Which type of Motion Graphics should be created in After Effects and Houdini in terms of efficiency?

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Client: Nymus 3D
Graduation teacher: Yvens Rebouças Serpa
The main question:

Which type of Motion Graphics (2D, 3D and particle animations) should be created in After Effects and Houdini in terms of efficiency?

Assignment briefly:
This is a research about methods of achieving Motion Graphics (2D, 3D and particles) in Houdini and After Effects. These methods were used to compare the level of efficiency in animating in both software programs, which would later analyse what software is more suitable for certain Motion Graphics. The results of this research were then later on optimized to fit into a promotional video serving as a portfolio item to the scientific animation studio, Nymus 3D.

Graduation company and client:
Nymus 3D

Final Product:
Final Promotional Video

Tutors:
Graduation coach: Yvens Rebouças Serpa
Company Supervisor: Rebecca Bertram

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Date:
21/01/2020
Preface

This study was conducted at the request of Nymus 3D, where I completed my internship. I would like to thank Vincent Bos for his guidance and for noticing my artistic capabilities, helping me become better by integrating me into projects. To Rebecca Bertram for she always made sure that I have a successful experience at Nymus 3D. Tamara van Gelder helped me tremendously in my journey to learn After Effects and was always patient and considerate when helping me. Luke Whitehorn would always offer to advise me when faced with the complexity of Houdini’s proceduralism. Two other amazing Scientific Animators, Miguel Mota and Luis Lopes, guided me and helped me advance my skills in compositing, shading and lighting. Finally, Remco Taken and Bram de Jong, two very skillful animators, were always supportive and offered to help.

I would like to express my deep appreciation for all the support that I have been receiving from my graduation coach Yvens Rebouças Serpa during the period of my research. I honestly believe that his support, guidance, patience and understanding during this period led me to put all my strength in finalizing this research. Hester van der Ent, my coach during Smart Solutions, was always eager to listen to me and guide me when I would not think I can succeed.

Lastly, I could not have succeeded without the support of my dear grandmother, she always made sure whenever I would doubt myself and my strength that there is a romanian proverb which revolves around courage: “Your eyes scare you but the hands save you” meaning that even though a project might seem impossible, once you just start working on it, the fears are replaced with courage.

Anca Axinte

Enschede, January 2020
Abstract

Motion Graphics (MG) are images in motion, meaning animations. MG can be used in the world of science as a means to visualize and explain and bring knowledge about complex topics to a wide audience, thus creating scientific animations. Nymus3D is a scientific animation company which also visualizes science. Nymus3D requested for pathways in Houdini to create more animations as they were already working in After Effects (AE) and wanted to switch to Houdini in the best, most optimal manner.

Upon visiting Nymus3D, the student discovered that the company lacked a promotional video that could help them display to their clients the possibilities in motion graphics that they can achieve.

The aim of this study is to research the benefits in terms of efficiency for creating Motion Graphics in Houdini and AE by comparing the two while using them in the creation of a promotional video for the company.

This divulged the following research question: “Which type of Motion Graphics (2D, 3D and particle animations) should be created in AE and Houdini in terms of efficiency?”

The main research question was answered by investigating related sub-questions. After the main problem was discussed with the relevant stakeholders at the company, objectives, and criteria. Desk research was performed to develop criteria for comparing the software based on the workflow and usability of creating the MG in both software in order to understand their level of efficiency. Additional research about Houdini and AE was conducted to further understand the problems discussed and the main differences between the two software. Further research about ways of promoting the core values of the company was conducted in order to design the MG that will be used in the promotional video and that will be created in both software. Field research within the company was conducted when developing the animations through trial and error. A qualitative method of interviewing the company was used to make adjustments to the animation and to better compare the methods of achieving them.

The findings show AE is best for custom 2D motion graphics, while Houdini is best for 3D, realistic, motion graphics. Additionally, Houdini can display realistic physics and is flexible when setting up. The promotional video was created based on the findings gathered and was tested with Nymus 3D iteratively in order to improve the quality.
More research in AE is recommended as not many methods were tested with it and it could yield more accurate results. Moreover, the promotional video should be tested with the target audience.

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Introduction

As the world of medicine expands and more scientific discoveries are made, abstract and complex subjects are needed to be processed by scientists and outreached to a large audience (Grossman et al., 2015). The tool that serves in such matters is called scientific animations (Banner & Ostherr, 2015), which are manipulations of electronic images by means of a computer, in order to create moving images (animations), thus visualizing and explaining scientific matters that otherwise would be intimidating (Banner & Ostherr, 2015; Lepito, 2018).

Motion Graphics (MG) are a sub-branch of animations (Carson, 2013). MG portrays the intertwine of animations and still images while being animated on sound, in order to convey a visual experience of storytelling and bringing awareness and explanation about a concept (Carson, 2013).

The same software that is used in creating Hollywood blockbusters are used in creating scientific animations, this is why the level of aesthetics is high (Banner & Ostherr, 2015; Lepito, 2018).

Some of the software used are After Effects (AE) and Houdini.

AE is a digital visual effects, motion graphics, and compositing application-oriented to 2D manual layer-based animation (Adobe After Effects, 2015). This type of animation allows precision in animation by creating and animating the graphics manually and structuring them in different segments called layers. However, it can be a time consuming and error-prone for big projects (Christiansen, 2013; Bourne, 2019). Houdini, is a 3D animation software application and is distinguished by its procedural nature. Proceduralism refers to the automation of a task through code which can provide unlimited iterations while also hinder the creative control of the animator (Magee, 2018).

The initial demand of the company was for the student to research different pathways of creating MG in Houdini. After the student has interviewed the company about their demand it was found that they would like to switch from AE to Houdini due to limitations in AE. However, Nymus3D was not sure of the usability of Houdini in the creative aspect.

After several interviews, it was signaled that the company is looking to acquire new clients and reach a new target audience but they did not have a portfolio that could showcase their full potential in MG.

At this point, the student signaled a potential product that could solve both issues from a commercial and efficiency matter. The student suggested creating a promotional video. This video would integrate the most efficient practices in terms of MG creation that were researched in AE and Houdini and moreover, it would serve as a portfolio piece that could be used as an
advertising tool to solve the actual demand: reaching a new target audience and acquiring new potential clients.

Company outline

Nymus3D is an innovative animation company, focused on creating scientific animations in 2D and 3D software.

The company was founded in 2007 by Vincent Bos, the managing director, and it consists of seven expert animators from the field of science and art. Nymus3D managed to reach the interests of highly known clients such as Harvard, CERN, and the Pasteur Institute.

The company has a department focused on creating MG. The graduation research was conducted under the coordination of Rebecca Bertman.

Problem indication

Until the present moment, Nymus3D has been using AE, which produces layer based animations and allows more control over the graphics that are animated this generates a more precise outcome but it is labor-intensive and time-consuming (Carson, 2013).

Nymus3D would like to switch to Houdini. The process of achieving MG in AE has limitations and Houdini’s procedural workflow is efficient, but the company is not aware of what can be achieved in it.

All the factors listed above lead to Nymus3D’s initial request for researching what are the best ways of creating MG in Houdini.

Problem Analysis

In order to bring a valuable solution to the problem, the student conducted several interviews with the MG department and the rest of the company. The outcome of this analysis helped to explore and clarify the reasons behind the client’s demand. This generated a new problem statement, with a direction on creating originality and benefit.
AE and Houdini

Ideally, Nymus3D would like to improve their efficiency in creating MG, desiring to know what is the most usable software application for achieving the desired result, while still keeping the aesthetics and functional requirements they have set.

Unfortunately, the company did not integrate Houdini in the MG department before, so they are not sure about the usability and efficiency level of the software. Concerning After Effects, one of the main issues is that AE has a layer-based structure of creating graphics. Layers perform special functions in holding the visual elements that were created within the software. This structure requires significant time investment as the complexity of the project increases.

