- **Autodesk Maya Entertainment Creation Suite 2012**

- **Efficiency Research and Benchmarking**

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Introduction

This document presents key findings of a benchmarking project designed to assess the impact of the Autodesk® Maya® Entertainment Creation Suite 2012 on the productivity of 3D professionals.

More specifically, the research project focused on three of the software products included in the Maya Entertainment Creation Suite 2012 Premium: Autodesk® MotionBuilder® 2012, Autodesk® Softimage® 2012 and Autodesk® Mudbox® 2012 software, and analyzed their potential impact on the efficiency and the creative potential of the 3D production pipeline. For details on the methodology used to conduct these benchmarks, see "Methodology: How We Measure Productivity" at the end of this report.

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About the Maya Entertainment Creation Suite 2012

Defining a Coherent and Efficient Suite Pipeline

With the Entertainment Creation Suite 2012, Autodesk has decided to expand Maya 2012, by integrating it with the animation software **MotionBuilder**, the 3D sculpting environment **Mudbox**, as well as (in the case of the Premium version of the Suite) **Softimage**.

Integration and efficiency

In order to provide a real benefit to the user, the key aspect of a worthwhile software suite is the **degree of integration** it provides between the core applications: just bundling together individual software packages is not enough; users **need to be able to move smoothly from one toolset to the other** in order to reap the benefits of the sophistication and features the additional tools provide without clogging down their production pipeline. The Entertainment Creation Suite 2012 provides this through **one-click integration** between Maya 2012 and the other Autodesk tool-sets.

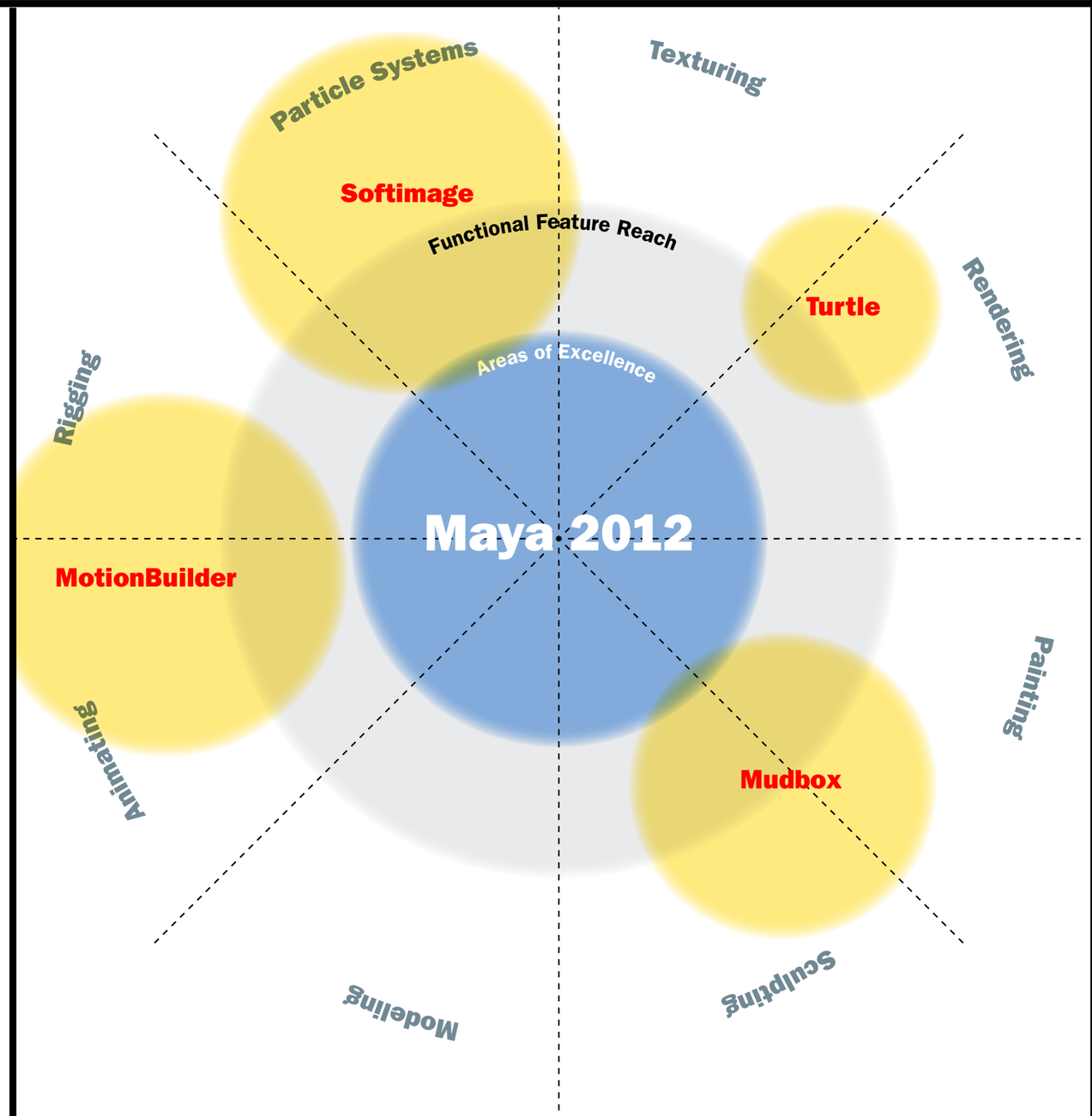
Grasping the potential

But there is another important benefit of a software suite: by offering a coherent, expanded feature set, **a software suite encourages and supports a more sophisticated, fine-tuned production pipeline**; it provides an expanded pipeline model that **draws its efficiency from the use of the right tool from the outset**, rather than using specialized applications such as MotionBuilder and Mudbox only in situations where their use has become indispensable.

Exploring the productivity gains

Exploring the productivity of the tool-sets and the overall efficiency of this new way of working is the aim of this research project and report.

For three of the software products of the Maya Entertainment Creation Suite 2012, **we are exploring not only the productivity it provides, but also some of the creative potential other software products provide**, exploring and documenting an expanded, coherent pipeline that draws upon the capabilities of the software products.



The Autodesk Entertainment Creation Suite Premium extends the functional reach and the efficiency of Maya 2012

Integrating the Entertainment Creation Suite 2012

Tapping all the available potential

Defining a coherent pipeline that unlocks all the available potential of the Maya Entertainment Creation Suite Premium 2012 requires a basic change of attitude. While many 3D professionals use software such as MotionBuilder or Mudbox, they do so in what could be called a **necessity-based pipeline**, i.e. they will use these specialized programs only as a last resort, when the job at hand can not be achieved within the core application — even if another application would be more efficient in handling the task at hand.

Using the proper tool for the job

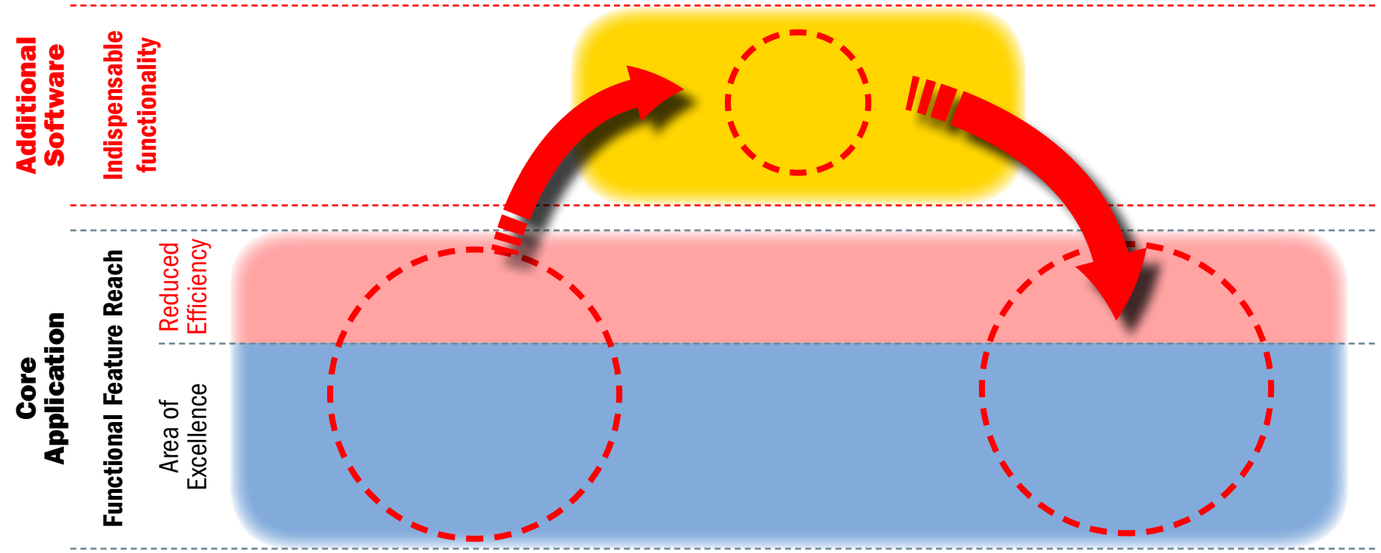
Maya Entertainment Creation Suite 2012, creates the basis for a more efficiency-based pipeline, by providing a coherently integrated environment, where several specialized tools are available to the user.

In other words, there are many cases where a specific operation (the creation of maps, for example) is achievable in the core software packages — yet using another component of the Entertainment Creation Suite 2012 (in this case, Mudbox) makes the process more efficient.

Throughout this report, we will explore how MotionBuilder, Softimage and Mudbox can be used to create such an integrated Suite pipeline.

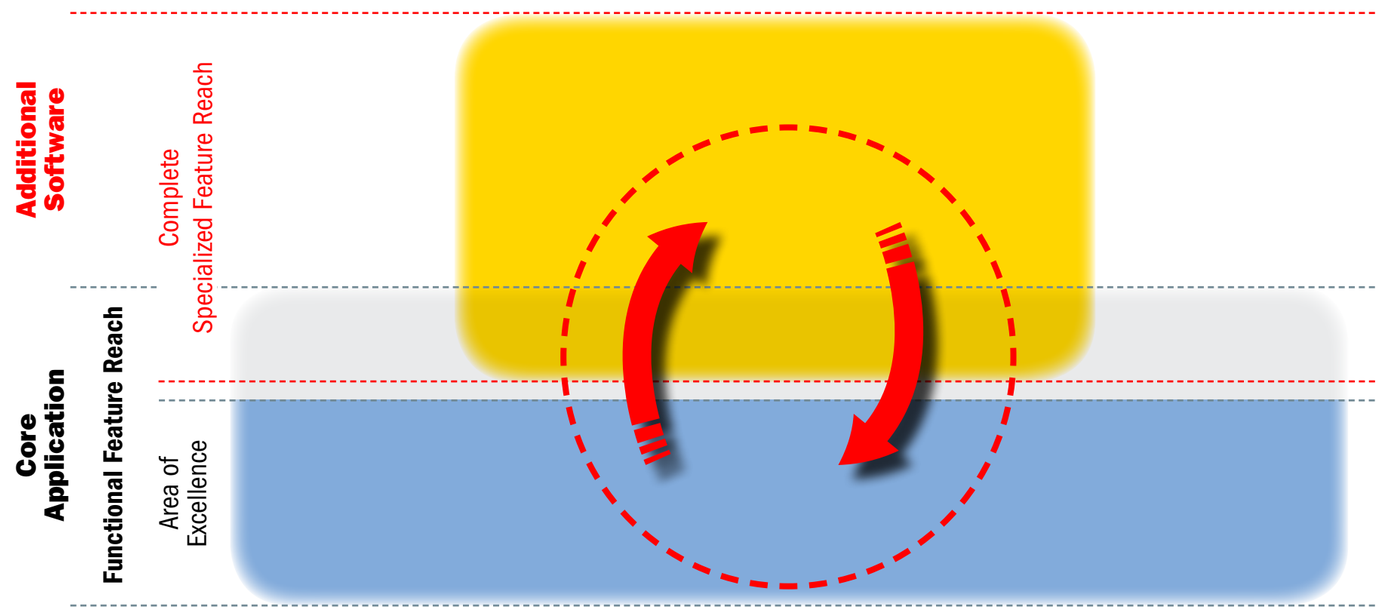
Necessity-based pipeline

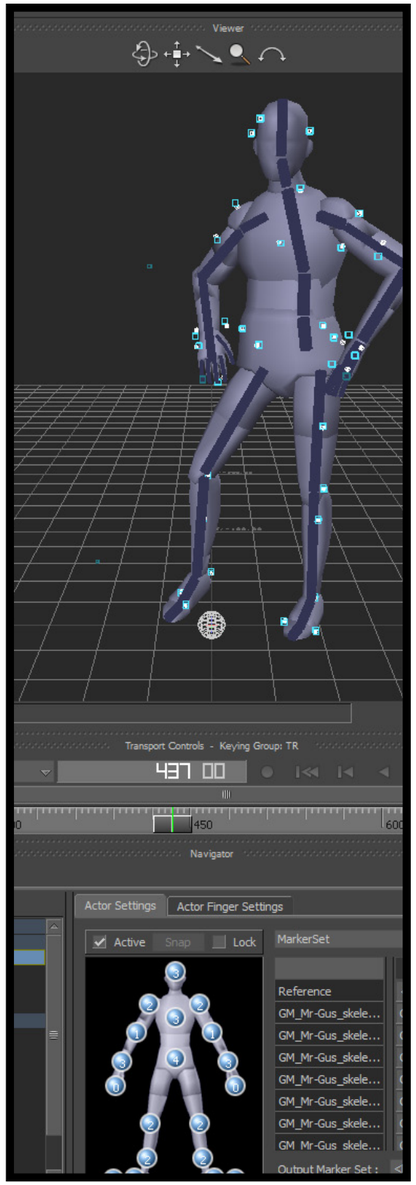
In the typical Maya 2012 pipeline, it is common to achieve whatever is possible using the core application, and to move to additional toolsets only if a problem can otherwise not be solved — **even if the core application is not the most efficient tool for all aspects of a job.**



