*
- *Training*
- *Signage systems*
- *Human factors*

Dubai RTA



BMT DSL



BMT DSL - Vidar submarine concept

GRAPHIC DESIGN, ILLUSTRATION & PRINT

Our experience in producing graphic design solutions and printed media is equal to our expertise in the production of 3D images.

To produce great graphics and printed material requires a keen eye for detail, creative flair, technical expertise and a firm grip on quality at every stage. DI will assist the client every step of the way and use our experience to help create the perfect design solution. We will advise you on all aspects of the design including the production of any illustrative material, copywriting and photography. We aim to provide a one-stop in-house solution where the client can feel total confidence in our ability to deliver on time and on budget.

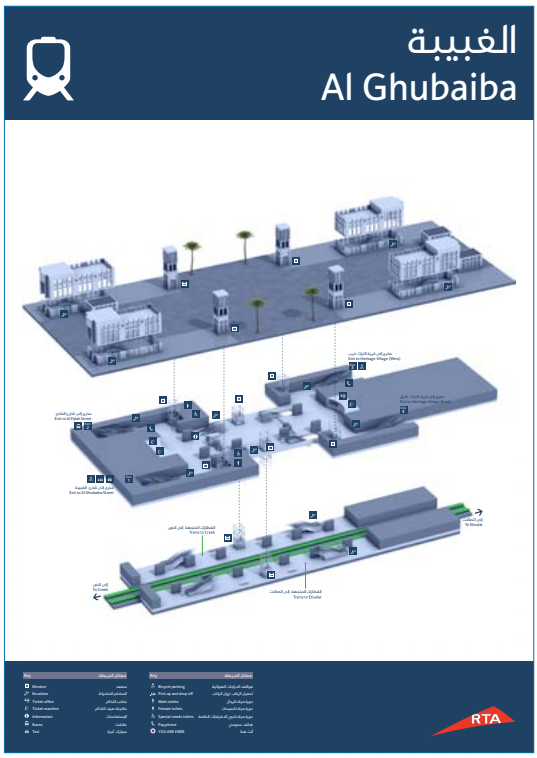
The team at DI is highly proficient with industry standard tools such as QuarkXpress, Adobe Photoshop and Illustrator; we can fulfil any DTP-style work with speed and accuracy and that ultimately reduces costs for the client.

An in-depth knowledge of printing processes also cuts out wasted time and can offer new creative opportunities. Using our experience we will advise you on additional printing processes such as foil-blocking, embossing, die-cutting, varnishing and laminating. We can also save you time and money by specifying the correct substrates and advising on 4-colour process and spot-colours, etc. In short, you can feel confident you're dealing with professionals who understand every stage of DTP, repro and print production.

We have forged close partnerships with many printers and proofers throughout the UK and also have experience managing medium-scale international print-jobs (Airbus, Volvo). Wherever you operate, DI can fulfil your printing project with speed, accuracy and on budget.

Primary applications:

- *Corporate literature*
- *Logos & brands*
- *Exhibition graphics*
- *Design consultancy*
- *Bid support*



Dubai Rapid Transport Authority (In partnership with TDC. London)

UK MoD Poster

Dyson Product Packaging

DESIGN & DEVELOPMENT

Rob Carter and James Malloch are formally trained in 3D industrial designand as such DI offers industrial design consultancy and use our 3D expertise to aid and faciliate the design development process.

Over the past few years, we have worked closely with Karrimor SF during the design and development of new load-carriage equipment for special forces and military organisations worldwide.

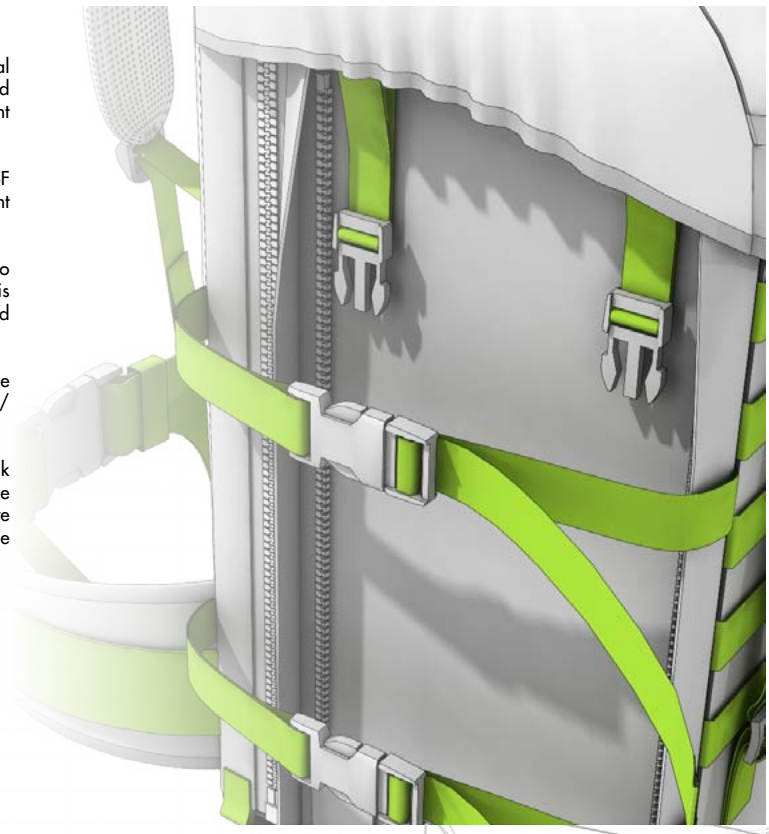
Our design skill and 3D expertise have allowed the design process to be streamlined and accelerated. The transition to final production is possible with fewer generations of physical samples and a reduced development phase.