Moreover, in the process of creating 2D MG, the company uses Adobe Illustrator(AI), a software application used to create vector drawings that will be animated in AE. However, sometimes the graphics made in AI cannot be imported into AE. Additionally, AE does not support 3D graphics implementation without acquiring a paid plug-in. Additionally, the creation of 3D graphics is limited to simple shapes.

As a consequence, the limitations encountered in AE can hinder the process of creating the MG products. Houdini requires resources to be invested in testing what can be achieved, and once the investment is made, it is not assured that the desired outcome will be reached, which generates waste. These consequences, unfortunately, are obstructing Nymus3D’s efficiency in creating MG.

As a proposal, the student suggested a comparison between the two software, in terms of MG creation, which will serve as a guideline to which one is more efficient in certain aspects to be used in order to achieve a certain type of MG.

Reaching new clients

Nymus3D wants to reach new target audiences which can lead to potential customers, by showcasing their capabilities in the MG field.
In reality, until the present moment, the company has only created MG catered towards specific clients they had in the past. As a result, the company does not have a portfolio that showcases the variety of MG they can create.

As a consequence, their full potential in MG is not displayed and this generates a lack of understanding from the target audience about what the company is specialized in and what they can achieve. Potential customers might lose interest or get confused by the different examples, which can lead to a loss of a potential offer.

The student suggested a logo animation could be created, which would showcase a variety of 2D and 3D MG, that the company would like to display to potential clients and would also serve as a means to reach new target audiences. Moreover, the logo animation would be made based on the findings gathered after comparing both tools, Houdini and AE.

**Theoretical Background**

In order to better understand the problems of the client encountered in AE and Houdini, a literature analysis was conducted. Moreover, concepts about efficiency in the MG animation workflow and usability were studied in order to serve as criteria for software comparison. The findings were used in the design and development section.

**Software Usability**

Software usability refers to the quality of a user's experience when interacting with software products or systems. (Nielsen, 2012).

**Learnability:** How easy it is for the user to understand how to accomplish the task without prior knowledge?

**Efficiency:** How effective can the user perform a task after understanding the set-up?

**Memorability:** How easy it was for the user to reproduce and reuse the set-up after not using it for a length of time?

**Errors:** How many errors were made during the process of achieving the set-up and how easily can the mistakes be fixed? (Nielsen, 2012)

These criteria will be used in the study by serving as a measurement of usability during the evaluation section of each method.
Compositing Motion Graphics

In the process of achieving MG, computer graphics need to be used in order to create and manipulate images, these computer graphics have two subcategories: 2D and 3D graphics. They symbolize either a two-dimensional or three-dimensional nature of work. (Carson, 2013)

The process of integrating different sequences of images into one whole product is called **Compositing**. MG is created through compositing a certain number of image sequences/animations, according to how detailed the final result must be.

The process of composting requires prior animations to be created. Thus, a MG product can become very complex and in case, there are changes to be made the animator should be provided with certain benefits in terms of compositing. (“The Art and Science of Digital Compositing,” 2018)

Ideally, it was found that editability, controllability, and transparency are important factors that influence the efficiency of an animation workflow. **Editability** refers to the ease of editing and optimization of the motion by the animator, manually. **Controllability** is the level of control over the flexibility of optimizing behavior by the animator. **Transparency** refers to the process of optimizing a behavior needing to be as intuitive and understandable as possible. (Koyama et al., 2018)

Having controllability, editability and transparency in animation are efficient in relation to time and aesthetics. Moreover, being easy to understand the set-up and perform and reproduce tasks without many errors drives the level of usability of software and tools in general.

Layer-based compositing

A layer-based composition uses layers, individual levels meant to store the graphics created and the operations applied to them. These operations are called effects and they provide the graphics to be in an animated state. Because MG require a multitude of graphics to be animated, layers can be created as many as needed and combined until the desired result is achieved. (After Effects, 2019)

Ideally from a transparency and controllability perspective, the animator should be able to have easy access to any desired animations in the project, in case they want to make changes to the animations (After Effects, 2019). However, AE does not provide a folder organizer for layers. As a consequence of this, the animators may create a composition with a high number of layers which will be hard to control, understand and intuitively be optimized by the current or future users. (Christiansen, 2013; Bourne, 2019)
From an editability and transparency point, ideally, it is required to have the possibility of replacing, optimizing and editing the graphics, freely by the animator both in 2D and 3D. However, AE has a lack of variety in tools for creating, editing and animating 3D elements compared to other software. But 2D animation is fully flexible. (Manovich, 2006, p.21; Christiansen, 2013)

Node-based compositing

Node-based compositing refers to the usage of nodes: singular containers holding certain information and functionality, having an input and output which can link to other nodes. Inside, calculations are made which will drive the output. The input will influence the calculations that are being made inside the node. These nodes are wired into networks (groups of nodes) that designate a procedure that will affect the graphics and produce a certain result. This type of compositing is found in the Houdini software. (Magee, 2018)

From a controllability and transparency perspective, the procedure can be changed by the user easily by combining different nodes or removing them, which makes it flexible for the user to optimize the behavior. Thus, it allows to refine and iterate the outcome indefinitely.

From an editable perspective, Houdini is a modeling and animation tool providing artists with freedom in 3D animation. But there are limitations given by its procedural workflow in regards to 2D graphics creation and animation. (Magee, 2018)

Main Research Question

The main question:
Which type of Motion Graphics (2D, 3D and particle animations) should be created in After Effects and Houdini in terms of efficiency?

Sub-questions:

- How to create similar looking motion graphics in both software programs, from a technical point of view?
- What are the main differences and similarities between the two software in terms of the level of efficiency in animating (controllability, editability, transparency) and usability?
- How to promote and communicate the vision of the company to the clients through motion graphics?
Deliverables

- Efficiency tables, which show how the MG animation workflow, time, usability and aesthetics were driven by the motion graphics created (2D, 3D and particle animations) in Houdini compared to After Effects.
- Up to two different animations for each comparison, show chasing similar motion graphics achieved individually in both software.
- Final Logo animation of Nymus 3D in order to attract new customers. It will include both AE and Houdini motion graphics elements, in order to showcase what visual elements are best to be created in which software.

Scope

Due to time constraints, the researcher will only focus on 2D, 3D and particle animations. Moreover, for every animation, the researcher will try to achieve a similar output in a maximum of two different ways per software. Only the final logo animation will be rendered and polished, ready to be shipped. Due to the time limitations and scope of the study, the Promotional video was only tested with the company and not with an audience. The results of this work were tested and were limited to the company's approval.

Methods

The answer to the main research question was dependent on the first and second sub-questions. Developing and evaluating the different methods of achieving the animations in both software programs helped in choosing the most efficient approach in creating certain MG. An additional sub-question was created as a tool to integrate the findings of the main research question into a promotional product.

For the development and testing stage, experimental research of trial and error was held, where different methods of achieving MG in both software were tested. In order to support this stage, an additional literature review and field research about the tools used in both software was gathered. In this stage, the first sub-question was answered.

Literature research was used to define the evaluation criteria based on which the different methods of achieving the animations were compared during the development and testing stage. Additional qualitative research was conducted by interviewing the company about the results.
obtained through the development and testing phase. These steps helped to answer the second sub-question.

During the design stage, literature research and interviews with the company were conducted which helped in designing the content that would get to be developed for the purpose of the Promotional video and the testing of the two software, this helped to answer the third sub-question. Additional interviews with the members of the company were held to ensure an optimal version of the final product.

**Redesign of a solution**

In order to answer the main question, the Logo animation of Nymus 3D was used as a promotional video. The logo design in terms of what MG technologies to be created, developed and tested, was based on the desire to promote and communicate the vision of the company.