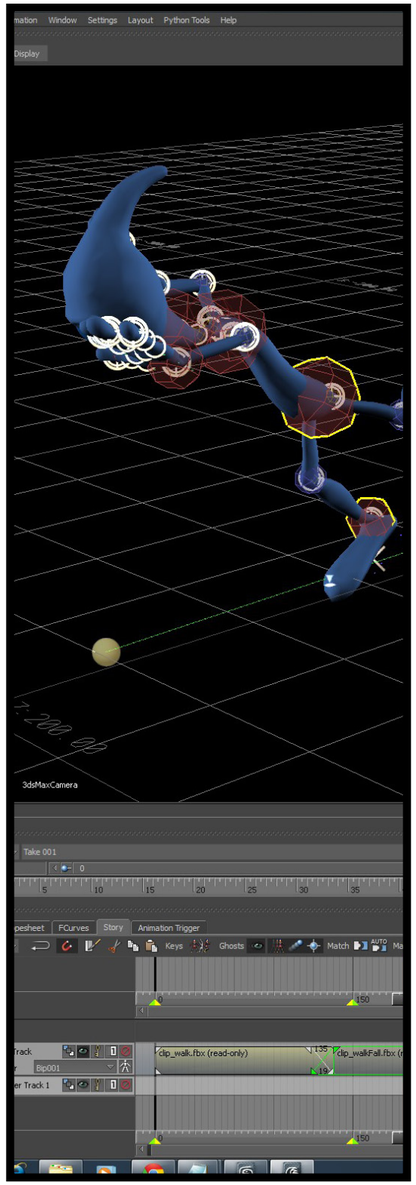
Efficiency-based pipeline

Using the Entertainment Creation Suite 2012, an efficiency-based pipeline can be established, **which moves between software products whenever a task can be more efficiently achieved in an another software product**. (As an example: MotionBuilder is more efficient in tasks that it would not be used for in a necessity-based pipeline.)

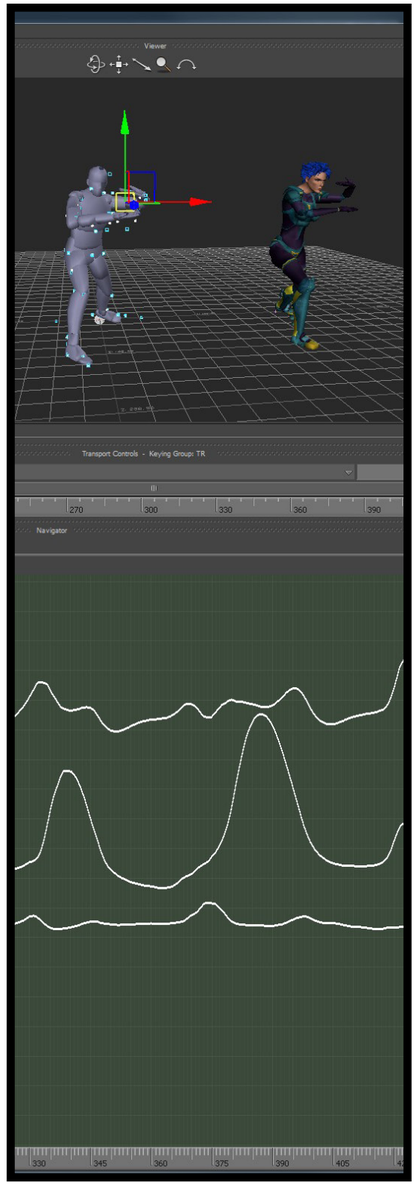




MotionBuilder: The Entertainment Creation Suite 2012 Pipeline



MotionBuilder: Efficiency in Managing Animations



MotionBuilder: Working with Motion Capture Data

MotionBuilder Creative Potential: Virtual Studio Work

MotionBuilder

MotionBuilder is a character animation system that surpasses complete 3D software in many respects.

MotionBuilder is capable of handling and playing back complex character animation in real-time — even when numerous, high-polygon models are active in a scene; its ease for retargeting, and mixing different animations makes it a valuable addition to the Maya 2012 pipeline.

The speed for handling complex scenes and animations also makes MotionBuilder a powerful tool for Virtual Studio work, where complex scenes and shots can be planned and arranged in real-time.

MotionBuilder: The Entertainment Creation Suite 2012 Pipeline

Key Features

Working with motion capture data is one of the key applications of MotionBuilder in the Suite pipeline, but the usefulness of the software exceeds this specific area. **MotionBuilder is a dedicated tool for efficiently managing animations, and excels at managing, combining and retargeting animations.**

Essential capabilities:

Working with animations from different origins and data types: HumanIK, keyframe animations, motion capture data, purchased animations that can come from certain other software applications.

Efficiency and real-time playback of complex animations with large character sets.

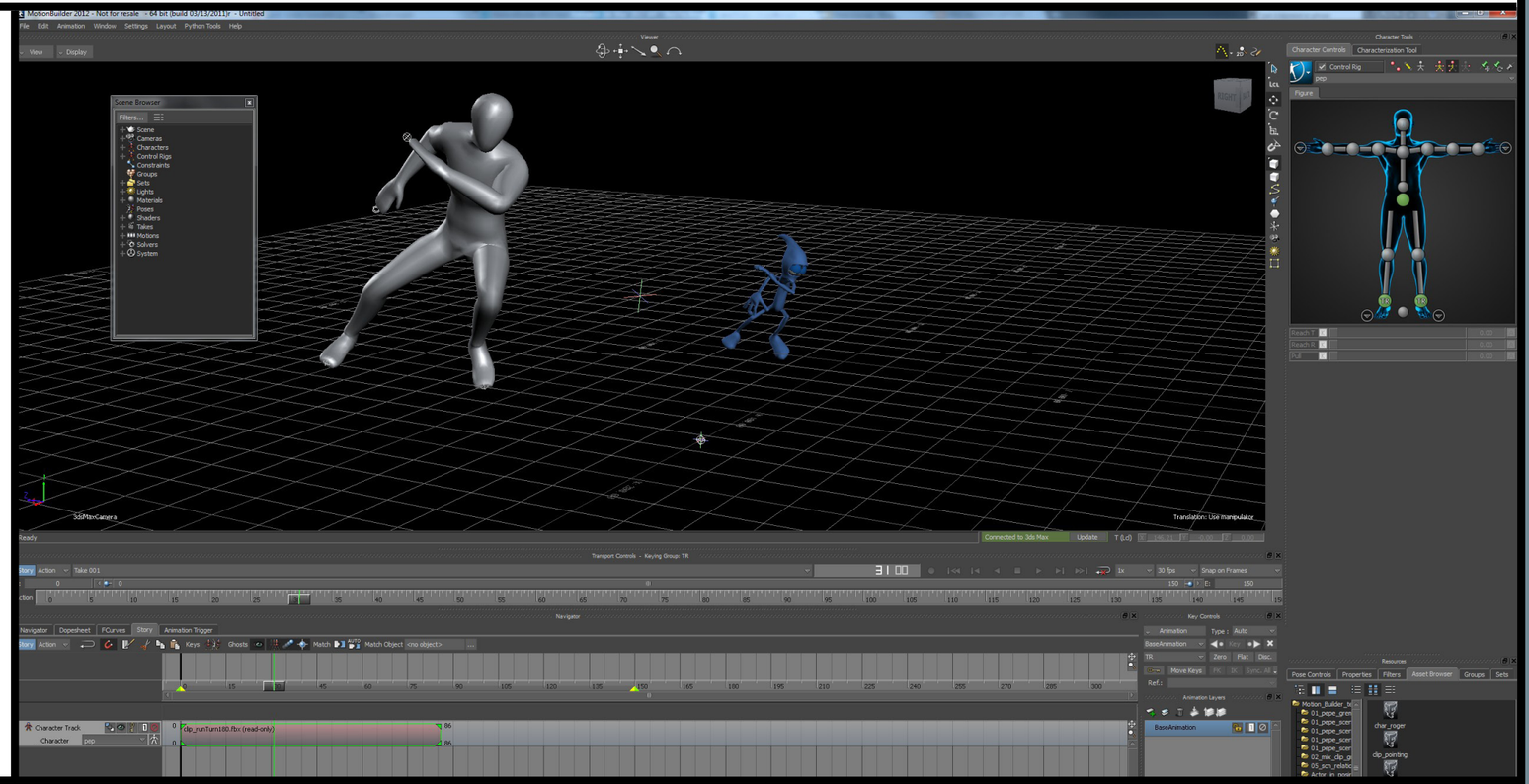
Device support for real-time motion capture, as well as certain other applications, for instance lip syncing to microphone input.

Integration

Integration of MotionBuilder with the rest of the Entertainment Creation Suite 2012 **operates through one-click data integration** based on FBX asset file exchange.

MotionBuilder offers **extensive tools for re-using, retargeting and combining different animations**: data sets from different environments and software packages.

MotionBuilder can be used **to plan complex scenes** even when rigs are extended and customized at a later stage in Maya.



	Maya 2012	MotionBuilder 2012
Areas of Excellence	▶ Sophisticated modeling ▶ Complex rigging, animation with animation layers ▶ Texturing and rendering	▶ Efficient animation handling ▶ On-line and off-line motion capture ▶ Support for certain hardware devices ▶ Easier combination of animation data from different sources ▶ Excellent performance with complex scenes and casts.
Feature Overlap (for pipeline purposes)	▶ Basic rigging and animation ▶ Animation mixing and retargeting for single-source animation data	
Pipeline Logic	Send scene/selected characters from Maya to MotionBuilder → Manage/plan/import/mix animations (even from different origins), apply basic rig → Send back to Maya	

MotionBuilder: Efficiency in Managing Animations

The possibilities

MotionBuilder has the potential to act as the animation hub that can cover a wider array of animation-related planning, managing and processing operations more efficiently than the core 3D application.

Maya 2012 now integrates several animation related options that originated in MotionBuilder: e.g. the humanIK toolkit; **yet it is generally far more efficient to achieve the same tasks in MotionBuilder than to confine them to the core application**.

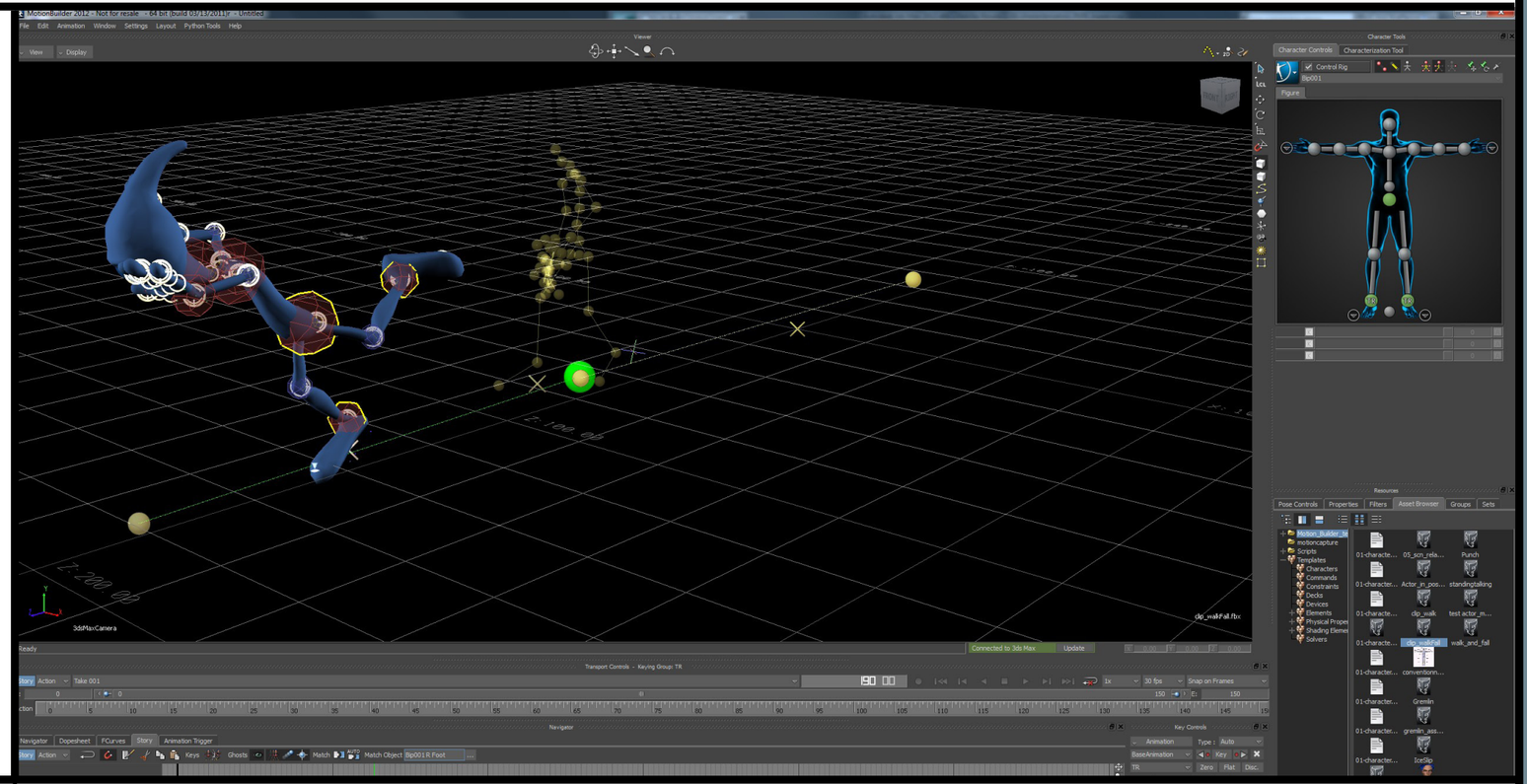
This means thinking of MotionBuilder as **the central application, where animation-related operations are first planned and tested.** MotionBuilder has the ability to mix and work with many different kinds of animations; a task beyond the reach of many other core 3D applications.