We were also involved in the design and development process of the forthcoming Spanish future soldier concept (Combatiente Futuro/ ComFUT).

Our current ongoing project in this field is assisting Altlas Elektronik with various design/logistics issues on their advanced, flexible mine countermeasures system. In conjunction with our design input we are creating a 7 minute CG video sequence which details how the system works and this is being used to 'sell' the concept to clients.

Primary applications:

- *Product development*
- *Problem solving*
- *System optimisation*
- *Concept design*
- *Product styling/branding*



DATA PACKS & TRAINING MANUALS

A huge growth area in recent years has been graphical training content, in particular, digital media based training such as videos, CD-ROMs and DVDs. Using powerful authoring tools and our 3D expertise, we can produce compelling and informative training material that will help your staff perform better, improve efficiency, increase motivation, reduce risk and raise safety standards.

Along with full motion video training tools, we can also produce diagrammatic stills and step-by-step image-based instruction sequences for print.

One of our most recent projects has been to produce a comprehensive data-packs for the UK MoD. These have been used to help specify the current load-carriage systems (used in Afghanistan) to potential kit manufacturers and suppliers.

DI produced over 80 highly detailed line-work illustrations using a system whereby a 3D model of the rucksack was constructed and then rendered in contours in the computer. This meant we could produce drawings from an infinite number of viewing angles to achieve optimum results for the client.

Primary applications:

- *Corporate promotional material*
- *Training content*
- *Direct marketing & sales*
- *Corporate Safety, quality control & HR*

Karrimor SF Predator Patrol Pack (Currently used by UK Forces in Afghanistan)

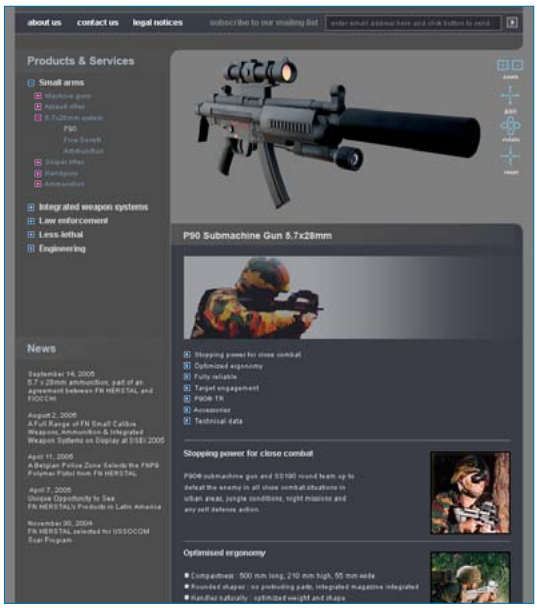
WEB & DIGITAL MEDIA

Both Rob Carter and James Malloch are formally trained in 3D product design. A significant part of that training involves ergonomics and interface design - vital components of a great website. Many websites are confusing, cluttered and lack information hierarchy. Our philosophy when dealing with web design is that less is most certainly more. A simple and logical structure is paramount; this should be coupled with clean graphics and images, an appropriate palette and above all a succinct message.

We believe online users are extremely time-aware and clarity from start to finish is absolutely essential. We will also optimise the site for fast redraws/downloads and for effective search- engine rankings.

Primary applications:

- *Web applications*
- *Offline presentations*
- *Interface logic*



Web Design

Photo Editing - Image on the left was altered to create ACS version

DIGITAL RETOUCHING

Together with copywriting, the photography used in any graphics work is extremely important and often overlooked. The best designed brochure will be severely compromised if the customer sees fuzzy stock photos or badly resolved diagrams. If budgets are tight and the supplied images are of average quality, we will recommend that we spend some time retouching and renovating using Photoshop. Wherever possible, we will recommend producing a set of photos which are specifically taken for the job; that way we can have full control over the composition, subject, lighting and quality.

Another application of our skills with programs like Photoshop is the ability to seamlessly add computer generated content to real-world scenes. This is useful for illustrating concepts, new buildings, new vehicles, 'what-if' scenarios, proof-of-concepts and producing dramatic creative situations.

We can offer photographic services in-house or if specialised photography is needed, we can call on our contacts in the industry and sub-contract under our supervision.

Primary applications:

- *Corporate literature*
- *Advertising & marketing*
- *Exhibition graphics*
- *Projected imagery*
- *Point-of-sale props*
- *Bid support*
- *Proof of Concept*

Original platform photo - South Eastern Trains

Integration of 3D model into 2D photo

CASE STUDY - DUBAI METRO (27 Stations)

With an incredibly diverse population, Dubai's new metro system presented some unique user-navigation problems. TDC in London were hired by the Dubai Rapid Transport Authority to design, from the ground up, a holistic signage solution for the entire network. In turn, Defence Imaging was brought in by TDC to provide the 3D expertise for the creation of 27 AO format images to aid passenger navigation at the entrances to all the stations.