Thus, a set of steps were taken in order to assemble a storyboard showcasing how the promotional video would look like and what MG elements would be created during the development stage. Firstly, an additional literature review was conducted in order to analyze what are the best practices when it comes to communicating the vision of the company through a video. Secondly, interviews with Nymus3D employees were conducted, where aspects of their core values as a company were gathered. These steps are read in the “Storytelling and core values” section.

**Storytelling and core values**

The initial step in communicating the vision of the company was analyzing the core values that they stand by. This step will create the core message of the video. These values can be conveyed in a compelling manner by using storytelling. The goal of storytelling is to help the viewer engage and remember the video by seamlessly transitioning between different core values. Moreover, clients develop high-quality expectations based on genuine core values which makes them more willing to recommend the brand to others. (Lepito, 2018; Yun-Pan & Hung Chen, 2019)

The second step was choosing a narrative structure where the core message can be properly explained and be memorized by the audience. One storytelling technique which can fulfill this is called “Nested Loops”. This narrative places the most important story/message in the center and uses stories around it to elaborate and explain the main values of the company. (Lindsay, 2015)
Research shows that the first story the video starts with should be the last story to finish and the second story to start should be the second to last (Lindsay, 2015). This pattern creates analogies between the main values of the company while encapsulating and making the core message memorable. It was found that brands who position the reason “why”, behind what they do at the center of the video, surrounded by “how” and “what” they do, are more successful in showcasing the core values they can bring through their products. (Lindsay, 2015)

As a third step, after gathering this research, Nymus3D employees were interviewed regarding the core values that the company wants to portray through the promotional video. The following statement was gathered: “Nymus3D visualize science in order to bring knowledge, through their artistic ability and technical understanding”.

Because Nymus 3D’s core value is bringing knowledge to a wide public, through research it was found that the most suitable brand archetype is the Magician. Research shows that the magician archetype can promote the company as a bringer of knowledge and experience to the audience. Moreover, it was found that the audience perceives an increase in their knowledge through this brand archetype. (Lindsay, 2015)

The fourth step was choosing the right MG elements that will portray these core values. This step was integrated into the Storyboard section.

**Storyboard**

The storyboards were created based on the literature findings mentioned above and structured in 9 acts. In order to portray Nymus3D’s core values, shape theory was implemented during the design phase of the MG elements, as visual metaphors for the company's values. Moreover, according to (Bradley, 2018) shape theory helps in conveying different emotions and creates points of interest leading the attention of the audience. An image with the storyboard containing all the acts can be seen in Figure 1.

The first and the last act are the same, following the Nested Loops method. The aim was to reinforce the name of the brand to make it memorable. Studies show that abstract shapes as letters are used to symbolize concepts and ideas. (Bradley, 2018)

In the second act, the aim was to show what the company does, which is visualizing science, transforming any abstract subject into something tangible. These values are similar to the Magician archetype value of making the impossible possible. They were visually conveyed as a cell morphing into a chip. Researcher Bradley, 2018 shows that organic and rounded shapes such as the cell symbolize irregularity while geometric shapes such as the chip symbolize structure,
order, and stability. Moreover, the morphing has a spiral pattern that can be used as a symbol of trust and flexibility during the transformation (Bradley, 2018).

In the third act, the aim was to bring an insight into how the company can visualize science, through the use of technology and continuous development. The MG element used to convey the first value was a chip rotating and the second value, an electric circuit that is expanding. The shape symbolistic of the first element and the abstract geometric shape of the electric circuit symbolizes efficiency while the growth of the circuit means constant development.

In the fourth and fifth acts, the aim was to portray why the company visualizes science: being the desire to bring knowledge and insight about the vast complexity of life. To showcase this, an infinite zoom inside the chip was used to portray the value of insight. While zooming blood cells can be found floating in a spiral pattern, these shapes are used as a means to portray constant growth of life (Bradley, 2018).

In the sixth, seventh and eight act the purpose was to convey how, through their artistic ability, Nymus3D can visualize science (“what”). The MG used to showcase their artistic ability was the logo Nymus3D being revealed when a blood cell a symbol of science, is exploding. The logo is holding both halves of the cell together aiming to symbolize the connection between art and science. The letters have an abstract shape showcasing creativity and the cell has a circular shape portraying (Bradley, 2018).

There were other 3 iterations made during the design phase, where scientific and technological symbolistic elements were created as well. For instance: blood cells creating the logo letters, drops of liquid morphing into letters, those iterations can be found in the Storyboard Iterations Annex.
Feedback
A feedback meeting with the Nymus 3D was held to choose the right storyboard. The stakeholders present were: Vincent Bos and Rebecca Bertman. The final storyboard chosen was the one explained in the previous section. They were very enthusiastic about the concept created for the promotional video stating that it showcases creatively their core values and the use of nested loops was a right move in solidifying their core message to their audience.

Development and Testing

In order to compare AE and Houdini in terms of efficiency when creating MG, different tables were created showing technical methods of achieving the animations from the final storyboard chosen by Nymus3D. These methods were then evaluated according to criteria designed on the literature findings in the Theory section and based on interviews and field research with the company. More time was invested in polishing the animations in Houdini for that the company requested that. Every animation has an analysis section where both AE and Houdini were compared and the right tool to be used for the particular case was chosen. The criteria can be found down below.
### Workflow criteria

<table>
<thead>
<tr>
<th>Level of editability (E)</th>
<th>It defines if the user can have complete access in editing for both 2D and 3D elements, manually and procedurally</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low</strong></td>
<td>The user has access to only one way of editing and only one type of element can be created and edited.</td>
</tr>
<tr>
<td><strong>Medium</strong></td>
<td>The user has access to both ways of editing and only one type of element can be created and edited. Or vice versa.</td>
</tr>
<tr>
<td><strong>High</strong></td>
<td>The user has access to both ways of editing and both types of elements can be created and edited.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level of controllability (C)</th>
<th>It defines if the user can easily modify the animation creating different iterations without the set-up breaking easily, thus the animation not functioning properly anymore.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low</strong></td>
<td>The set-up can break easily and the animation can’t be easily modified</td>
</tr>
<tr>
<td><strong>Medium</strong></td>
<td>The set-up is stable but the animation can’t be easily modified or vice versa.</td>
</tr>
<tr>
<td><strong>High</strong></td>
<td>The animation is easily modified without the set-up breaking.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level of transparency (T)</th>
<th>Animating is intuitive if after the process of animating is finished the user can preview the animation fast, making it easy to keep track of it. Animating is understandable if the tools used in both softer in order to achieve a certain animation are low in numbers and easy to understand.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low</strong></td>
<td>The set up is hard to understand and it makes the process of animating unnatural.</td>
</tr>
<tr>
<td><strong>Medium</strong></td>
<td>The set is hard to understand but the process of animating is intuitive. Or vice versa.</td>
</tr>
<tr>
<td><strong>High</strong></td>
<td>The set up is easily understandable and the process of animating is intuitive.</td>
</tr>
</tbody>
</table>
Usability criteria
To grade, the level of learnability and memorability criteria of easy ( < 2 hours), medium ( < 4 hours) and hard ( > 6 hours) was created based on how long it took to understand and reproduce the animations. To grade the level of errors and efficiency, the criteria was based on how often mistakes were made and how fast it was to iterate.

Feedback criteria
After consulting with the stakeholders it was stated that in terms of aesthetics (A) the results should provide freedom in implementing basic principles of animation: such as preserving volume when the element gets deformed, adding squash and stretch deformation and overall the animation should be natural looking. Moreover, reusability (R) was also another factor brought up by the stakeholders, as they would like to be able to reuse the set-ups in future projects and testing with different elements than the ones that were already tested.