In addition, **MotionBuilder can be used as a more efficient way of managing an animation library** of different animation clips, regardless of their origin or type.

The benchmarks

Our animation management benchmarks focused on **retargeting, mixing and combining portions** of animations of different origins.

In this example, MotionBuilder was used to combine the **running action from a motion capture sequence** with the **falling action from from a legacy project.**



Benchmarks	**Combining portions of two different animation clips** (Combining a boxing motion from one animation, with the walking motion from a different one)	**less than 30 seconds**
	Retargeting animation (Transferring animation from different origins from one MotionBuilder control rig to another)	**3 seconds**
	Comments	
Maya Entertainment Creation Suite 2012	▻ MotionBuilder can more easily combine different animations that would otherwise be incompatible.	
Maya 2012	▻ Combining these animations would not be possible in Maya and would require having the animation data to be converted to one common format.	

MotionBuilder: Working with Motion Capture Data

The possibilities

Motion capture is often perceived as the key use for MotionBuilder in the production pipeline; the program **offers a wider variety of processing, characterizing and clean-up operations** for motion capture data.

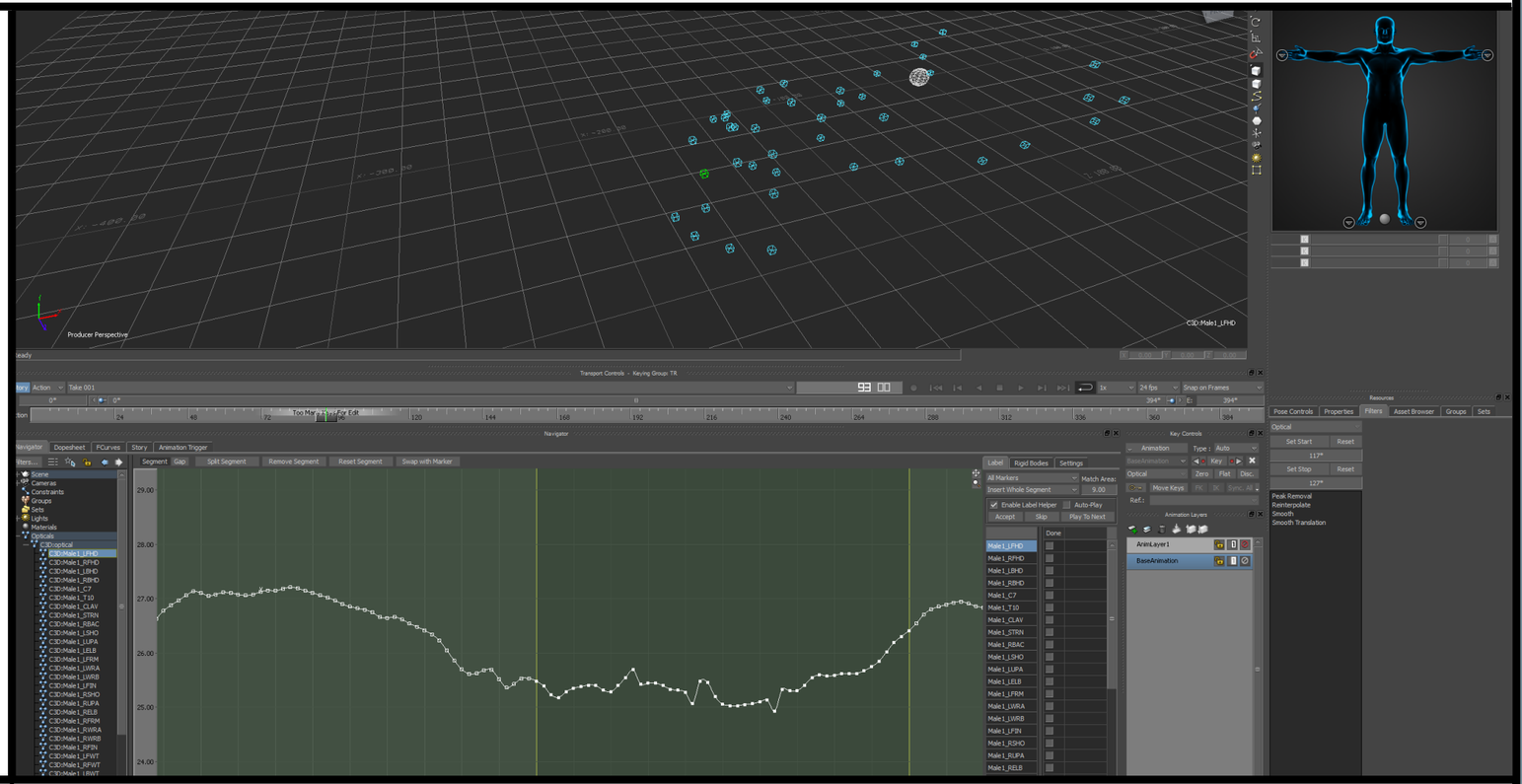
In addition, MotionBuilder offers **extensive device support**, which allows it to act as a platform not only for off-line, but also for live motion capture, and **it can handle both full-body motion capture and facial motion capture** and animation.

The benchmarks

The benchmarks for this project included motion capture set-up and motion capture clean-up:

Motion capture set-up measured the time necessary to characterize an imported motion capture point-cloud, and to use it with a rig within MotionBuilder.

Motion capture cleanup: The motion capture clean-up benchmark processed applying several clean-up filters on a raw motion capture file.



Motion capture clean-up - in this case, peak-removal - is one of the key features for working with motion capture data.

Benchmarks		
	Motion Capture clean-up benchmark (Import raw motion capture file, select portions to be cleaned, apply Butterworth, peak removal and key reduction filters)	**1 minute**
	Motion Capture Set-up (Import the optical data, pose actor, create marker set, use actor as source for other character with rig.)	**10 minutes**

	Comments
Maya Entertainment Creation Suite 2012	▶ MotionBuilder allows interactive, sophisticated motion capture clean-up. ▶ Peak removal only removes unwanted peaks in the curve of motion capture data, but leaves overall curve unchanged.
Maya 2012	▶ Maya 2012 provides limited motion capture clean-up operations during the import motion capture data. ▶ Peak removal can be applied, but the operation averages out the curve, rather than only removing the peaks.

Motion Builder Creative Potential: Virtual Studio Work and Previsualization

The possibilities

Virtual Studio work, previsualization and scene planning is an increasingly important use of 3D technology in the movie-making process and in game development.

In this field, using **MotionBuilder in conjunction with Maya 2012 helps extend the virtual studio pipeline significantly.** MotionBuilder integrates a highly optimized display engine, which offers **real-time realistic display of complex scenes** involving dozens of actors.

In addition, MotionBuilder software's device support has the capacity to integrate live motion capture into a scene and **allows the director to interactively manipulate the camera within MotionBuilder scene** using a handheld screen, while live motion capture is acquired by the system.

The benchmarks

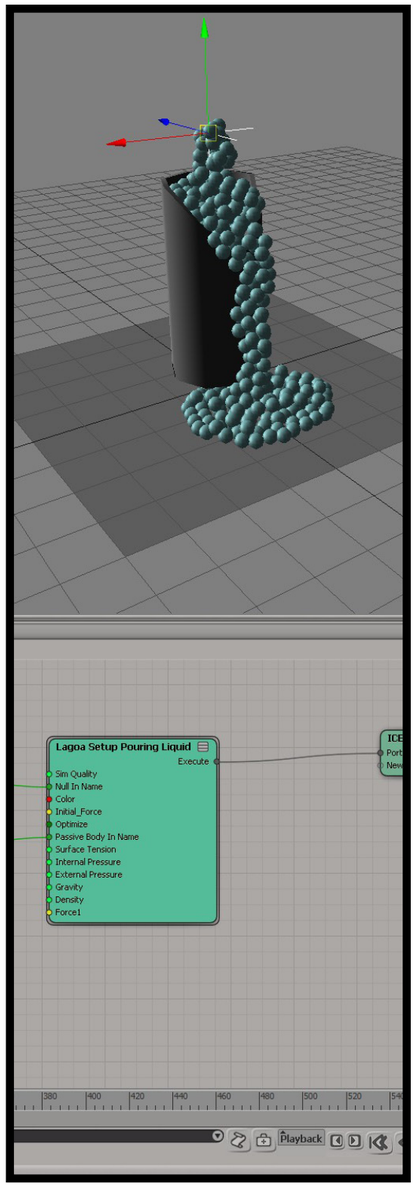
Multiple-Character Display Speed Benchmark:

The benchmarks for this project measured the **display speed in the viewport for several, high polygon characters** with plotted (baked) animations.

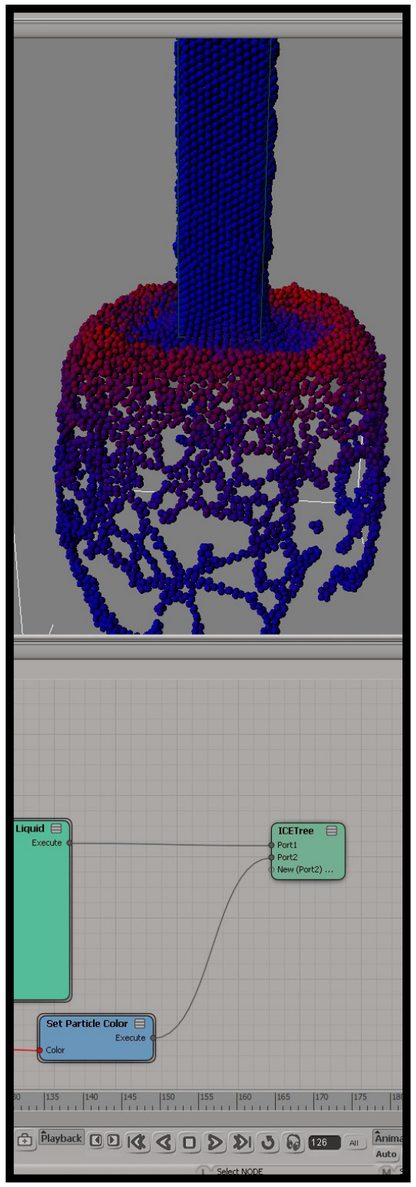
MotionBuilder excels in displaying complex scenes with numerous characters; this makes it a powerful tool for previsualization and virtual studio work.

Benchmarks		MotionBuilder Viewport Display	Maya 2012 Viewport Display
	1 character (40 000 skinned polyg.)	real-time	11 fps
	5 characters (total of 90 000 skinned polyg.)	real-time	2.5 fps
	16 char. (total of 281 000 skinned polyg.)	real-time	no playback
	32 char. (total of 563 000 skinned polyg.)	real-time	no playback

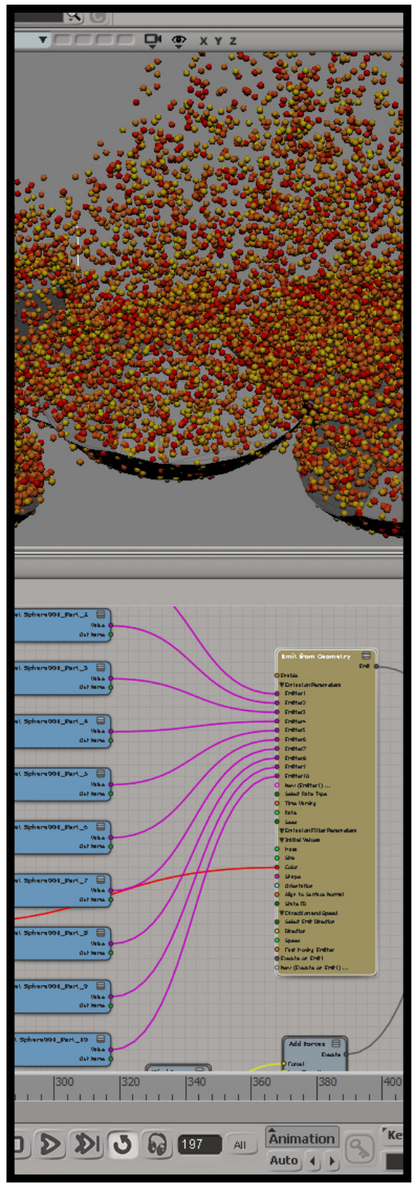
	Comments
Maya Entertainment Creation Suite 2012	▸ MotionBuilder can display extremely complex scenes with many cast members in real time in the viewport. ▸ Viewport display provides realistic display of lighting and shadows, as well as some particle effects.
Maya 2012	▸ Maya 2012 is a highly sophisticated 3D production environment. Integration with MotionBuilder provides a streamlined and more efficient previsualization pipeline for virtual studio work and scene planning,