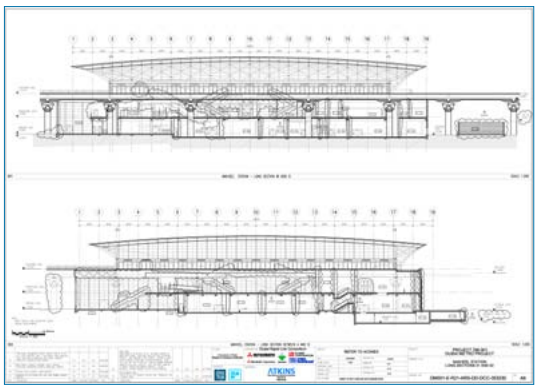
For our role in the project, detailed engineering drawings were supplied and from those we distilled the main features of each station into Adobe Illustrator files and imported these into Maya. Using these sections and plans, simplified models were created which depicted the major achitectural features: concourse, gangways, staircases, bridges, platforms, roofs, ticketing areas and entrances.

Once an overall aesthetic for the images was agreed, we rendered the various station levels seperately and applied additional effects and colour corrections in Photoshop.

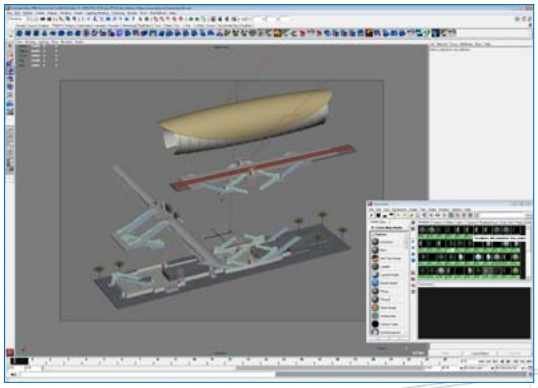
Each finished composite image was then made available to TDC in London for checking and once verified, they applied the RTA brand graphics and map icons. The finished documents were then output as high-resolution PDFs and emailed to the TDC offices in Dubai where they were printed and installed in each station.

Conclusion
In a project lasting over 2 years, we worked seamlessly with the primary contractors and stakeholders to interpret and distill the architectural language of this massive infrastructure project. Along with our colleagues at TDC, we created simple and clear exploded 3D images of all the stations on the metro.

From concept to installation, the whole project was completed on time and on budget and to the full satisfaction of the Dubai RTA.

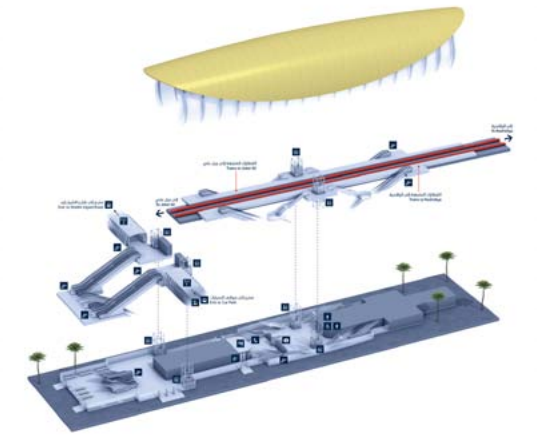


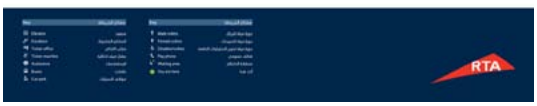
Detailed engineering drawings used to build the 3D

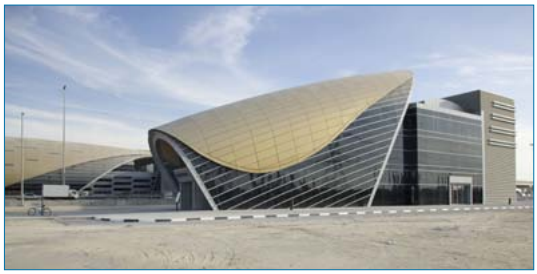


3D model of station created in Maya

Poster installed at Nakheel station, Dubai, UEA.







Above: Final poster image Below: Photo of Dubai Metro entrance (TDC)

CASE STUDY - VIDAR-36 SSK Submarine

BMT Defence Services began working on the VIDAR-36 SSK concept in 2009. In an effort to promote both the submarine design and the advanced engineering capabilities within BMT DSL, they approached Defence Imaging to help with the marketing.

Working directly with the senior naval architect for the project we used their engineering CAD data for the main hull-form and some inner structures. Liaising constantly with the design team we built the other 3D elements within Maya and started applying various surface materials to complete the look of the boat.

The unique black panelled appearance of a submarine was a particular challenge as the subtleties of the surface are really what defines it visually. In the final video this surface was built with various overlaid 'passes' which help to give maximum control over the look. These included seperate reflection, specular, occlusion shadowing, diffuse and caustics layers. These layers were then compiled in our digital compositing package before going into the final video edit.