Additional tables and pictures describing more in depth the process of achieving the animations were added in the Animations Development Annex.
Animation nr.1

“How to achieve a 2D/3D looking animation of independent graphical elements which are interacting with each other?”

<table>
<thead>
<tr>
<th>Process H method 1</th>
<th><strong>[Houdini]</strong> Animation #1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creating the 3D elements by using a premade sphere from H and the 2D elements by using a circle plane (<em>Figure 2</em>). Animating the elements through a 3D custom Rig (<em>Figure 3</em>) with controllers (<em>Figure 4</em>). Additional details were added with the Deformation Tools. (<em>Figure 5</em>) <strong>[Houdini]</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Deformation tools showcase</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Evaluation and Feedback H method2**

**Criteria**

- **E: Medium** Even though the user cannot manually edit the animation directly, they could manipulate a certain area of the element and the program would procedurally insert the rest of the frames. These were the controllers used and they had a high level of flexibility. Moreover, both 2D and 3D elements could be tested;
- **C: High** The user could experiment freely with the Rig controllers and even push to the extreme the deformation while the set-up will still work correctly. The additional deformation tools were not as flexible.
- **T: Medium** The process of optimizing the behavior was *intuitive* because the complete deformation was in real-time and could easily be kept track of. In addition, keyframes were saved in one place for one animation. It was *understandable* that the controllers had identical characteristics so once the user understood how to use one controller they could use the others with ease, but prior to this, it required considerable time and investment to understand how to set up the controllers. Concerning the **Deformation Tools**, the process was not intuitive because the complete deformation required two controllers to be used simultaneously, making it hard to keep track of the animation and the keyframes were saved in two different places for one animation.

**Learnability:** medium  **Memorability:** hard  **Errors:** low  **Efficiency:** high

**Feedback:** The result provided by using the Rig brought the aesthetics desired, and the level of control over the elements was higher than with the Deformation tools. However, the deformation tools could be used without requiring an initial set up as the rig did, making them efficient in terms of quickly editing an animation.

The volume of the 3D object was preserved with the Rig, while the squash and stretch animation was applied. The deformation was smooth and pleasant to the eye. Reusability is provided. As a note, the company desired more exaggeration in the deformation of the element. The feedback was implemented in the development of the promotional video by using the Deformation tools.
**Proces AE method 1** [After Effects] Animation #1 - PuppetTool, CC Sphere & shape layer

Creating the elements with the Pen Tool (*Figure 6*) and a CC sphere and animating the elements with the Puppet Tool (*Figure 7*) by placing pins onto the elements. (*Figure 8*)

### Evaluation and Feedback AE method 1

**Criteria**

- **E: Low;** The user could edit the animation only manually in this method by dragging the pins. However, automatic editing was not provided. Moreover, this method was limited to 2D elements and the only 3D element available was a CC sphere.
- **C: Low;** The process of animating was not very flexible as the user required more time to test different iterations of the aesthetics because the animation was manual, moreover the setup could break when the scale and the position of the elements get changed. (*Figure 9*)
- **T: Medium;** The process of optimizing the behavior was understandable because the number of tools to be controlled was limited to two and only one layer was needed. It was intuitive for the user so that they could keep track of the animation easily since it was processed fast and could be clearly accessed.

**Learnability:** easy  **Memorability:** easy  **Errors:** low  **Efficiency:** low

**Feedback:** Even though the object deformed the overall volume was not preserved so the final animation would not follow the main animation rules. Reusability was not provided. (*Figure 10*)

---

**Analysis animation nr.1**

From a workflow perspective with the rig the user could set-up and control the animation easily. However, it was harder to understand than other methods. The rig gives control to the entire animation without it breaking, whereas the deformation tools have direct and time-efficient controls as the user does not need to set them up. Moreover, with the rig, the animation could be controlled more intuitively. Concerning usability the rigging method was less prone to errors and iterations could be made faster. The rigging method provided a realistic deformation of the elements by preserving the volume automatically moreover the set up can be reused.

**In conclusion,** for more efficient and stable animation of independent graphical elements, the base animation should be made with custom controllers through a rig and to add details to the animation fast, the deformations tools can be used, as they do not require a complex set up. By combining these two processes the animation was brought closer to the level of the storyboard.
Animation nr.2

“How to achieve a 2D animation of two different elements, a chip and a sphere, morphing?”

<table>
<thead>
<tr>
<th>Process H method 1 [Houdini] Animation #2</th>
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<tbody>
<tr>
<td>Creating the element by using a premade 3D model animating the elements with Particle simulations (Figure 11): where ScatterNode (Figure 12) was used to be able to replace the elements and keeping the functionality of the setup. The starting and ending elements of the animation were set through Source POP and POP Group, creating morphing between the elements was done with POP force attract and POP drag.(Figure 13)</td>
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<thead>
<tr>
<th>Evaluation and Feedback H method 1</th>
</tr>
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<tbody>
<tr>
<td>● E: Low; The user could edit the animation procedurally with the controllers but not manually because the program did not give control to the points specific to the behavior of the element. However, both 2D and 3D elements were able to be tested within the program.</td>
</tr>
<tr>
<td>● C: Medium; The user could experiment freely with the controllers but the set-up would not work all the time because the animation would break when additional physics would be set to extreme values. The user had to wait longer to preview the animation compared to the previous set-ups because it took longer to calculate.</td>
</tr>
<tr>
<td>● T: Medium; The process of optimizing the behavior was understandable if the user only had access to the main controllers, otherwise it required more time to invest in understanding the entire particle set-up as it was more complex than the previous set-ups. The program was intuitive for the user so that they could keep track of the animation but not easy because of the number of keyframes.</td>
</tr>
</tbody>
</table>

Learnability: medium  Memorability: hard  Errors: high  Efficiency: high

Feedback The basic morphing meets the aesthetic requirements but the level of details is not intricate enough. This set-up is more suited for abstract animations that do not need custom details. However, reusability is possible. This is because: The object deformed and morphed naturally. But the detailed fluid motion was not achieved as the level of control over the details were not provided. Reusability is fully possible;

<table>
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<tbody>
<tr>
<td>Creating the element with the Pen Tool by placing points that create the element and animating the elements automatically with Turbulent Effect and by manually dragging the points. (Figure 14)</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Evaluation and Feedback AE method 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criteria</td>
</tr>
</tbody>
</table>

23
• **E:** Medium; The pen tool method allows complete manual control but is time-consuming by placing every point manually. The turbulent effect method has less manual control but time-efficient due to it being procedural.

• **C:** Medium; The process of animating was flexible as long as the user combined both methods by drawing the mainframes of the animation and then using the turbulent effect to fill in the gaps.

• **T:** Medium; It was **understandable** for both methods as it did not require a detailed setup since only three tools were necessary. It was **intuitive:** as it was easier to keep track of the animation than with just the pen tool method because it was time-efficient.

**Learnability:** easy  **Memorability:** easy  **Errors:** medium  **Efficiency:** low

**Feedback**
The company advised for this method to be used in creating a different effect for the promotional video instead of morphing between the sphere and the chip as it would be more time-efficient to create a rather less complex, shorter but more polished animation. The company's opinion about the method is stated below.

This method achieves the desired results from an aesthetic point of view, the morphing is fluid and intricate but is time-consuming and this set-up can not be reused. However, for a custom 2D animation, this set-up gives the most control to the user thus the final result would be worth the time invested. The object deforms and morphs naturally and is intricate enough only by manually animation, reusability is only possible by using the turbulent effect as it does not require manual animation.