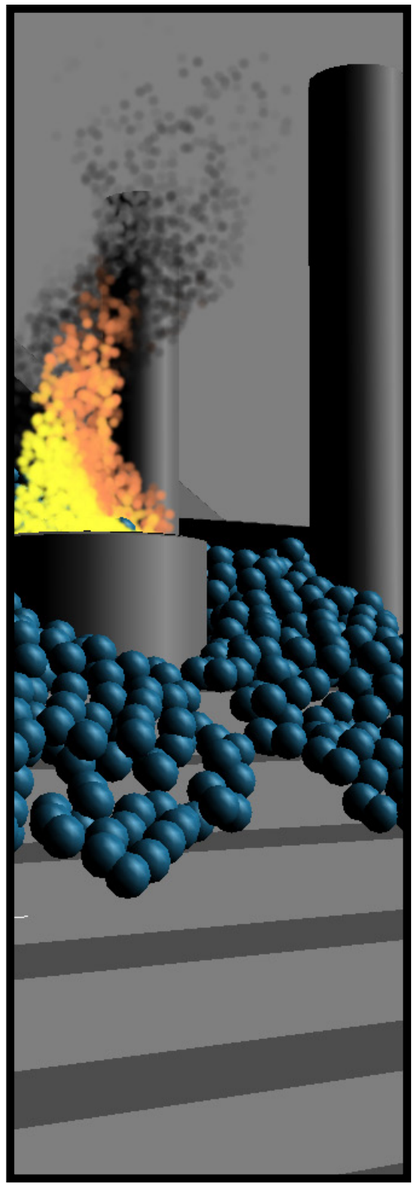
Softimage: The Entertainment Creation Suite 2012 Pipeline



Softimage: Realistic Fluid Simulation with ICE



Softimage: Creation of Complex Particle Systems



Softimage Creative Potential: Sophisticated Physical Simulations

Softimage

Softimage is a 3D modeling, animation and rendering system, that is well known for its capabilities in terms of handling large data sets, as well as the sophisticated particle systems effects it supports.

The inclusion of Softimage in the Entertainment Creation Suite Premium adds valuable functionality: thanks to the ICE (Interactive Creative Environment) tool-set, Maya 2012 users can more easily tap the considerable power of Softimage to more quickly create and integrate near-realistic physical simulations into their projects.

Softimage software's Face Robot® module provides interesting facial animation features for games engines.

Softimage: The Entertainment Creation Suite 2012 Pipeline

Key Features

Softimage provides Maya users with a more easily accessible environment for creating particle-based effects. While Maya offers powerful particle systems, it does not have the same breadth of physical simulations and effects Softimage ICE provides. The Lagoa Multiphysics engine included with Softimage 2012 **allows creative users to experiment more easily (and with real-time feedback) with sophisticated physical simulations** that would be very hard if not impossible to realize with many other software applications.

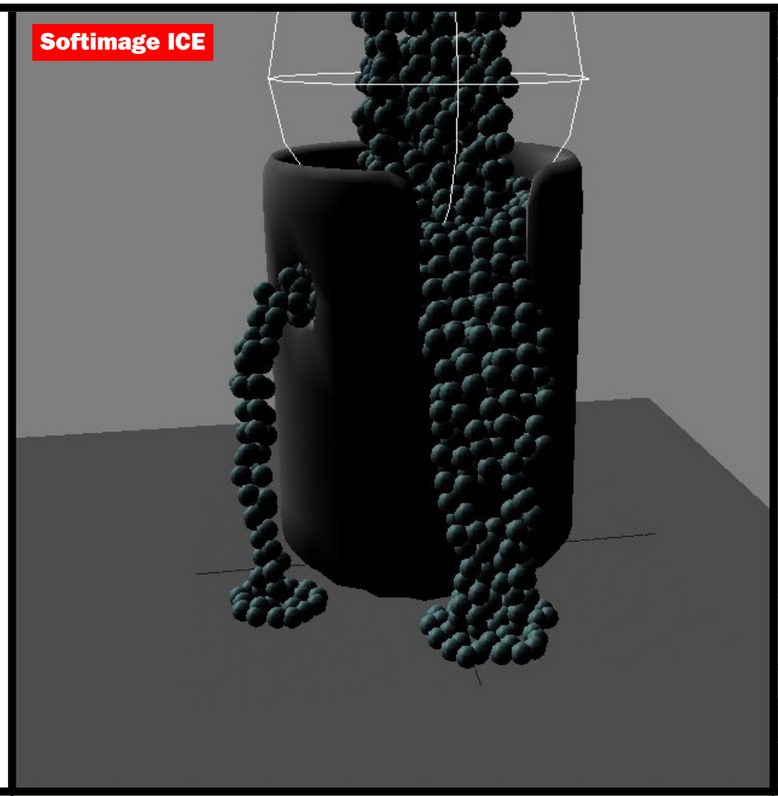
Integration

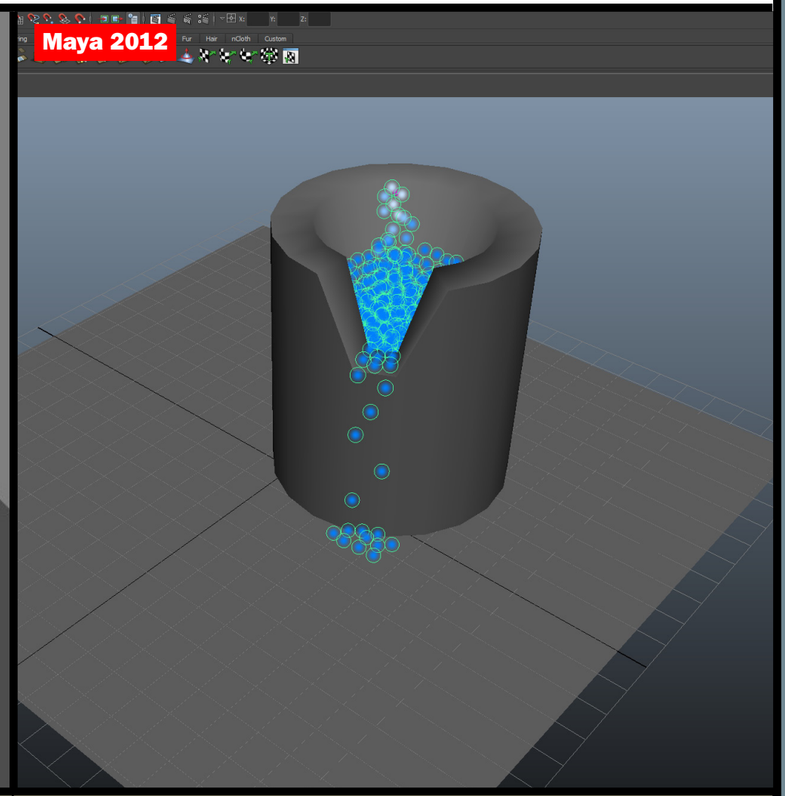
Integration between Maya 2012 and Softimage ICE is simpler: Sending the elements to include in the particle simulation to Softimage is a one-click operation that creates a dynamic link between the two applications.

Once the desired effect is created, Softimage calculates the particle cache (using the same nCache format used by Maya) and the animated particle cloud is sent back to the Maya scene. Only modified elements will be updated.

Softimage ICE **makes it easier to experiment with a wider variety of physics-based effects**: in this example, near realistic fluid simulations. (Image on the left.)

Once the cache is calculated by Softimage, it is sent back to Maya, where it is immediately displayed. (Image on the right.)





	Maya 2012	Softimage 2012
Area of Excellence	Sophisticated modeling · Complex rigging, animation with animation layers · Texturing and rendering	Sophisticated 3D production environment · Sophisticated physics-based particle effects with real-time feedback · Powerful facial rigging features (Face Robot) · Highly efficient handling of large data sets
Feature Overlap (for pipeline purposes)	Basic particle effects	
Pipeline Logic	Send selected objects/ animations from Maya to Softimage → Create effect with ICE, fine-tune with real-time feedback → Render particle cache in Softimage ICE → Send back to Maya (Updates only modified objects)	

Softimage: Realistic Fluid Simulation with ICE

The possibilities

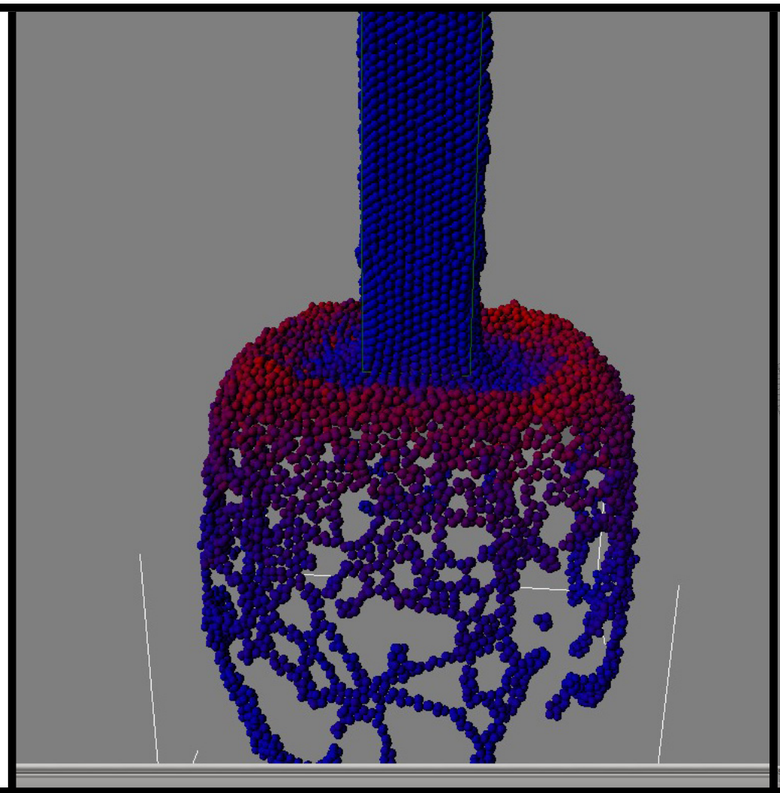
Realistic fluid simulations are complex. The problem is not so much to create the *appearance* of a liquid, **but to generate a particle system that *behaves* like a fluid and interacts with its environment in a way that displays correct physical behavior**. If you pour water into a container, for instance, it will need to fill it, and, if the pouring action doesn't stop, it should overflow and flood the environment around it.

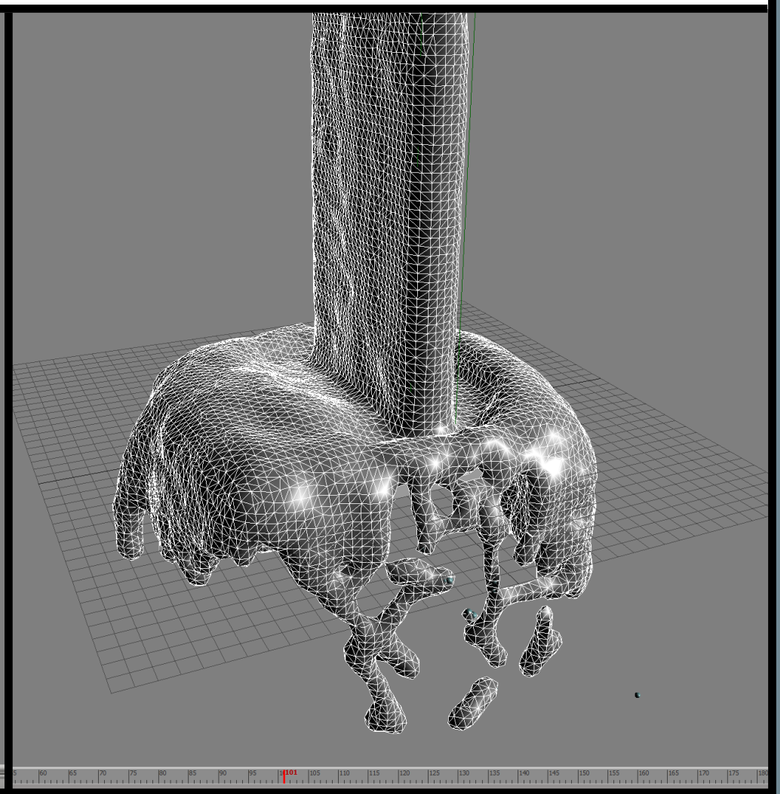
Softimage ICE offers this possibility, and brings a level of realism to 3D scenes. **Creating such a simulation within Softimage ICE is straightforward and offers a wide range of creative potential.**

The integration with Maya 2012 works as with simpler examples of particle effects: you send the elements which need to interact with the scene to Softimage, create the effect, render the particle cache and send it back to Maya, where it is automatically integrated into the scene.

The Benchmarks

Fluid Simulation Benchmarks: We executed several fluid simulation benchmarks, simulating a liquid pouring into a container or onto a surface, and flood the scene as it exceeds the capacity.





Softimage ICE can create highly realistic fluid simulations: In this case, a liquid pouring over a flat object; including a color change as the liquid bounces off the surfaces.

Image on the right: the same particle simulation with polygonized surfaces. (Despite polygonization, Softimage provides playback for the animation without rendering the cache.)