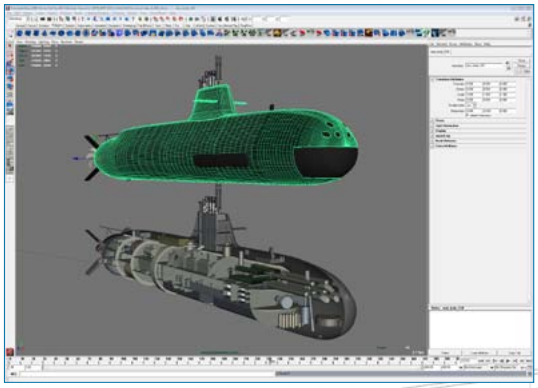
During the project, we also worked closely with BMTs marketing team to ensure all aspects of the new vessel's performance and characteristics were covered in the final 4 minute animation. A multi-stage process involving the production of storyboards and animatics (for approval) was undertaken before we could embark on the final video production.

The VIDAR's defence systems were also heavily researched and then custom built for the various launch and attack sequences. For instance, the tube-launched Cruise Missile sheds it's protective outer casing when it exits the water and the booster rocket fires.

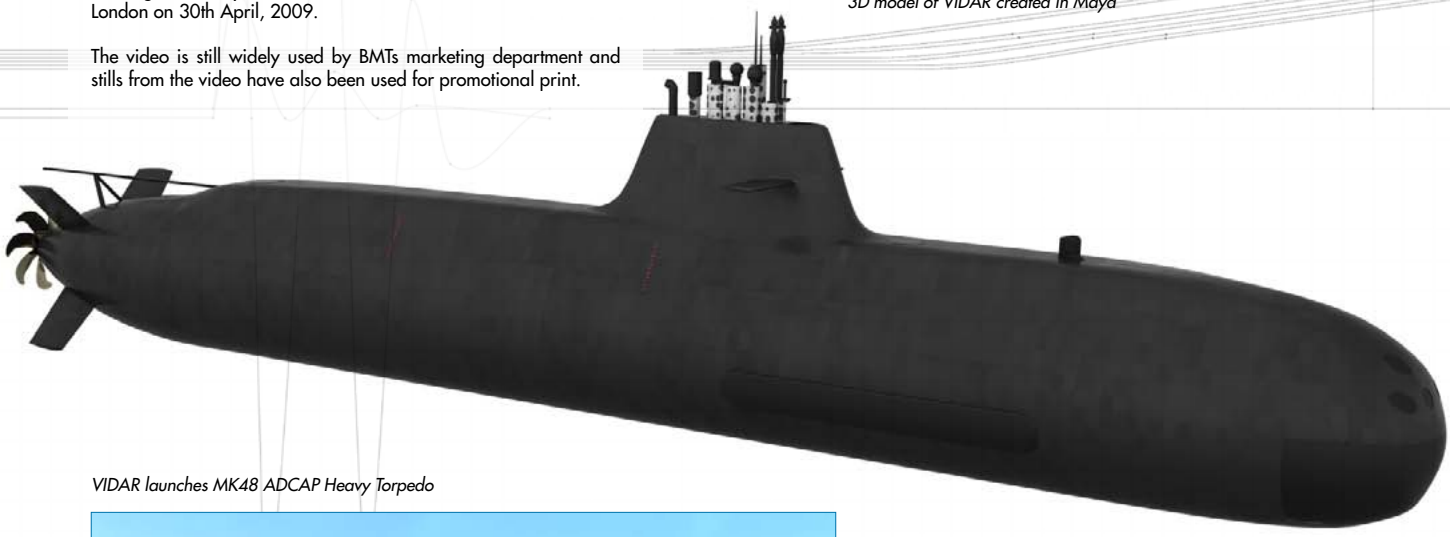
Conclusion
Our CG video and the overall project was extremely well recieved and Simon Binns, senior naval architect at BMT Defence Services received the 2008 David Goodrich Prize at the annual general meeting of the Royal Institution of Naval Architects (RINA) held in London on 30th April, 2009.

The video is still widely used by BMTs marketing department and stills from the video have also been used for promotional print.

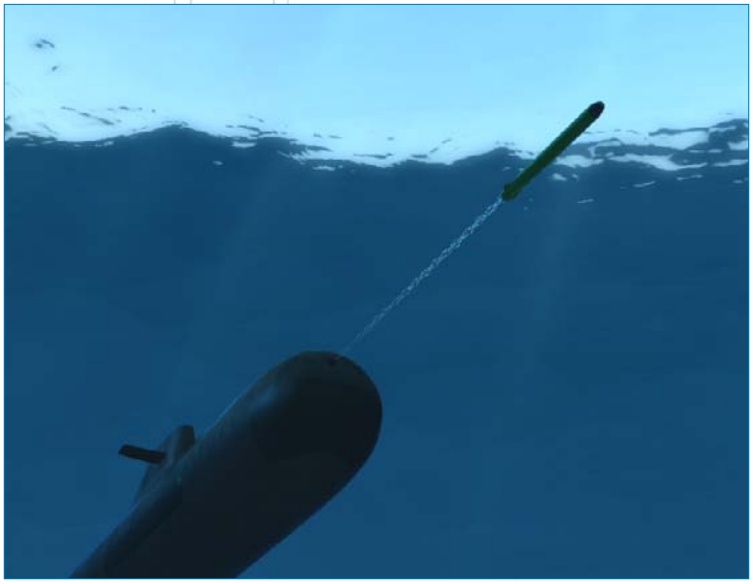
Special Forces divers exit from LILO chamber through concealed hatch



3D model of VIDAR created in Maya



VIDAR launches MK48 ADCAP Heavy Torpedo



Below: Frame from video sequence

CASE STUDY - MBDA CAMM Missile System

The Common Anti-Air Modular Missile (CAMM) is a Surface-to-air missile and Air-to-air missile made by MBDA for all three branches of the British Armed Forces.