The feedback was implemented by creating a smoke effect by following this method (*Figure 15*). Additional improvement in the aesthetics of the animation was added through the use of Gaussian Blur and Levels, as it made the motion more natural. (*Figure 16*)

---

**Analysis animation nr.2**

The animation is a custom one and it requires a high level of manual editability. From a workflow perspective, the AE set-up provided the most control over the details of the animation, however, it was not as flexible as the H set-up because it required extensive time investment in manually iterating. From a usability perspective, the most efficient was the H set-up because iterations could be made automatically. Although, from an aesthetic perspective, AE could bring the most customization. The easiest set-up to learn and understand was the one from AE.

**In conclusion** for a basic morphing, H is better to be used as iterations can be made more frequent. But for higher control over the level of details and how intro quite the animation is AE is better. Thus, as a result of a custom fluid morphing animation, between two elements, the most efficient to use AE where both manual animation and the turbulent effect are used.
Animation nr.3

“How to achieve a 3D animation of an element (3D chip) rotating while a path (an electric circuit) is emerging and growing?”

Process H method 1 [Houdini] Animation #3

A premade 3D element was imported. To create the electric circuit a Grid made out of squares was used as ramifications together with the Edit Node (Figure 17) [Houdini] Animation #3 - Chip EditNode. The start of the animation was defined in a Group Create (Figure 18) and the animation of the electric circuit was done with the Find Shortest Path node (Figure 19) and (Figure 20) and Carve Tool [Houdini] Chip CarveTool. The chip and the electric circuit properties were linked to each other. (Figure 21)

Evaluation and Feedback H method 1

Criteria

- **E: Medium**: The user could either procedurally generate the behavior of the animation or edit the animation through the controllers manually by dragging the points. Only 3D elements were tested as that was within the scope of the test.
- **C: High**: The process of animating is flexible as the user could experiment with different patterns of the circuit and it would still be compatible with both elements of the animation without breaking.
- **T: High**: The process of optimizing the behavior is intuitive as the complete animation in real-time which made the iterating faster for the user. This lets the user keep track of the animation and it would synchronize procedurally without any input. It was understandable and relatively easy to use the tools even though they were more than before, they were very self-explanatory. The implementation step had difficulties for the user, and it required more time investment as each effect added increased the complexity of the animation, making it hard to understand and proceed correctly.

**Learnability**: medium  **Memorability**: medium  **Errors**: low  They increased when trying to implement the feedback.  **Efficiency**: high

Feedback

The company stated that the animation meets the requirements but more dynamism would have to be added to the elements by integrating more animation rules. This is provided by the set-up. The animation is intricate enough and even if it is made out of two different elements they enhance each other, making it look unified. The setup is reusable. The company suggested adding more details to the electric circuit. Moreover, Nymus3D stated that when the chip starts rotating the electricity should follow the rotation; The feedback was implemented by using Attribute Transfer (Figure 22). Moreover, spheres were used to add additional details to the animation by using the Copy to points node. (Figure 23)
Process AE method 1

The chip was created with the Pen Tool (Figure 24) and converted to a 3D element by creating a 3D Shape Layer (Figure 25). The electric circuit was animated with the Trim Path. (Figure 26) + (Figure 27)

Evaluation and Feedback AE method 1

Criteria

E: Medium; the 3D elements could only have basic editing and were limiting however the user could edit the animation both by controlling the parameters found in the Trim Path interface and by manually changing the shape of the elements

C: Low; The process of animating was not very flexible as the pattern of the circuit was created manually limiting the level of experimenting possible and because the user couldn’t experiment easily with 3D animation as the set-up needed to be made completely in 2d first.

T: Medium; The user can find difficulties in keeping animation easily because the process of animating is back and forth. The process of optimizing the behavior is not intuitive for the user could find difficulties in keeping animation easily because the process of animating is back and forth. Understandably only two tools were used and they were easy to understand.

Learnability: easy  Memorability: easy  Errors: high  Efficiency: medium

Feedback The company stated that: Aesthetically the 3D elements are not intricate quite enough because there is not much control in making the circuit look better as only basic controls are provided. In order to figure out how to work around these obstacles more time would need to be invested without knowing if it will turn outright. Reusability is not possible.

Analysis animation nr.3

From a workflow perspective, the method from H is easier, more flexible and iterative friendly, while the AE method has limited manual editing of 3D elements. However, the set-up is harder to understand, learn and memorize from a usability perspective. Reusability was only provided in H. Both H and AE set-ups have similar functionality in animating the electric circuit: Carve tool and Trim tool.

In conclusion, the set-up in H was the chosen one because the level of detail and the animation was intricate enough especially after the feedback from the company was implemented, making the animation look similar to the storyboard. The limitations in 3D creation encountered in AE interfered in the procedure of improving the aesthetics and further time investment
Animation nr.4

“How to achieve animation of blood cells floating and aiming their stream to a certain point, lowering their number until only one main cell is left?”

Process H method 1 [Houdini] Animation #4

The elements were created with the modeling shelf tools. The animation was created by using Particle simulations (Figure 28) where the blood cells replaced the particles (Figure 29). The behavior of the particles was procedurally driven with the POP Force (Figure 30), Pop collision detection and Pop grains (Figure 31) and manually driven with a curve, secondary animation was provided with the use of Deformation Tools. (Figure 32)

Evaluation and Feedback H method1

Criteria

- **E: High**: The user could control and edit the animation easily and with flexibility by using the curve controller, manipulate the physics on a slider, and manually driving the animation by using the curve.
- **C: Medium**: The process of animating is flexible with different nodes that could be attached in order to experiment with different behaviors of the animation. When collisions happen between the particles, the set up broke with the pop collision tool as the math was difficult to predict but not with the pop grains as it makes calculations faster and iteratively.
- **T: Low**: The process of optimizing the behavior is hard to understand as it was not self-explanatory because of the high quantity of options available. The process of optimizing the behavior is only intuitive as long as the level of detail was kept to a minimum, otherwise, it would take longer to preview the animation as each addition of effect took longer to calculate.

Learnability: hard Memorability: hard Errors: low Efficiency: high

Feedback: Aesthetically the animation is dynamic and the movement of the cells is following the rules of animation. Reusability is fully complete. As a note for more diversity and a sense of depth, the cells should have different sizes. This was implemented by randomizing the scale of the cells in a POP Wrangle. (Figure 33)

Process AE method1 [After Effects] Final Particles

To create the elements the user tested multiple possibilities: Pen Tool, Puppet Tool [After Effects] Particles PuppetTool does not work a 3D Shape Layer [After Effects] Particles shape layer animation. The animation was created using CC particles and the behavior was controlled automatically in the
Physic and Producer tab and manually by making the particles follow a curve. [After Effects]

Particles following path

**Evaluation and Feedback AE method**

**Criteria**

**E: Medium;** The user could edit the elements and their behavior automatically by using the producer tab and manually by creating a curve path. Additionally, the user could procedurally edit elements and their behavior by using the physics modules in the editor. 3D particles are limited to the provided elements from AE but 2D custom particles can be created and edited in it as well. (Figure 34)

**C: Low;** The process of animating was not flexible because the animation was prone to breaking easily as it required to work in different compositions linked to each other. Once one composition has changed, the changes sometimes would not work in the main composition (Figure 35). Moreover, the set-up broke, when trying to implement custom 3D particles (Figure 36). Iterations could be tested only on the 2D particles.

**T: Medium;** The process of optimizing the behavior was understandable as the number of parameters that need to be controlled is low. However, it was not intuitive for 3D custom particles since the user found difficulties in keeping track of the animation easily because the process of animating is not automatically synchronized. Additionally, the number of layers being used would increase when more details added. **However,** for simple 3D particles and custom 2D particles, the process was more intuitive but limiting.

**Learnability:** easy  **Memorability:** easy  **Errors:** high  **Efficiency:** low

**Feedback**

The company stated that this set-up could be used for simple particle animations as a secondary visual effect to compliment the main animation. Aesthetically is too simple because secondary animations to the 2D elements and custom 3D could not be implemented and created. After consulting with the company it was suggested that due to time limitations it would be more efficient to focus on the particle setup made in H as it already looked more promising than this one.