Benchmarks	**Set up realistic fluid simulation 1** (Water pouring on a flat surface and changing color)	**1 minute and 40 seconds**
	Set up realistic fluid simulation 2 (Water pouring into a cup until it flows over and floods scene)	**1 minute and 21 seconds**
	Comments	
Maya Entertainment Creation Suite 2012	▶ Setting up basic physical effects (e.g. fluid simulations) in Softimage ICE is straightforward; certain additional functionality can be explored interactively.	
Maya 2012	▶ While Maya 2012 offers powerful particle tools and physical simulations, the set-up of complex particle systems requires an experienced, specialized user and doesn't lend itself to interactive experimentation.	

Softimage: Creation of Complex Particle Systems

The possibilities

Softimage ICE can be used to **create highly complex particle simulations, that combine a wider variety of physical properties** and would be hard if not impossible to realize in certain other 3D applications.

What makes this possibility particularly interesting is the relatively intuitive nature of the experimentation process: while a user can go very deep into the specific settings that create an effect, **it is also easy to create ICE effects without becoming a particle systems expert.**

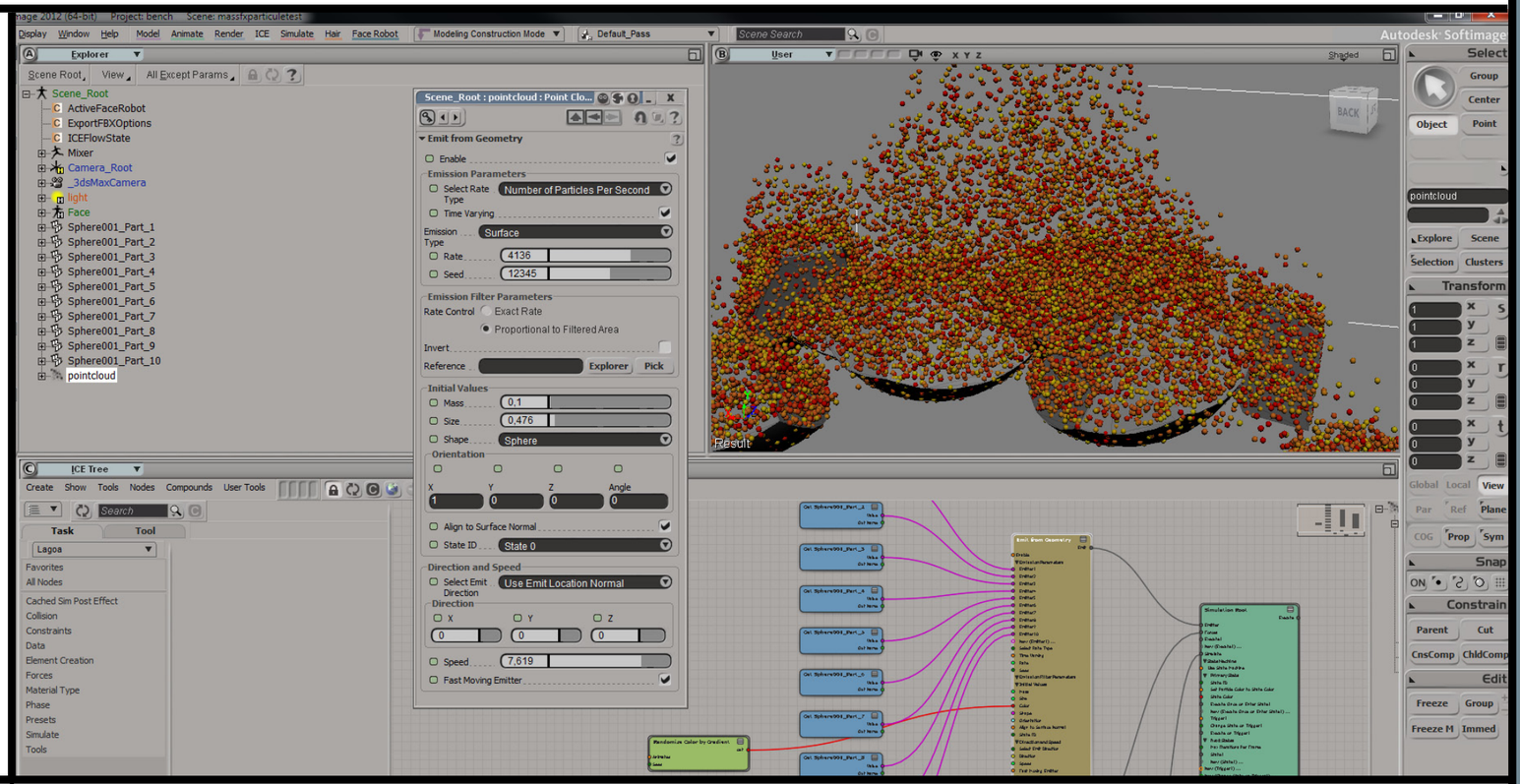
About real-time playback

Beyond the breadth of available features, what sets the ICE environment apart from particle systems in Maya is **real-time feedback.** In other words, particle animations provide immediate response when settings (the force of wind, or gravity, for instance) are changed. As a result, **the often cumbersome process of fine-tuning complex particle simulations becomes more interactive**, and thus more efficient.

The benchmarks

Complex Particle System Benchmark: The benchmark measured the time to set up a complex particle system with multiple emitters, multicolored particles and physical effects in Softimage ICE.

This complex particle system, combining several particle emitters, multicolored particles and complex behaviors **can be played back interactively** while the parameters are fine-tuned.



Benchmarks	**Create a complex particle simulation** (2 emitters, multicolored particles, particles coagulate when close to each other and bounce off any surface. If some particles manage to quit the volume they are erased)	**2 minutes 10 seconds**
	Comments	
Maya Entertainment Creation Suite 2012	▶ Integration with Softimage ICE is simpler, particularly since Maya 2012 and Softimage 2012 use the same nCache format for particle simulations.	
Maya 2012	▶ Creating a comparable particle simulation in Maya would take much more time and expertise to configure. ▶ While Maya can track collision of particles, creating a coagulation effect would be difficult.	

Softimage Creative Potential: Sophisticated Physical Simulations

The possibilities

One of the most exciting creative potentials offered by the addition of Softimage to the Entertainment Creation Suite toolset is **the ease of exploring complex combinations of different physical attributes and effects.**

It is important to note that this power can be accessed even by occasional users who wish to experiment with physical simulations; yet it can be explored in great depth if need be.

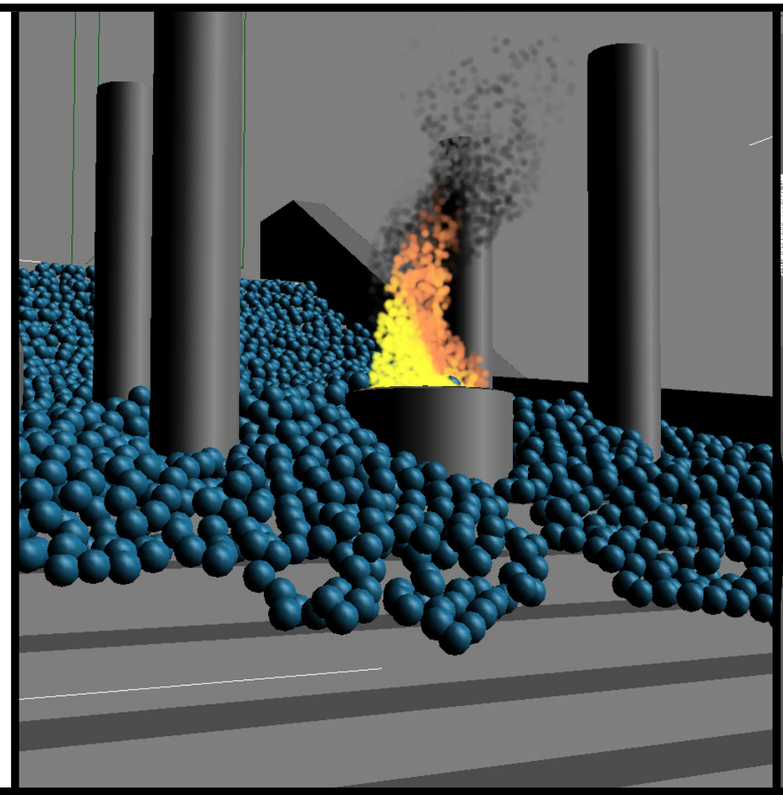
The benchmarks

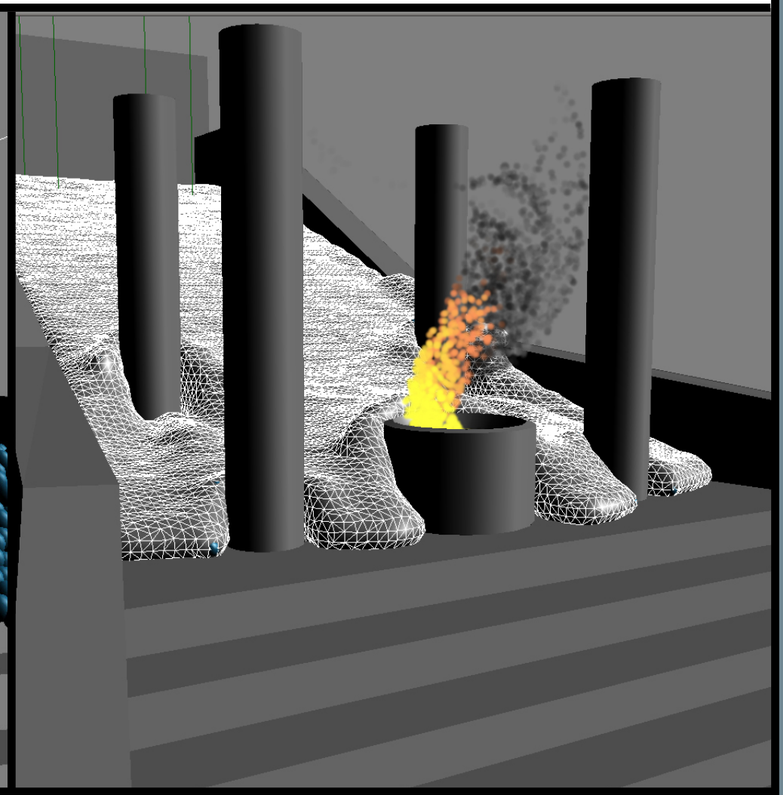
Sophisticated Physical Simulation Benchmark:

For our benchmark **we combined several physical simulations, a liquid flooding a staircase, smoke rising from a fire, and a strong wind** that affects both the fluid and the flames and smoke.

The base model was created in Maya 2012 and then sent to Softimage.

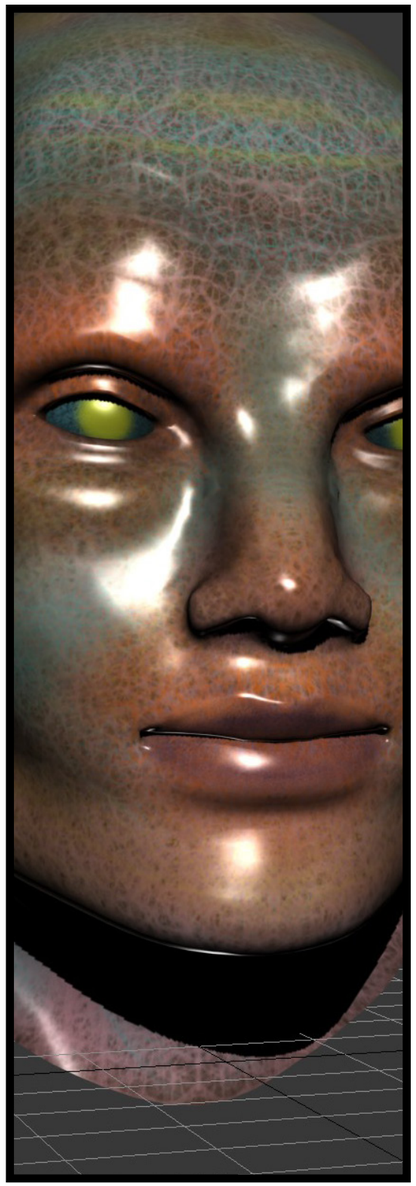
Setting up and fine-tuning the necessary particle systems took just 10 minutes.



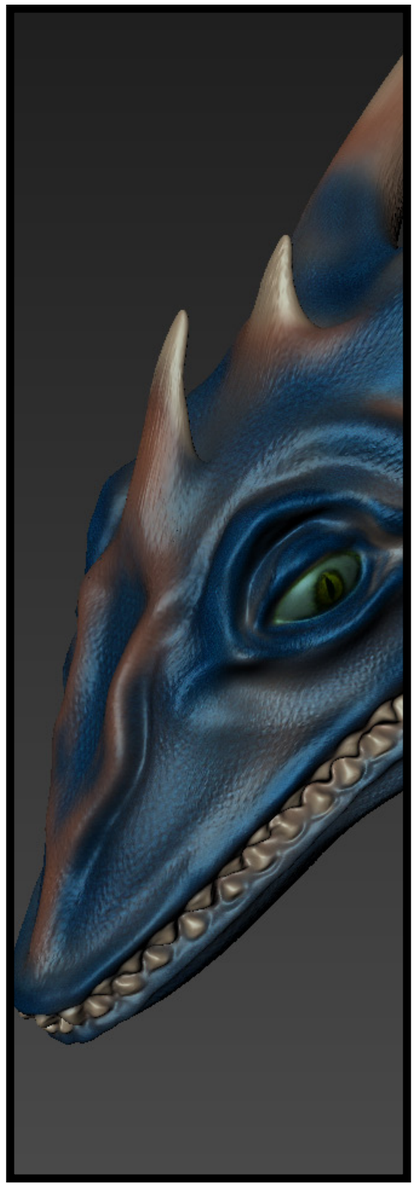


The same scene, combining fluid simulation wind, fire and smoke, **in particle display** on the left, and **in polygonized view** on the right. (Currently, only the particles can be sent back to Maya; if polygonization is required it should be applied in Maya.)