During its development, Defence Imaging was approached by MBDAs Head of Future Systems. We were asked to create a number of CG videos highlighting the ground-breaking technology used in this new defence system and to show key stake-holders how it operates, with stealth, in different environments and using varied launch platforms.

In one variant, the land-based truck-launched system, a video was required to highlight the flexibilty and strategic advantage offered by such a setup. DI created a full CG video which showed a CAMM launch operation from a truck concealed in a forest environment. The scenario for the video was that CAMM was to be used to eliminate an incoming 'Cruise style' missile threat.

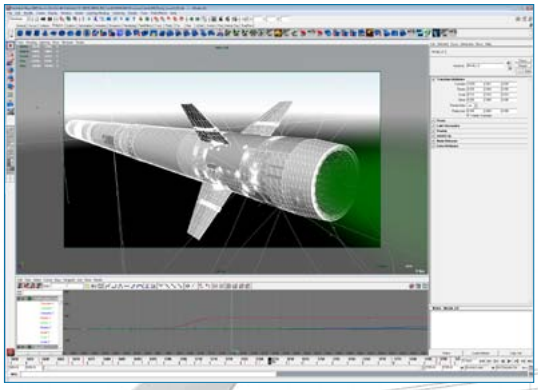
Working closely with the engineers and project leaders, we built the missile launch systems and the MAN HX60 launch vehicle. We also studied restricted test footage which showed how the missile actually behaves during the launch and its unique flight pattern: The way it has an initial vertical launch phase and is then 'kicked' by small tail thrusters into the correct target vector before the solid rocket ignites.

One of the most technically demanding aspects of this project was realising the synthetic forest environment for the broad vistas. This was mostly created in a cutting-edge landscape generator widely used in the film industry. For the close-in shots we used a mixture of photographic composites and some computer-generated vegetation. This gave an additional level of realism to the animation.

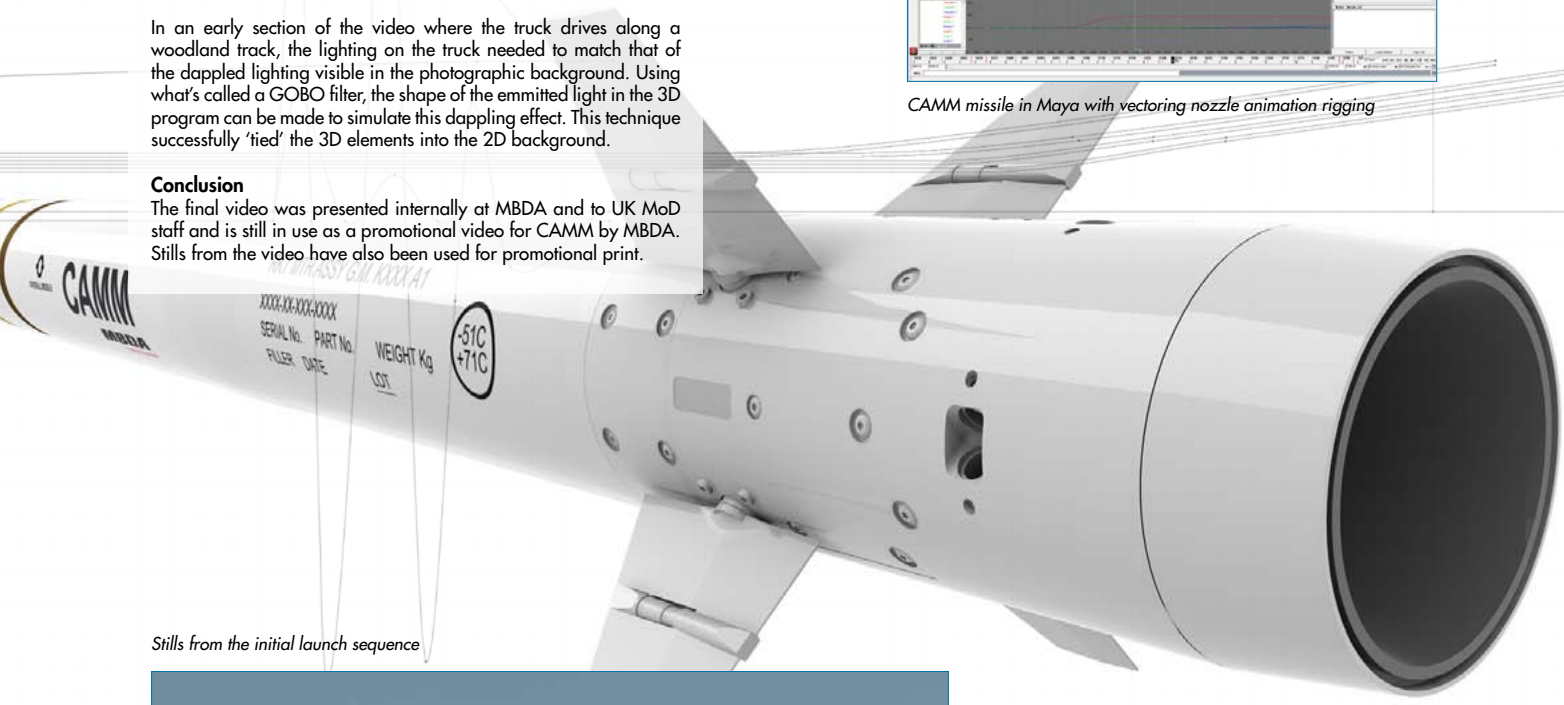
In an early section of the video where the truck drives along a woodland track, the lighting on the truck needed to match that of the dappled lighting visible in the photographic background. Using what's called a GOBO filter, the shape of the emmitted light in the 3D program can be made to simulate this dappling effect. This technique successfully 'tied' the 3D elements into the 2D background.