**Analysis animation nr.4**

Since the particles required a natural behavior from a workflow perspective, more manual and procedural freedom was given in H. In AE manual 3d editability was limited. However, both AE and H are similar in how the behavior of the particles can be driven through the curve tool. The most intuitive to use was in H as it only required a lot of testing but the nodes could be intuitively altered however this produced more errors but the set-up was more stable than the one from AE. From a usability perspective, the set up was the easiest in AE. It took more time to set up the animation environment in Houdini than in AE. However, after the first iteration, it was found that the set-up could already achieve the results desired in H and AE could not. Therefore, the time restrictions and polishing time were invested only in H.
In conclusion, the set-up from AE could be used as a secondary visual effect that would compliment the main animation, but not as the main one as long as the particles need to be 3D customizable. Thus, the set-up in H was the one chosen as it was the closest to the storyboard aesthetics.

**Animation nr.5**

“How to achieve animation of a 3D element exploding and splitting into two parts?”

<table>
<thead>
<tr>
<th>Process H method</th>
<th>Animation #5 (the animation of the logo was only added in the development of the promotional video)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The element was created as in the previous set-up. To create the anticipation of the element exploding the collision between a cell(the element) and a plane was calculated by using Vellum. <em>(Figure 37)</em></td>
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</table>

**Evaluation and Feedback H method 1**

**Workflow**

- **E: High:** The user could edit the element and animation by using the vellum controller and sculpting the element directly. *(Figure 38)*
- **C: Medium:** The user could easily control the element and the animation by test multiple iterations fast without the set-up breaking as it was non-destructive. **However,** when making the anticipation frame of the element exploding, the set-up broke unexpectedly and deformed the element *(Figure 39).* There was no way to determine why this happened.
- **T: Medium:** The process of optimizing the behavior is: **not intuitive** because the process of animating is not streamlined. The user invested the most time in getting the anticipation of the element right. **However,** the simulation could be iterated fast. The tools used were intuitive and easy to understand compared to other setups and only four tools were necessary for the animation.

**Learnability:** easy  **Memorability:** easy  **Errors:** medium  **Efficiency:** high

**Feedback**

The company stated that the animation has an organic deformation when anticipating the explosion and the timing of the cell exploding is correct. Reusability is fully complete. As for advice, they stated that adding secondary animations to the cell right after exploding would enhance the entire motion and make it more realistic. This was implemented by using the rig to add the details in the animation. *(Figure 40)*

<table>
<thead>
<tr>
<th>Process AE method</th>
<th>Cell Exploding PuppetTool &amp; CCSphere <em>(Figure 41)</em> + <em>(Figure 42)</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>The same process described in <strong>Animation 1 process AE</strong></td>
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</table>

**Evaluation and Feedback AE method 1**
Analysis animation nr.5

From a workflow perspective, the method in H was the most effective for animating. The controls brought ease in editing the animation intuitively and adding the right details to enhance the animation. However, it was the first time that the set-up broke but the level of iterations still stood high. From a usability perspective, the Velum set-up used fewer nodes than in the previous setups but the AE method was the easiest to understand, however more mistakes were made in AE. Whereas in H fewer errors were made because the user did not require to concentrate too much on how to improve the aesthetics because the calculations were procedural making the deformation realistic and natural from the start. From a time perspective, it took more time to set up the animation environment in Houdini than in AE but is more time-efficient to Animate with the set-up from H.

In conclusion, the Vellum set-up from H was chosen, as it was a great tool to create the exact resemblance of the storyboard. Vellum is a great tool for realistic deformations where no prior knowledge in animating is required to achieve a natural effect.
Development of the Promotional video

The Development of the promotional video was based on the findings gathered during the design, development and testing phase, showcasing what visual elements were the best to be created in which software. In order to finalize the product, was required additional work.

The steps were the following: additional adjustments based on feedback were added iteratively to animations, setting up lights and animating the cameras for every scene and for every visual element, materials were created and implemented. After these steps were finished the following step was to make a composition in AE with all the scenes based on the storyboard created in the design phase.

It required several versions to be created where feedback from the company would be gathered and later on implemented. The final video was constructed out of 11 iterations overall. Every animation had 1 to 2 iterations on top of the initial feedback implementation shown in the development section.

Scene 1: contains an additional act created to loop the video
The iterations can be found in the Scene 1 Iterations Annex
The scene contains an animation of the logo of Nymus 3D by following the process described in Animation 2 for AE.
Version 1 The animation starts with the letters N3D and fluid animation was created of the logo melting. The logo position is in the center to give a sense of staging. The animation starts slowly and ends slowly as well. Scene 1
Feedback version 1: the company was positive about the animation and suggested for the logo to be scaled down so that it will loop smoother with the final shot of the video.

Scene 2: contains act 1 and 2 Scene 2
The iterations can be found in the Scene 2 Iterations Annex
This scene contained an animation of three different cells, the process of developing this animation can be checked in the tables provided in the previous development chapter and is under the name Animation1 for H. After the feedback of the company, the animation was changed and the new one, was developed by following the process described in Animation 2 for H. An additional 2D particle effect was created by following the process described in Animation 4 for AE. Act 2 was changed from the morphing of the cell and the chip at the request of the company. Below more information about the new animation can be found.
Version 1 [Houdini] Animation #1
Feedback version 1: The company suggested that instead of this animation a more complex element should be created.
**Version 2:** The previous feedback was acted upon and a new animation was created in H, after following the process described in Animation 2 and adjusting it. A high detailed cell that is constantly morphing, was created. Lights inside the cell were added to convey more depth and guide the viewer.

**Feedback version 2:** The company stated that the scene feels empty and the level of detail is not high enough so it was suggested that either the cell will get scaled up or more cells would be added to the scene. Moreover, the morphing animation should be replaced with a smooth transition of the cells disappearing because the morphing animation is not polished enough.

**Version 3:** To implement the feedback, three other cells, transparent 2D particles, ground, and background were added to fill up the scene.

**Feedback version 3:** This version met the expectations of the company. Final materials were added after testing 4 different materials.

**Scene 3: contains act 2, act 3 and act 4** [Scene 3]

The iterations can be found in the **Scene 3 Iterations Annex**
The scene contains the iterative version of the animation developed in Animation 3 for H, from the tables development chapter. An additional **smoke effect** was created by following the process described in Animation 2 for AE.

**Version 1:** [Houdini] Animation #3

**Feedback version 1:** the company stated the scene should have additional 2D effects added to it.

**Version 2:** A 2D smoke effect coming from the chip was added to compliment the animation. The bubbles’ shape was changed to have an exaggerated diverse appeal in the scale moreover. An additional animation of the chip anticipating its rotation was created as well.

**Feedback version 2:** The company was pleased with the result thus materials were tested and applied to the elements in order to finalize the animation.

**Scene 4: contains act 5 and 6** [Scene 4]

The iterations can be found in the **Scene 4 Iterations Annex**
The scene contains the iterative version of the animation developed in Animation 4 for H, from the tables development chapter. [Houdini] Animation #4

**Version 1:** Additional lights were added to the scene for the materials to be tested in the correct environment.

**Feedback version 1:** the company expressed no concerns with the animation and only suggested that the initial scene with the blood cells should be changed and made faster.

**Version 2:** In this version, the start of the animation has been changed by changing the camera animation and 5 different materials were tested in order to find the right one. Additional effects such as particles and vignette were added in AE to provide a cinematic look.
Feedback version 2: The company picked two materials: a cartoon one and a realistic one. The first one being a 2D representation of MG in H.