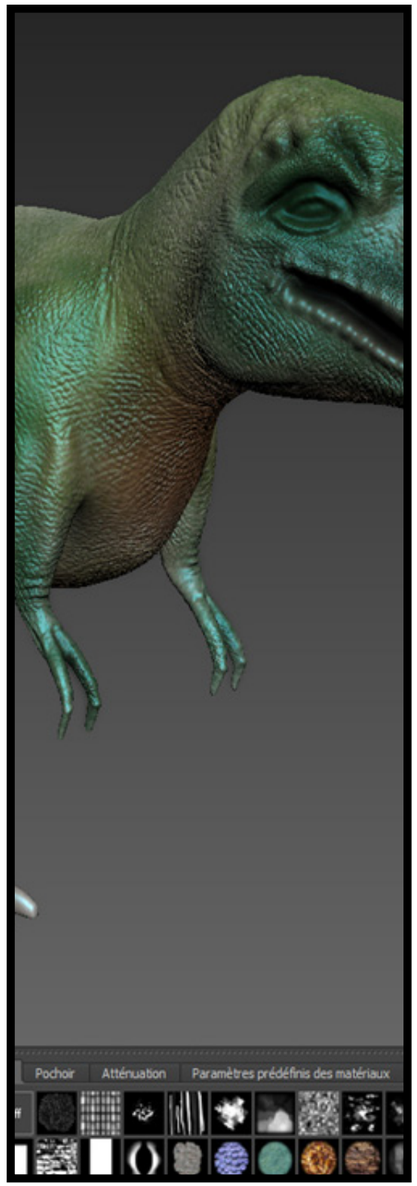
Benchmarks	**Create sophisticated physical simulation** (The benchmark combined a fluid simulation, simulation of fire and smoke, with a strong wind blowing over the scene and affecting the movement of liquid and smoke)	**10 minutes**
	Comments	
Maya Entertainment Creation Suite 2012	Softimage ICE provides interactive creation of particle systems with real-time feedback and can manage even very large scenes with relative ease.	
Maya 2012	While Maya 2012 has very powerful particle systems and physical simulations, accessing the power of these tool-sets requires a significant learning curve and is usually beyond the reach of the occasional user.	



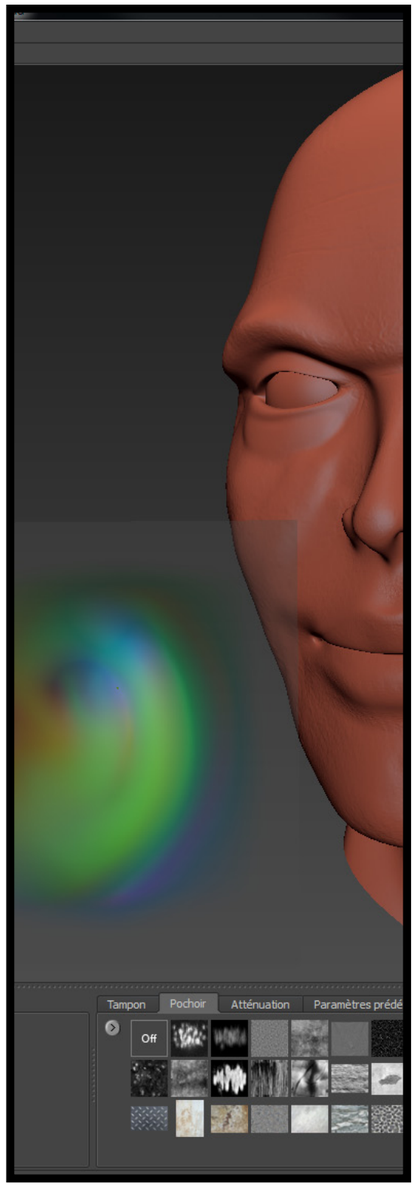
Mudbox: The Entertainment Creation Suite 2012 Pipeline



Mudbox: Sculpting Complex Objects



Mudbox: Painting and Map Creation



Mudbox Creative Potential: Vector Displacement Maps

Mudbox

Mudbox is a sophisticated 3D painting and sculpting environment that is tightly integrated with the other applications in the Maya Entertainment Creation Suite 2012.

The painting and sculpting tools of Mudbox significantly extend the modeling and map creation features of Maya 2012. The latest release of the program offers support for vector displacement maps and simple integration with the core 3D production environment.

One key aspect of Mudbox is it's ease of use, opening up 3D sculpting to creative users daunted by the steep learning curve often associated with certain 3D sculpting applications.

Mudbox: The Entertainment Creation Suite 2012 Pipeline

Key Features

In the past, brush-based sculpting and map creation suffered from two basic limitations: the learning curve of a new and unfamiliar tool, and a relatively cumbersome integration of the sculpting application with the core 3D environment.

Mudbox 2012 provides significant improvements in both areas: the program has **a surprisingly low learning curve** for a sophisticated 3D program, and it provides a **streamlined integration** between sculpting/painting toolset and the core 3D production environment.

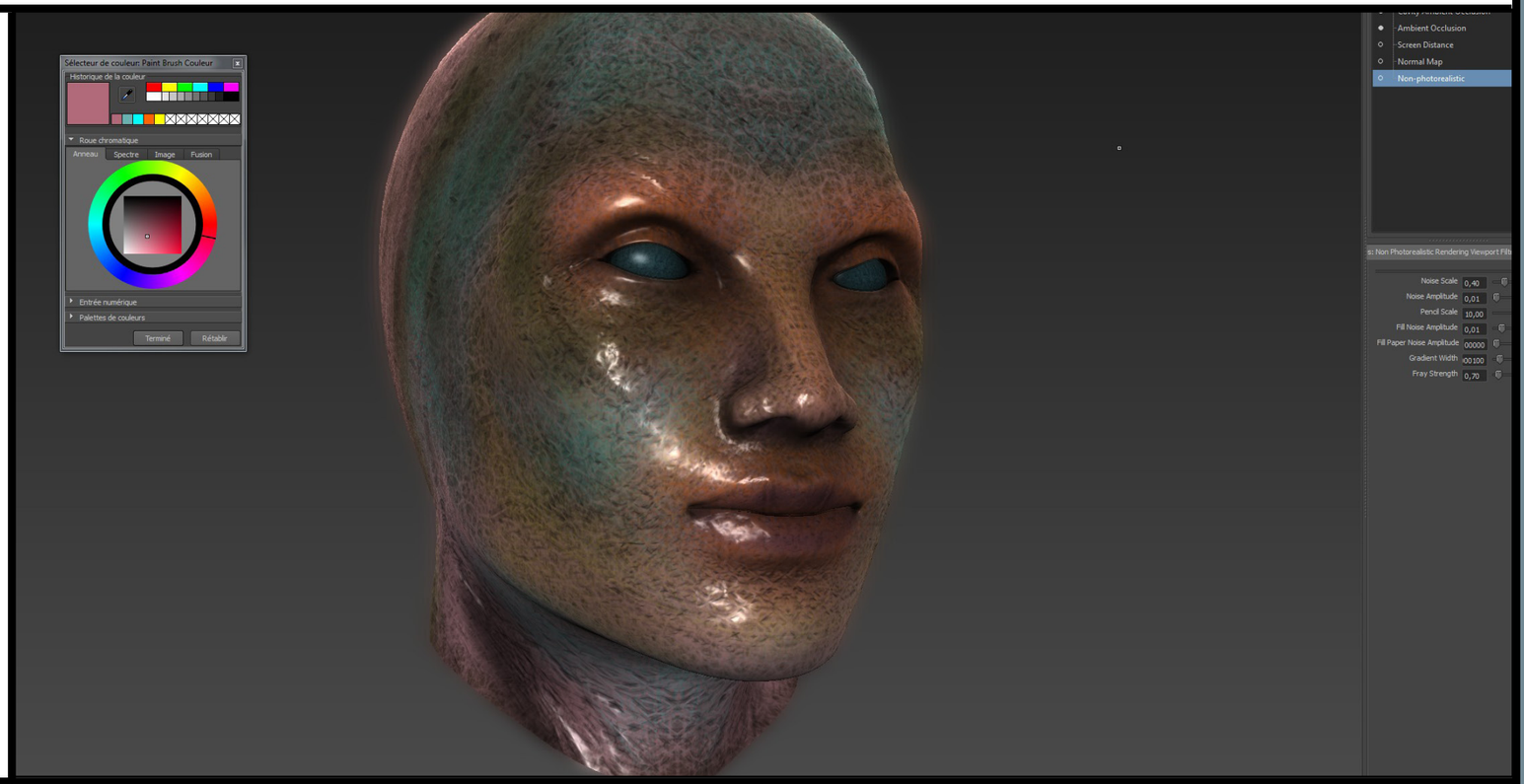
In addition, the latest release of Mudbox brings **support for vector displacement maps**: this makes it possible to create highly complex shapes (e.g. a human ear), to extract the vector displacement map, and then to use this map either to enrich sculptures inside Mudbox, or to export the map to Maya 2012, where it can be placed and rendered through the mental ray renderer.

Integration

Like MotionBuilder and Softimage, **Mudbox offers one-click integration with Maya 2012**: the user sends a selected object to Mudbox, where it is sculpted and painted, and then sent back to Maya, where it is updated in its new shape and with all maps in place.

While many 3D programs allow users to paint directly on 3D objects, Mudbox pushes the process to a considerable degree of sophistication.

Particularly useful in this process is the possibility **to paint on a 3D object in a rendered view** that takes into account **sophisticated lighting effects** and **depth of field rendering.**



	Maya 2012	Mudbox 2012
Areas of Excellence	▶ Highly sophisticated modeling ▶ Complex rigging, animation with animation layers ▶ Texturing and rendering	▶ Brush-based sculpting and painting ▶ Sophisticated map creation: extraction of vector displacement maps ▶ Simpler creation of layer-based states for morph-targets ▶ Ease of use and low learning curve
Feature Overlap (for pipeline purposes)	▶ Basic integrated paint tools for map creation ▶ Basic brush-based sculpting	
Pipeline Logic	Send placeholder object from Maya to Mudbox → Sculpt and create maps with sophisticated brush tools → Send object and automatically extracted maps back to to Maya	

Mudbox: Sculpting Complex Objects

The possibilities

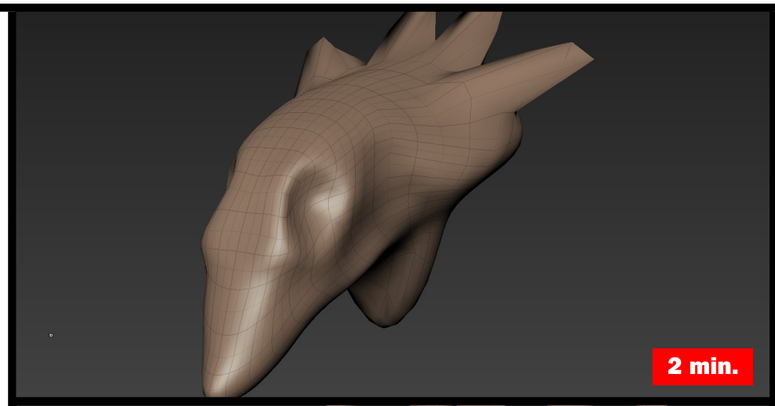
Mudbox offers sophisticated, brush-based sculpting, that **allows even an inexperienced user to get impressive results in a short amount of time**, and without having to go through a lengthy learning process.