Conclusion
The final video was presented internally at MBDA and to UK MoD staff and is still in use as a promotional video for CAMM by MBDA. Stills from the video have also been used for promotional print.

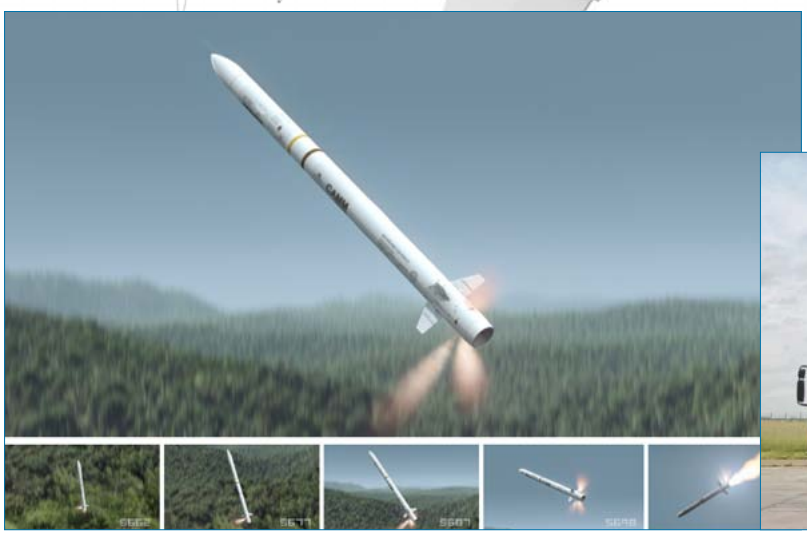
CG HX60 Truck composited in 2D photographic environment



CAMM missile in Maya with vectoring nozzle animation rigging



Stills from the initial launch sequence



Above: CG rendering of the CAMM missile

Below: Truck mounted CAMM system now at advanced stage

GLOSSARY OF TERMS:

- 2D. Two dimensional

- 3D. Three dimensional

- Animatic. A more advanced storyboard using proxy models to rough out basic animation and camera shots. (Film industry term)

- Anti-aliasing. Over-sampling methods for avoiding the unwanted visual effects or artifacts caused by limited display resolution. These aliasing effects include 'jaggies' (stair-casing along diagonal lines), moiré effects (checkerboards), and temporal aliasing (strobing) in animated scenes.

- Alpha channel. A view of an image that represents the presence and degree of opacity of objects. The channel associated with each pixel determines the degree of opacity of that pixel using a greyscale range. In video production, the alpha channel is used to determine layer masking (mask channel).

- Animation. The process of developing the actions (poses, timing, motion) of objects. Animation methods include key-frame animation, path animation, non-linear character animation, and motion capture animation. Animations are sequences of frames.

- Aspect ratio. The proportions of an image expressed as the ratio between the horizontal and vertical dimensions. Because pixels are not necessarily
proportional, the aspect ratio is independent of the number of pixels in the X and Y directions. For example, both NTSC and PAL television screens are 4 x 3 (aspect ratio 1.33). However, a CCIR601 NTSC image is 720 x 486 pixels, while a PAL image is 720 x 576 pixels.

- Atmosphere. In rendering, the environment that surrounds the objects in a scene. For example, the simulation of fine particles (fog, smoke, or dust) in the air. When an object is photographed in the real world, it is usually within an atmosphere (for example, air) and can be surrounded by other background objects.

- Axis. One of three vectors (X, Y, and Z) that define the three dimensions of a scene. Often defined as local space, object space, origin axis or world space.

- Bezier curve. In modelling, a curve with at least four control points available to control the shape of the curve. This term may also refer to a NURBS curve.

- Bezier patch. In modelling, a parametric surface, approximately rectangular, that is quilted together with other Bezier patches to form a large, curved surface. The shape of a Bezier patch is controlled by 16 control points distributed uniformly over the surface. Also known as patch surface.

- Bitmap. Image comprising pixels (as opposed to vector artwork such as EPS).

- CAD. Computer-aided Design. Designing 2D and 3D objects on a computer.

- Camera. Like a real-world camera, the 3d camera frames the view of a scene by tracking, tumbling, panning, and zooming. Unlike a real-world camera, the 3D camera does not automatically capture lighting, motion blur, and other effects - these effects must be explicitly created and tuned for realistic output.