Scene 5: contains act 7 and 8 and 9 Scene 5
The iterations can be found in the Scene 5 Iterations Annex

The scene contains the iterative version of the animation developed in Animation 5 for H, from the tables development chapter. Moreover, an additional element, a logo of Nymus3D, was developed by following the process described in Animation 1 for H.

Version 1: [Houdini] Animation #5
Feedback version 1: The company stated that the animation of the logo and the cell together complement each other making them look unified. However, the animation of the logo needs better timing and the cell should disappear in a different manner.

Version 2: The animation of the logo dropping was better staged by making the two halves of the cell shrink and reattach while hiding behind the logo after it is being revealed. Additional bloom and particle effects were added in AE. The same cartoon shader was used as in the previous scene. Feedback version 2: The company was positive about the improvements and as a final advice music was added to the final video to enhance the experience of the viewers.

Final feedback:
Nymus 3D stated that the final product has a creative way of symbolizing their core values, through various pleasing aesthetics show chasing the possibilities both in AE and Houdini.

Final Promotional Video
Conclusion

This research paper aimed to compare Houdini and AE in terms of efficiency for creating certain MG. The second objective was to promote the vision of the company through a video containing MG. During this research, different methods of achieving MG in Houdini and AE were developed, tested and iterated. These methods were analyzed based on the criteria gathered during the literature research and the feedback of Nymus3D. The chosen methods were used in the development of a promotional video. The promotional video was evaluated based on the feedback gathered from Nymus3D.

From the various methods that the student tested with, the following analysis was derived.

The main question was answered by creating every animation in both software and analyzing the findings based on which the most efficient software was chosen for every type of MG. It was found that for 2D particles and 2D elements, AE is the quickest and the most effective one to use but has 3d limitations because the variety of tools is not as broad as in Houdini which should be used for complex 3D particles. More iterations can be done in Houdini because the set up in procedural so the calculations can be done faster and previewed faster. Moreover, with H is easier to create a realistic 3D animation as the program uses physics to calculate this correctly for the user.

The first sub-question was answered through experimental research, where the following techniques to achieve the animations were found. To animate custom 2D elements, the puppet tool and the pen tool can be used in AE. To quickly create a morphing animation the turbulent effect can be used as it provides automatic control and gaussian blur and levels can create a more natural aesthetic. To create 3D elements a 3D shape layer can be used but it is limited to basic alterations. To create 2D elements in Houdini, a plane can be used as a 2D representation of an image and to manually and procedurally animate the Edit node, the deformation tools, and the rig can be used. To create a basic morphing animation using, s.Particle simulations is an efficient method in Houdini. Vellum is an efficient tool for simulating realistic deformations during the interaction between different 3D elements. Both programs can simulate particle effects but AE has the recurring 3D limitations as stated before while Houdini does not.

The second sub-question was answered after analyzing every method based on the level of efficiency in animating. In terms of 3D editing, Houdini is very effective because it provides the artist with a larger pool of unique results and iterations which can be achieved in a short amount of time. While AE provides more manual control and is best for 2D. Moreover, both automatic and manual control can be achieved in Houdini. However, 2D animation in Houdini implies that the artist has to think in a procedural manner to achieve a traditional 2D look, that down the line
can affect the intuitive aspect of the creative process. It is harder to understand the setup in Houdini than in AE because the tools are more complex and not as self-explanatory as AE. This comes at the cost of Houdini having a harder set-up time to master. Thus, if a quick mockup is necessary, AE is preferred as it has an easier set-up time. It was found that the set-ups in Houdini were more flexible and stable than in AE.

In order to answer the third sub-question, analysis within the study shows one optimal way, that has been researched, to promote the company’s vision is by using shape theory to design the core values of the company, creating metaphors between the shapes and the values they represent. Additionally, the use of storytelling to promote the core values of the company to the public. Using nested loops as a narrative pattern can help embed the key message of the company in animation by surrounding the key message with the core values of the company. This reinforces the image of the company into the viewers' minds, making them feel like they have left the experience both more knowledgeable and rewarded.

**Recommendations for future work**

This research could be improved by decreasing the limitations encountered during this study, several suggestions are further described.

Firstly, since Nymus 3D desired more time to be invested in polishing the MG from Houdini, less time was invested in researching pathways of achieving MG in AE. As a suggestion, more time and research invested in finding out different methods in AE could ensure a better perception of the possibilities given by AE in terms of creating MG.

Secondly, due to the scope of this study and time limitations, the promotional video was only tested with Nymus 3D and only several methods of promoting the vision of the company were researched. Further research about different methods of promoting the vision of the company, could benefit by making the video more impactful to a broader target audience. Moreover, different approaches besides interviewing the company, additional questionnaires aimed towards target groups could provide a better insight into what changes should be made to the video which could attract the desired customers.
Resources


Annex

Storyboard Iterations
Animations Development

Animation 1 Development Houdini

[Houdini] Figure 2: Animation (Elements interacting) 2D version by replacing the sphere with a circle plane

[Houdini] Figure 3: Animation 1 (Elements interacting) Rig assigning individual parts of the element by grouping the points of the elements
[Houdini] Figure 4: Animation 1 (Elements interacting) Rig for all three elements

[Houdini] Figure 5: Animation 1 (Elements interacting) Deformation tools
The elements were created: the same as in the previous set-up
The elements were animated with:
- Creating a 3D rig for the sphere, by accessing the points that construct the mesh and then moving those points, a specific part of the element could be chosen to be deformed and controlled. A set of controllers were created and tested in order to have complete control over the geometry.
- These controllers were all visible and the user could interact with them in the viewport.
- Realistic deformation while the volume is being preserved, was achieved by assigning a gradient property of the way the deformation gets calculated. This deformation could be brought to extreme and the volume would still be preserved.
- Once the user keyframed two extreme poses of the animations the in between frames were calculated procedurally.
- One set of frames were saved in the playbook control, for every individual control. The user could easily modify the data attached to them in the animation editor because they were located intuitively.
- This setup was tested for 2D elements as well and the process of animating did not have major impediments but it was easier in 3D.
- The user could replace the object but deformation might need to be adjusted in the controllers.

The Controllers:
- Rig of the sphere with controllers;
- Master Controller: controls translation, rotation and sizing of entire object;
- Upper and lower controller translation, rotation and sizing of the upper and lower part of the object;
- Medial controller: same but for the center region of the object;

[Houdini] Animation 1 Elements interacting Rig development
[After Effects] Figure 6: Animation 1 (Elements interacting) Shape layer made with the pen tool
[After Effects] Figure 7: Animation 1 (Elements interacting) PuppetTool and CCSphere

[After Effects] Figure 8: Animation 1 Puppet grid
[After Effects] Figure 9: Animation 1 (Elements interacting) Puppet does not work when position is changed

[After Effects] Figure 10: Animation 1 (Elements interacting) Puppet does not deform smoothly
The elements were created: by Drawing in the Composition panel with the Pen tool a path of points that constructed the element this created a layer called Shape Layer. The shape layer had points that could be positioned on the liking of the user making it easy to change the aspect of the element (E).

Animate the elements:

The user tested the Puppet Tool which works by placing pins (points which act as controllers) onto an element. This tool warps the element:

- These pins can be moved in order to drive the deformation of the element according to their position (E).
- A movement in one part of the image causes natural, life-like movement in other parts of the element (A).
- Meanwhile the rest of the element stays rigid thus making it hard to achieve a realistic squash and stretch and exaggeration effect because the volume is not preserved (A).
- The element was divided into a mesh of triangles, the level of deformation was clearly shown (T).
- Each time the position of the pin was changed the keyframe was modified automatically, calculating the inbetween frames (T).
- The frames were saved in the timeline panel. The user could easily modify the data attached to them in the graph editor (T).
- The mesh did not update once the element was changed (R).
- This tool did not work once the user changed either the scale or the position of the element, if the element was set to high resolution (R)(C).
- It does not work on 3D elements (R)(S).