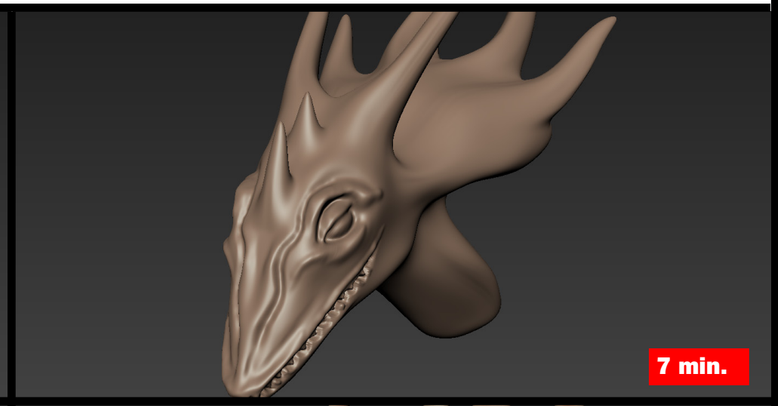
While most 3D modeling applications offer some form of brush-based sculpting and texture-painting, **they can not rival the power and the ease of use provided by Mudbox**. The program offers an **uncluttered user interface**, that does not distract the user; the tools in Mudbox provide a familiar user experience that is familiar for creatives used to express themselves with a brush. In addition, **the wider array of stamps and brushes included with Mudbox have been fine-tuned for the sculpting and texture-map creation purpose.**

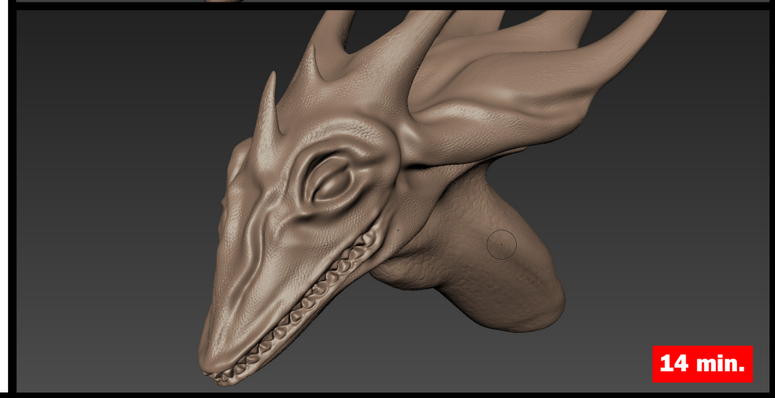
The benchmarks

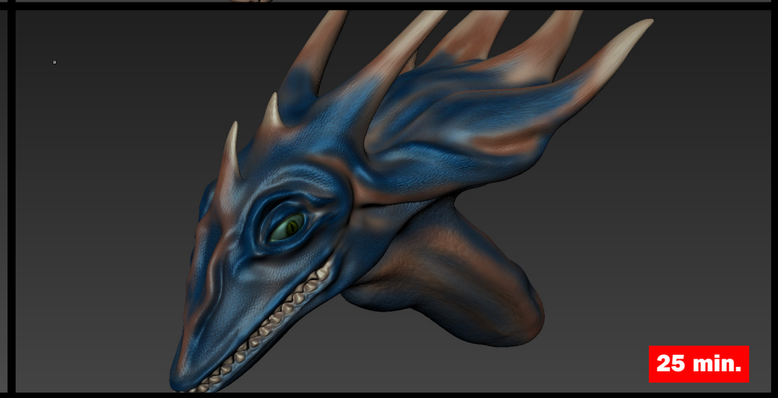
Creating a dragon's head: Our benchmark consisted in the creation of a dragon's head, starting with a simple sphere-shaped placeholder in Maya 2012. It took (a relatively novice) user of Mudbox all of 25 minutes to sculpt a complex head, paint it, and update the scene in Maya with the new model and maps in place.

The images on the right show the sculpting and painting stages of the dragon's head in our benchmark, and the time it took to get to this level of detail.









Benchmarks		
	Sculpt and paint dragon's head (including sending place-holder object from Maya 2012 to Mudbox, and exporting sculpted object and maps back to Maya 2012)	25 minutes

	Comments
Maya Entertainment Creation Suite 2012	▻ The ease of integration with the main 3D environment, the sophistication of the tools, and the low learning curve make Mudbox an ideal extension to the Maya 2012 tool-set.
Maya 2012	▻ While it is not technically speaking impossible to create such a model in Maya 2012, matching the speed and efficiency and sophistication of Mudbox for this job would be extremely challenging.

Mudbox: Painting and Map Creation

The possibilities

The creation of texture maps for the core 3D environment is one of the key applications for the Mudbox tool-set.

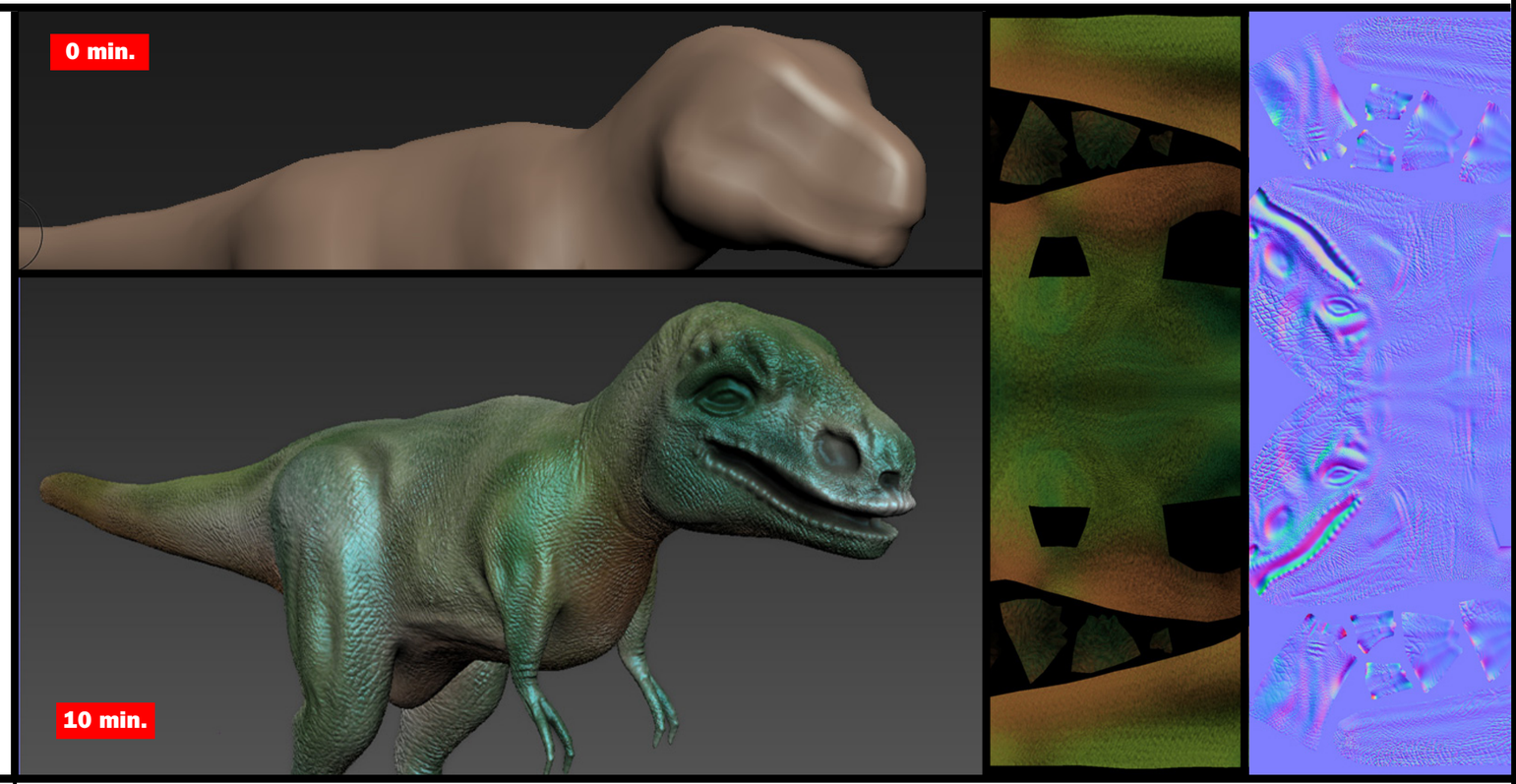
As is the case with sculpting, the core 3D applications offer basic texture painting features, and, in recent releases allow the user to paint directly on 3D objects in the viewport. **Yet this functionality does not offer the sophistication of the tools and the work environment provided by Mudbox**, which supports a very intuitive and faster way of working, allowing creative work in a rendered view with sophisticated lighting options. In addition, **Mudbox can automatically extract a variety of map types**: paint layers to normal maps and vector displacement maps based on the sculpted object.

The benchmarks

Sculpting texture and painting a base model:

Our benchmark consisted in refining the texture and detail in a very simplistic model of a T-Rex, and to export the automatically extracted maps back to Maya 2012.

Mudbox allows the user **to paint and sculpt in a photorealistically rendered viewport** that supports custom lighting and depth-of-field rendering. This creates an intuitive and interactive environment that helps boost the efficiency for this type of work.



Benchmarks	**Sculpt texture and paint a base model** (exporting diffuse and normal maps to Maya 2012)	**10 minutes**
	Comments	
Maya Entertainment Creation Suite 2012	▻ Painting and brush-based texturing tools of Mudbox considerably exceed the functionality available in Maya 2012. ▻ Isolating the creative process from the main 3D environment increases the efficiency of painting and sculpting.	
Maya 2012	▻ While Maya 2012 allows some brush-based painting and texturing operations, it does not match the sculpting and painting features available in Mudbox.	

Mudbox Creative Potential: Vector Displacement Maps

The possibilities

Vector displacement maps are a relatively recent technique for speeding up the modeling of complex, repetitive objects. The process is relatively straightforward: one creates the model that will need to be reused in Mudbox, and extracts the vector displacement map, which only takes a few seconds.

Using this map, it is possible to add this object to existing geometry with a brush — and it can of course be reworked the way one chooses.

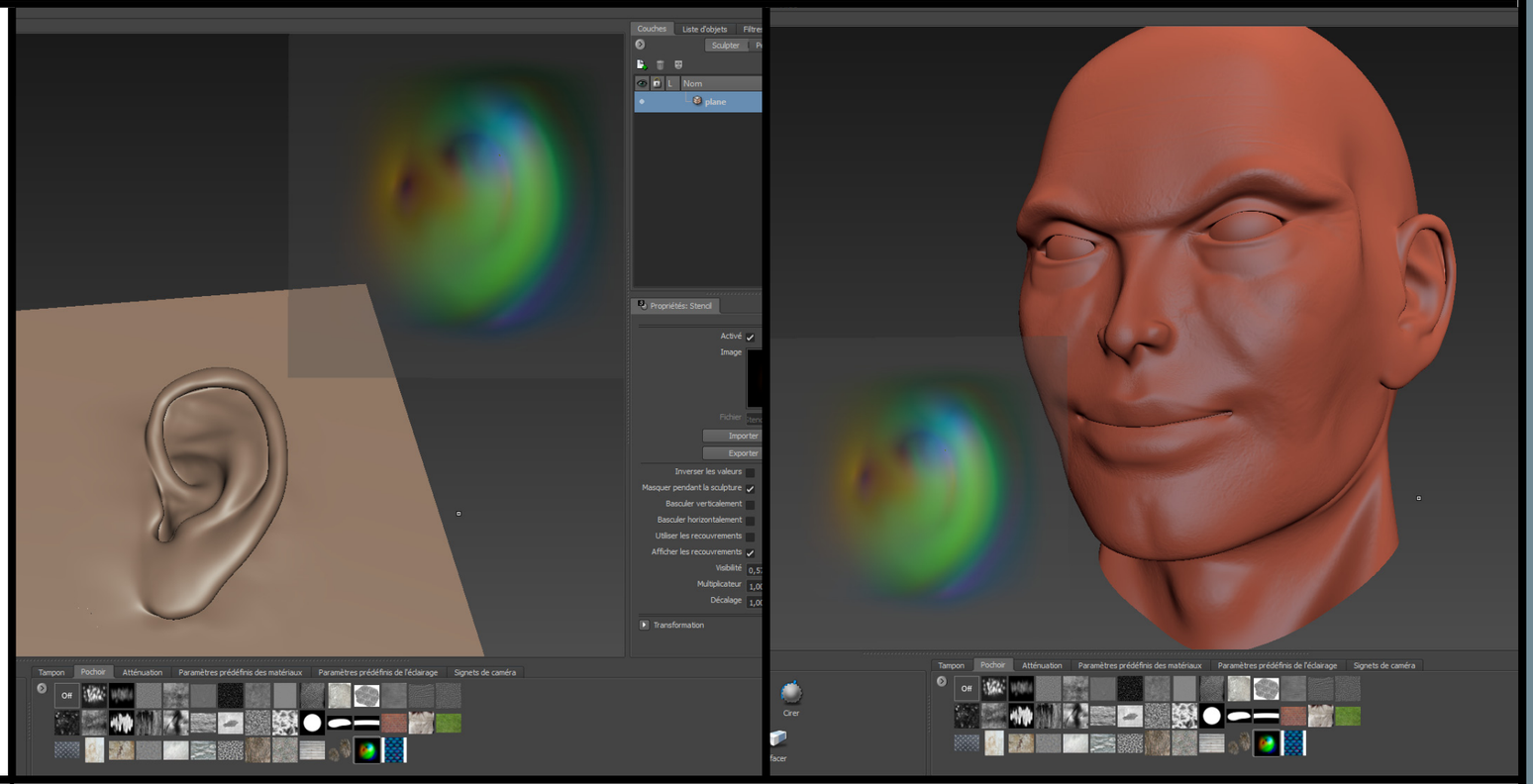
Another pipeline scenario is to extract the vector displacement map in Mudbox, and to use it directly in a Maya 2012 scene. While the displacement effect will only show up in an image rendered with mental ray, this method allows to reduce the polygon count in situation when memory constraints are tight.

The benchmarks

Vector Displacement Map Benchmark: For our vector displacement map benchmark, we used an existing model of an ear, sculpted in Mudbox, extracted the vector displacement map, and added it to the model with the brush. (Using the Symmetry function, the ears were automatically added to both sides of the head.)

On the left: the original sculpted object and the vector displacement map extracted by Mudbox.

On the right: the same map has been used to add the ears to the model of the character with a brush.



Benchmarks		
	Create and apply vector displacement map (Extract a vector displacement map from an existing model, place it and add the geometry encoded in the map with a brush)	**35 seconds**

	Comments
Maya Entertainment Creation Suite 2012	Mudbox opens up the considerable creative potential of vector displacement maps to Maya 2012 users. Vector displacement maps speed up repetitive modeling operations within Mudbox. Vector displacement maps created in Mudbox can be placed and rendered in Maya 2012.
Maya 2012	While Maya 2012 accepts vector displacement maps, they will only appear in a mental ray rendering. Maya 2012 does not currently allow the extraction of vector displacement maps from geometry.