- Caustics. Light pattern created by specular reflection or refraction of light, such as the patterns of light on the bottom of a swimming pool, or light through a glass of wine.

- Cartesian coordinate. A mathematical representation of Euclidean space. Every point can be described by three coordinates (X, Y, Z) representing the position along the orthogonal X, Y, and Z axes. The point (0, 0, 0) is called the origin, which is the global centre of the 3D world.

- CG. Computer generated. Design output from a computer.

- CODEC. Short for "compressor/de-compressor". This is the term used to reference the way that software programs handle different movie files, such as Quick Time, AVI, etc. The CODEC can control image quality, and can assign the amount of space given to the movie file.

- Colour depth. The number of bits used to represent a colour. For example an 8-bit image uses 2^8=256 colours. The bits build up the three primary colours red, green and blue. The following table indicates the number of colours an image can have.
  8-bit = 2^8 = 256
  16-bit = 2^16 = 65536
  24-bit = 2^24 = 16 million
  32-bit = 2^32 = 4.3 billion (inc alpha channel)
  Also see Floating Point, or HDR images.

- Compositing ('Comping'). The process of combining two or more images to form a new image. In video, compositing is the process of combining two or more video sequences to form a new video sequence.

- CMYK. Cyan/Magenta/Yellow/Black. the four ink colours used in 4-colour process printing.

- DCC. Digital Content Creation. Software used for the design of animated sequences and special effects in motion pictures, broadcast and visualisation. Leading examples are such products as Maya from Alias and Softimage| XSI from Avid/Softimage.

- Depth channel. The distance of objects from the camera. Also known as Z-depth or Z-buffer channel.

- Depth of field (DOF). A photographic term for the range of distances within which objects will be sharply focused. (Objects outside of this range appear blurred or out of focus.)

- Device aspect ratio. The aspect ratio of the display device on which you view the rendered image. The device aspect ratio represents the image aspect ratio multiplied by the pixel aspect ratio.

- Diffuse. surfaces reflect (or scatter) light, and colour in many angles. This type of surface causes light and colour to spread freely.

- Dynamics. A branch of physics that describes how objects move using physical rules to simulate the natural forces that act upon them. Dynamic simulations are difficult to achieve with traditional keyframe animation techniques, but new technology lets you set up the conditions and constraints that you want to occur, and then automatically solves how to animate the objects in the scene.

- Encoding. The process of converting uncompressed image/s to a new format, usually compressed. e.g. Mpeg, QuickTime, Wmv, Cinepak etc.

- File texture. A bitmap image that can be mapped to shading attributes.

- Focal length. A photographic term describing the distance from the camera lens to the film plane that determines the angle of view.

- FPS. Frames per second. The number of single frames needed to be displayed in a second to achieve smooth animation (usually 25 fps).

- Fractal. A three-dimensional random function with a particular frequency distribution. Fractal textures are useful for simulating many natural phenomena, such as rock surfaces, clouds, or flames.

- Frame. In animation, the basic unit of time measurement. The duration of an animation is changed by increasing or decreasing its frame range. Typically, 25 frames of animation correspond to one second on PAL video.

- Frustrum. A volume of space that includes everything that is currently visible from a given camera viewpoint. A frustum is defined by planes arranged in the shape of a 4 sided cone with dimensions that correspond to the film aspect ratio. If a point is inside this volume then it is in the frustum and it is potentially visible (if not obscured by another object). If a point is outside of this volume then it is outside the frustum.

- Geometry. In general, a NURBS surface, NURBS curve, subdivision surface, or polygonal surface (mesh).

- Hardware render. An interactive rendering method that uses the capabilities of a computer's graphics card (GPU) to create lighting and texturing effects.

- HDTV. High definition TV. Available in two resolutions:
  HD720 - 1280x720, Aspect ratio = 1.777
  HD1080 - 1920x1080, Aspect ratio = 1.777

- HSV. Hue, Saturation, and Value. A colour model that determines the shading and tint of a colour. Hue corresponds to the pure colour; saturation to the amount of white mixed with the hue; and value to the amount of black mixed with the hue.

- HDRI. High dynamic range imaging. An HDRI image has an extra floating point value associated with each pixel that is used to define the persistence of light at that point. A high-dynamic range image can be created (using a light probe) from several images with different exposures combined to show the full range of light.

- IBL. Image based lighting. The simulation of light emitted from an infinitely distant (environment) sphere to create photo-realistic images. With image-based lighting, an environment texture (an image file, ideally HDRI) is needed to illuminate the scene and provide the necessary environment reflections.

- Key-framing. Is the process of assigning values to parameters at specific moments in time to create an animation. The most important parameters to be key-framed are the transformations of models (objects), the camera,

and lights. Thus all objects in the scene can be scaled (resized), rotated and transformed (moved) the course of the animated sequence. The lights can be translated and rotated. The rendering camera can also be transformed and rotated. The surface material characteristics of an object, the colour or intensity of a light, the zoom ratio of the camera, and even the geometry of objects can be key-framed. The 3D application interpolates between the key-frames, creating the frames in between the key-frames when rendering. Interpolation can occur in both space and time. Animation curves are used for full control.