Considering Return on Investment

Return on investment (ROI) is a complex notion, particularly in a field as sophisticated and diversified as 3D production.

In addition, the very notion of ROI can vary significantly between different people and companies: while in some cases (especially in the case of smaller studios), the increased competitiveness the features of a new software package brings may be sufficient ROI, other companies will look more closely at the productivity gains a solution provides.

On the following pages we present the productivity data from our benchmark project, and analyze how the increased productivity can impact the ROI of the Autodesk Entertainment Creation Suite.

MotionBuilder ROI Scenarios: The impact of an efficiency-based pipeline

About these tables

In these tables we are comparing **benchmarks and key features of an efficiency-based pipeline built around the Maya Entertainment Creation Suite Premium 2012** with different scenarios for achieving comparable results in a standalone version of Maya 2012.

While each company situation is of course different, it is clear that the combined benefits of a production pipeline built around the Maya Entertainment Creation Suite 2012 **can significantly affect cost, efficiency and competitiveness**, once they are integrated in a production pipeline.

Autodesk Maya Entertainment Creation Suite Premium 2012: Return on Investment Scenarios

Entertainment Creation Suite Premium 2012 Features and Benefits			Maya 2012 (Standalone Software)	
Feature/Benchmark	**Time**	**Benefit**		
MotionBuilder 2012			**Workaround**	**Cost/Impact**
Retargeting animation (Transferring animations from different origins from one MotionBuilder control rig to another.)	**3 sec.**	▻ Efficiency ▻ Format-independent animation handling	▻ Try to manage with **built-in tools**	▻ **Efficiency decrease**, deadline pressure ▻ Loss of **competitiveness**
			▻ Find **third-party tool** or **plug-in**	▻ **Cost**
Combining portions of two different animation clips (Combining a boxing motion from one character, with the walking motion from a different one.)	**30 sec.**	▻ Efficiency ▻ Format-independent animation handling	▻ Try to manage with **built-in tools**	▻ Loss of **competitiveness**
			▻ Find **third-party tool** or **plug-in**	▻ **Cost**
Motion Capture clean-up benchmark (Import raw motion capture file, select portions to be cleaned, apply Butterworth, peak removal and key reduction filters.)	**1 min.**	▻ Efficiency ▻ Selective application of clean-up filters	▻ Try to manage with **built-in tools**	▻ **Efficiency decrease**, deadline pressure
			▻ **Subcontract** to MoCap Specialist	▻ **Cost**
Motion Capture Set-up (Import the optical data, pose actor, create marker set, use actor as source for other character with rig.)	**10 min.**	▻ Efficiency ▻ Simple integration of MoCap data with existing rigs	▻ **Delegate to MotionBuilder user** in company if possible	▻ **Efficiency decrease**, deadline pressure
			▻ **Subcontract** to Motion Capture Specialist	▻ **Cost**
Viewport Display Efficiency (Display complex scenes and large casts of complex, rigged and animated characters in real-time.)	**real-time**	▻ Efficiency ▻ Creative potential	▻ Try to **build simplified simulations** for planning purposes	▻ **Efficiency decrease**, deadline pressure ▻ Loss of **competitiveness**
			▻ Try to **build simplified simulations** for planning purposes	▻ **Efficiency decrease**, deadline pressure ▻ Loss of **competitiveness**
Real-time Motion Capture and Device Support (Integrate a multitude of devices to combine live Motion Capture and other devices for previsualization and virtual studio work.)	**real-time**	▻ Efficiency ▻ Creative potential	▻ Try to **manage without**	▻ Loss of **competitiveness**
			▻ **Subcontract** to Motion Capture Specialist	▻ **Cost**

How to read this table:

Left side: MotionBuilder features, **efficiency** and **benefits**.

Right side: Methods for achieving **comparable results with the standalone version of the Maya 2012**, as well as their **impact on productivity and cost** of the project.

*This analysis is conducted according to **two different production scenarios**: the situation where the **timeliness and quality of the result** is the determining constraint for a project, and conversely, the situation where staying within a limited **budget** is primary focus.*

Determining Constraint: **Budget**

Determining Constraint: **Result**

Softimage ROI Scenarios: The impact of an efficiency-based pipeline

About these tables

In these tables we are comparing **benchmarks and key features of an efficiency-based pipeline built around the Maya Entertainment Creation Suite Premium 2012** with different scenarios for achieving comparable results in a standalone version of Maya 2012.

While each company situation is of course different, it is clear that the combined benefits of a production pipeline built around the Maya Entertainment Creation Suite 2012 **can significantly affect cost, efficiency and competitiveness**, once they are integrated in a production pipeline.

Autodesk Maya Entertainment Creation Suite Premium 2012: Return on Investment Scenarios

Entertainment Creation Suite Premium 2012 Features and Benefits			Maya 2012 (Standalone Software)	
Feature/Benchmark	**Time**	**Benefit**		
Softimage 2012			**Workaround**	**Cost/Impact**
Multiple object particle emission (Apply particle effect to multiple moving objects, test and fine-tune)	**28 sec.**	▻ Efficiency ▻ Ease of revision and fine-tuning	▻ Try to manage with **built-in tools**	▻ **Efficiency decrease**, deadline pressure
			▻ Try to manage with **built-in tools**	▻ **Efficiency decrease**, deadline pressure
Set up realistic fluid simulation (Water pouring into a cup until it flows over and floods scene)	**1 min. 21 sec.**	▻ Efficiency ▻ Ease of use of creative users	▻ Try to manage with **built-in tools**	▻ **Efficiency decrease**, deadline pressure
			▻ Try to manage with **built-in tools**	▻ **Efficiency decrease**, deadline pressure
Create a complex particle simulation (2 emitters, multicolored particles, particles coagulate when close to each other and bounce off any surface. If some particles manage to quit the volume they are erased)	**2 min. 10 sec.**	▻ Efficiency ▻ Sophistication of effects ▻ Ease of use of creative users	▻ Try to manage with **built-in tools**	▻ **Efficiency decrease**, deadline pressure ▻ Loss of **competitiveness**
			▻ Find **third-party tool** or **plug-in** ▻ **Subcontract** to expert	▻ **Cost** ▻ **Cost**, increased **deadline pressure**
Create sophisticated physical simulation (The benchmark combined a fluid simulation, simulation of fire and smoke, with a strong wind blowing over the scene and affecting the movement of water and Smoke)	**10 min.**	▻ Efficiency ▻ Sophistication of effects ▻ Creative potential	▻ Try to manage with **built-in tools**	▻ **Efficiency decrease**, deadline pressure
			▻ Find **third-party tool** or **plug-in** ▻ **Subcontract** to expert	▻ **Cost** ▻ **Cost**, increased **deadline pressure**
Real-time feedback of particle simulations (Interactively test the impact of movement and physical simulations and particle systems by moving objects with the mouse and observing real-time display in viewport)	**real-time**	▻ Efficiency ▻ Speed of revision cycle	▻ Try to manage with **built-in tools**	▻ **Efficiency decrease**, deadline pressure
			▻ Try to manage with **built-in tools**	▻ **Efficiency decrease**, deadline pressure
Face Robot (Simply create and fine-tune facial rigs and device interaction like lip-syncing; export to game engine. Work with facial motion capture data)		▻ Efficiency ▻ Feature depth ▻ Creative potential	▻ Try to manage with **built-in tools**	▻ **Efficiency decrease**, deadline pressure ▻ **Loss of competitiveness**
			▻ Find **third-party tool** or **plug-in** ▻ **Subcontract** to expert	▻ **Cost** ▻ **Cost**, increased **deadline pressure**

How to read this table:

Left side: Softimage features, **efficiency** and **benefits**.

Right side: Methods for achieving **comparable results with the standalone version of the Maya 2012**, as well as their **impact on productivity and cost** of the project.

*This analysis is conducted according to **two different production scenarios**: the situation where the **timeliness and quality of the result** is the determining constraint for a project, and conversely, the situation where staying within a limited **budget** is primary focus.*

Determining Constraint: **Budget**

Determining Constraint: **Result**

Mudbox ROI Scenarios:
The impact of an efficiency-based pipeline

About these tables

In these tables we are comparing **benchmarks and key features of an efficiency-based pipeline built around the Maya Entertainment Creation Suite Premium 2012** with different scenarios for achieving comparable results in a standalone version of Maya 2012.

While each company situation is of course different, it is clear that the combined benefits of a production pipeline built around the Maya Entertainment Creation Suite 2012 **can significantly affect cost, efficiency and competitiveness**, once they are integrated in a production pipeline.

Autodesk Maya Entertainment Creation Suite Premium 2012: Return on Investment Scenarios

Entertainment Creation Suite Premium 2012 Features and Benefits			Maya 2012 (Standalone Software)	
Feature/Benchmark	**Time**	**Benefit**		
Mudbox 2012			**Workaround**	**Cost/Impact**
Sculpt and paint dragon's head (sending place-holder object from Maya 2012 to Mudbox, and exporting sculpted object and maps back to Maya 2012)	**25 min.**	▻ Ease of use ▻ Feature depth ▻ Creative potential	▻ Try to manage with **built-in tools**	▻ **Efficiency decrease**, deadline pressure ▻ **Less sophisticated result**
			▻ Use **third-party tool** ▻ **Subcontract** to expert	▻ **Cost**, learning curve ▻ **Cost**, increased **deadline pressure**
Sculpt texture and paint a base model (exporting diffuse and normal maps to Maya 2012)	**10 min.**	▻ Ease of use ▻ Feature depth ▻ Creative potential	▻ Try to manage with **built-in tools**	▻ **Efficiency decrease**, deadline pressure ▻ **Less sophisticated result**
			▻ Use **third-party tool** ▻ **Subcontract** to expert	▻ **Cost**, learning curve ▻ **Cost**, increased **deadline pressure**
Create and apply vector displacement map (Extract a vector displacement map from an existing model, place it and add the geometry encoded in the map with a brush)	**35 sec.**	▻ Efficiency ▻ Feature depth ▻ Creative potential	▻ Try to manage with **built-in tools**	▻ **Efficiency decrease**, deadline pressure ▻ **Less sophisticated result**
			▻ **Subcontract** to expert	▻ **Cost**, increased **deadline pressure**
Create morph-targets for facial animation (Sculpt 3 different expressions of face model for game animation)	**3 min.**	▻ Efficiency ▻ Feature depth ▻ Creative potential	▻ Try to manage with **built-in tools**	▻ **Efficiency decrease**, deadline pressure
			▻ Try to manage with **built-in tools**	▻ **Efficiency decrease**, deadline pressure
Photorealistic rendering in viewport (Photorealistic rendering of model and maps during sculpting and painting, including depth-of-field rendering and multiple customizable lightsources)	**real-time**	▻ Efficiency of creative process ▻ Acceleration of revision cycle	▻ Try to manage with **built-in tools**	▻ Longer **revision cycles** ▻ Increased **deadline pressure**
			▻ Try to manage with **built-in tools**	▻ Longer **revision cycles** ▻ Increased **deadline pressure**

How to read this table:

Left side: Mudbox features, **efficiency** and **benefits**.

Right side: Methods for achieving **comparable results with the standalone version of the Maya 2012**, as well as their **impact on productivity and cost** of the project.

*This analysis is conducted according to **two different production scenarios**: the situation where the **timeliness and quality of the result** is the determining constraint for a project, and conversely, the situation where staying within a limited **budget** is primary focus.*

Determining Constraint: **Budget**

Determining Constraint: **Result**

Methodology

This benchmark project was commissioned by Autodesk and independently executed by Pfeiffer Consulting.

All the productivity measures presented in this document are based on real-world workflow examples designed and executed by professionals.

No scripting or programming of any kind was used during the execution of the benchmarks.

About the Productivity Benchmarks

The productivity figures in this report are part of an extensive and ongoing productivity benchmarking project commissioned by Autodesk, in order to independently assess the productivity gains that the Autodesk Entertainment Creation Suite 2012 can provide 3D professionals.

Pfeiffer Consulting independently developed and executed the benchmarks presented here, by analyzing creative pipelines in four different segments of activity: design, web and interactive, digital imaging, and video. The benchmarks were designed and executed by experienced 3D professionals.

How we design the benchmarks

The basic approach is simple: in order to assess productivity gains that a new release or a different product may (or may not) bring, we start by analyzing the minimum number of steps necessary to achieve a given result in each of the applications that have to be compared.

Once this list of actions has been clearly established, we start to execute the operation or pipeline in each program, with the help of seasoned professionals who have long-standing experience in the field and with the programs that are tested.

In order to be certain that no lag or operator-induced delays are included in the productivity measures, each benchmarked example is cut down into small segments of three or four steps each. After an initial training phase, each segment is executed three times, and the average time is used as a result. The cumulative times for all segments that form a complete pipeline example are then used as benchmark results.

How we prepare hardware for testing

We use factory-standard configuration hardware, that has been completely re-initialized prior to benchmarking. Only the system software and application software necessary for tests, as well as all required updates at the time of testing, are installed on the benchmark system. No peripherals other than the ones required for the benchmarks are connected. Network access is only enabled when required by the benchmark protocol, or for software activation.

Hardware

Benchmarks were conducted Dell Precision(TM) T7400 workstations equipped with 2.83GHz quad-core Intel®Xeon® processors and 32 GB of RAM, running a standard installation of Windows® 7 operating system.

About Pfeiffer Consulting

Pfeiffer Consulting is an independent technology research institute and benchmarking operation focused on the needs of publishing, digital content production, and new media professionals.

This report was created by Pfeiffer Consulting
(http://www.pfeifferconsulting.com).

Pfeiffer Consulting
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