- LOD. (level of detail). System used to handle high definition models in a real-time environment. Models have multiple instances with varying levels of detail that are replaced based on distance to camera. (Games industry term)

- Lighting model. Mathematical formula describing the interaction of light with CG surfaces. Physically accurate lighting models require great computing power.

- Light probe. A tool used to create custom HDR environment maps.

- Light source. In rendering, an object that provides illumination to a scene. In the real world, the surfaces of objects are illuminated by light rays emitted from various light sources (for example, light bulbs, flashlights, the sun).

- Match moving. The process of matching the camera or object movement from live action footage with a computer-generated (CG) scene.

- Model. A computer-based description and representation of a three-dimensional object. See Geometry also.

- Motion blur. The simulation of the blurring that occurs when a fast-moving surface is captured by a camera.

- Motion capture. In animation, the recording of joint positions and rotations from movements performed typically by a human actor. This information is then applied to a CG skeleton to simulate real-life motion on a character.

- Motion path. In animation, the use of a curve to control the motion of an object.

- Normals. In modelling, the directional line perpendicular to a surface. Polygon normals indicate the orientation of polygonal faces.

- NTSC. National Television Standards Committee. The standard for composite video in North America, Japan, and most of South America. 30fps, 720x486 with a pixel aspect of 0.9

- NURBS. Non-uniform rational B-spline. These are surfaces described by parametric curves. CAD software usually outputs geometry as NURBS compliant data (i.e. IGES).

- OpenGL. A widely used 3D graphics language.

- PAL. Phase Alternate Line. The industry standard for composite video in most of Europe. 25fps, 720x576 with pixel aspect ratio of 1.0667.

- Particles. In dynamics, a point displayed as a dot, streak, sphere, or other effect. You can animate the display and movement of particles with various techniques. Typically used in large quantities to create effects like rain and explosions.

- Pixel. A picture element. The smallest controllable segment of computer or video display or image.

- Polygon. Cross-platform industry standard for constructing geometry. N-sided facet defined by 3 or more vertices in space. A polygonal object can be closed, open, or made up of shells, which are disjointed pieces of geometry. Often referred to as a mesh.

- Pixel aspect ratio. The aspect ratio of each pixel, which may be square (1.0) or non-square (such as for PAL video).

- Procedural texture. A texture that is calculated based on some algorithm or mathematical formula.

- Projection map. A technique of projecting a 2D image onto 3D geometry, useful for creating textures or icons on a rendered object.

- Ray tracing. A rendering technique, based on complex mathematical algorithms, to accurately represent any conceivable representation of light, including reflections and refractions as well as any conceivable surface forms and materials.

- Rendering. Creating a 2D image from a 3D scene is a process known as rendering. To create a rendered image, the scene must first be constructed within the dedicated 3d graphics software on the computer workstation; this software allows the artist to describe geometry, lighting, surface properties, special effects and animation (time based changes). 3D rendering is a creative process similar to photography or cinematography. The camera is defined at a location in 3D coordinate space, pointing in a given direction. Unlike traditional photography, everything appearing in a 3D rendering needs to be created in the 3D space before it can be rendered - allowing an almost infinite amount of creative control over what appears in the scene and how it is depicted. Artists need to create this scene before the rendering can commence. The rendering output can be setup for photo-realism or be designed to appear stylised. As an animation requires as many as 30 renderings for every second, rendering time is an extremely important consideration in all 3D animation. Rendering time is a function not only of the power of the computer used, but also of the complexity of the scene, the lighting model, and the presence of computationally-intensive elements [to mention a few]. The properties of rendered image files can be controlled according to post-production or presentation requirements. Also known as software rendering.

- Render-farm. Computer network setup to render frames at a fast rate. Tasks can be distributed between dedicated machines for effective power. Rendering is highly CPU intensive, requiring 100% access to CPU, therefore dedicated machines must be used at render time.

- Resolution. For images, the total pixel size of a bitmap image.

- RGB(A). Red, Green, Blue, Alpha. A colour space most commonly used in computer graphics and component video, where the three additive colour components are mixed to create a colour. Alpha is the extra component that is used to indicate transparency. RGBA is the base for most computer-generated images formats.

- Rushes. The first renders before final compositing. (Film industry term)

- Scene. A scene is a file containing all the information necessary to identify and position all of the models, lights and cameras for rendering. A scene can be identified with the 3D coordinate space in which rendering takes place. This space is often called the "global" coordinate space, as opposed to the "local" coordinate spaces associated with each individual object in the scene.

- Shader. The specification of properties and lighting for a surface. Surface properties must be defined in respect of their colour, reflectivity, surface bump texture, specularity, transparency, translucence etc. Usually comprise a network of connected nodes that control specific aspects of the shading effect. Shading networks define how various colour and texture nodes work with associated lights and surfaces. The placement of textures on surfaces is also controlled by nodes within the network. Nodes in a shading network can be connected in a non-linear way to create the desired effect.

- Skeleton. In animation, a structure that consists of joints and their bones, used to create hierarchical, articulated deformation effects on deformable objects.

- Storyboard. A series of drawings used in the early planning an animation.

- Texture mapping. The process of projecting a (usually) two-dimensional image onto a three-dimensional surface.

- Volumetric fog. In rendering, the simulation of light shining through fine particles (fog, smoke, or dust) in the air. Also known as light fog.