After more iterations it was found that the puppet tool can work on CC sphere which is a 3D representation of a sphere; however the puppet tool doesn't work on customized 3D elements. The user had to make a sub composition with the CC sphere where it was animated by using the puppet tool and then transferred in a main composition where the position of the cell was animated to be made to look like the cell is floating.

[After Effects] Animation 1 Elements interacting development
Animation 2 Development Houdini

[Houdini] Figure 13: Animation 2 (Morphing) Choosing the start (the sphere) with the POP source and the end (the chip) of the animation with POP Group. Adding the swirling details to the animation with POP attract and drag

[Houdini] Figure 12: Animation 2 (Morphing) The scatter node was used so that the elements can be replaced; a cube replacing the chip was used in order to test the animation faster
For time efficiency the animation was created only with 3D elements, and if the set-up would work 2D elements would be tested as well.

The elements were created by:
The cell and the chip could be modeled with the modeling shelf tools but for the purpose of testing and due to time restrictions a premade 3D model(selfmade) was imported (E).

The elements were animate:
- **Particle simulations** were used to simulate a fluid morphing because of these objects are made out points which have certain data attached to them, for instance position and velocity. The points could be directed to change their position from the sphere to the chip, and direct their motion (E).
- **Particle simulations** require a detailed set-up of nodes (T).
- **Scatter Node**: Scatter points onto the two objects in order to be able to change the elements and for the setup to still work. This set-up was tested on 2D elements as well and it still functioned however the aesthetics did not meet the expectations (E) (R).
- The animation started from the sphere and ended to the chip. Thus, the initial object was set to be the sphere through **Source POP : POP group** for the chip.
- **POP force attract** points's position from the sphere to the chip. This node when tested with different values, would break the animation easily (C).
- To create a fluid and swirling animation, **POP drag** and **POP Force** were used to make the points swirl and move in arcs (A).
- The frames were calculated and stored similarly to the other set up mentioned above. However the time required to preview the animation was longer as the set-up required more time to calculate the behaviour of the animation. Moreover, this time the user had to keep track of more sets of keyframes as there are more controllers used (T).
- The user could control the swirling level of the particles in the parameters interface but not have access to create intricate patterns (E) (A).
- The user tested also the deformation tools which could be used to achieve a more intricate animation but this was not efficient as the element keeps changing its shape so will not be calculated correctly and would still not provide enough control. **As a side note**, after more research it was found that another method in H would be to use the **Edit node** tool which is similar to AE’s pen tool.
Animation 2 Development AE

[After Effects] Figure 14: Animation 2 (Morphing) Shape Layer animation made with the Pen Tool and Turbulent Effect and additional Gaussian Blur and Levels added to it

[After Effects] Figure 15: Animation 2 (Smoke Animation) Shape layer animation
Create the elements
- The chip was created with the pen tool: a set of points could be created and moved interactively in the scene. These points drove the shape of the element; (E)
- Changing the element was not possible as it will not keep the functionalities; (R)

Animate the elements:
- The element was created with the pen tool making it a shape layer which can be animated and the points can be repositioned until creating the desired shape thus it requires manual animation; (E)
- The chips shape was saved as the last keyframe in the timeline as it will be the last frame of the animation. Moving to the start of the timeline, the vertices were repositioned in the shape of a sphere; (S)
- From here the user tested two methods to make the animation look fluid:
  - By using the turbulent effect which will add noise to the shape layer. Creating a wavy effect which can be animated by controlling the offset the value of turbulence. This did not provide complete control over the level of detail of the animation but the animation is procedural and the functionalities were kept after changing the element; (E) (I) (R)
  - Move the vertices until the desired result is achieved, for every frame, this requires significant manual work and the functionality is not kept after changing the element; (A) (R)
- It was found through testing that if both methods are combined, the user could experiment more freely and faster; (C)
Animation 3 Development Houdini

[Houdini] Figure 17: Animation 3 (Chip) Edit node; editing the grid

[Houdini] Figure 18: Animation 3 (Chip) Grid animation and creating the start and the end of the circuit with Group Create
Figure 19: Animation 3 (Chip) Finding the shortest path from the start to the end of the electric circuit based on the grid.

Figure 20: Animation 3 (Chip) The electric circuit created through the grid and shortest path and the chip.
Figure 21: Animation 3 (Chip) Linking the animations between the chip and the electric circuit

Figure 22: Animation 3 (Chip) Attribute transfer
[Houdini] Figure 23: Animation 3 (Chip) Copying spheres onto the electric circuit
Creation of the elements:

The animation is 3D so the set-up only required 3D testing

The cell and the chip could be modeled with the modeling shelf tools but for the purpose of testing, or a premade 3D model was imported.

Create the growth path of the electric circuit:

This required points which will connect and create a path with ramifications. The points can be found on a grid made out of squares which can be used as ramifications.

The grid could be manually altered by repositioning the points with the Edit node, to fit the desired outcome.

To connect the points, a start and an end of the connectivity was created through:

- **Group Create**: Assigning a starting group and end group of points. This drives the points from where the growth will start and the points where the growth will stop.
- **The starting group** being the points of the chip. So the chip can be changed to any other element and the circuit will start from the right position.

Find Shortest Path node finding the shortest paths from start points to end points, following the edges of a surface.

- While the chip was rotating, the animation of the electric circuit could be adjusted simultaneously with the chip and vice versa.
- The chip and the electric circuit properties were linked to each other, so no further adjustments needed to be done to the entire animation once either the chip or the circuit were changed.

Animation of the elements.

- **Transform node**: position, rotation, scale can be animated.
- **Carve tool**: shortens or lengthens the circuit.
- **Poly wire tool**: gives width and height to the circuit making it 3D.
- Through the nodes enumerated above the user could control the motion of the chip the length and width of the electric circuit in the parameters interface.
- The frames were calculated and stored the same as in the previous set-ups.

Feedback Implementation

Rotation of electricity based on the chip: the starting position and rotation of the growth needs to be the same as the chip’s.

- **Attribute Transfer**: transfers the position of the points from the chip to the electricity; This functionality is kept when the chip is changed or altered to another element.

[Houdini]Animation 3 Chip Animation development
Animation 3 Development AE

[After Effects] Figure 24: Animation 3 (Chip) Making the path with the pen tool

[After Effects] Figure 25: Animation 3 (Chip) 3D modeling and animating the rotation
[After Effects] Figure 26: Animation 3 (Chip) Animating the path of the circuit with trim path

[After Effects] Figure 27: Animation 3 (Chip) Making the path 3D
Create the elements:
Create the path for the electric circuit
Draw in the Composition panel with the Pen tool this will create a shape layer which can be animated.
In order to create a 3D element: The element was converted from a 2D layer to a 3D layer which creates a 2.5D visualisation of the chip. The chip was made to look 3D by extruding it. The circuit was created with the same manual process and the animation of it was created in a similar manner to the previous process in H, as the user used a tool which can trim the paths created. (C)

Animate the circuit through shape operations:
Trim Path: trims/cuts the path.
- Animate when the circuit starts and when it finishes growing, by controlling the value of start end of the path found in the parameters interface (E).
- Because the electricity consists of multiple ramifications thus, paths, the user could either choose to have the paths trimmed simultaneously or trimmed individually.
- The circuit could be made to be 3D but only the thickness and the height of the electricity could be controlled (E) (C)
- The edges of the circuit would intersect and overlap and circuit would look blocky. (A)
- The two elements had their scale, position and rotation controlled in the translation tab. (E)
- Animating the chip and electricity simultaneously was not possible because the properties/motion of the electricity was not linked to the properties/motion and of the chip so if the chip was altered the animation of the electricity needed to be adjusted as well (T).
- Once the elements were replaced the functionality of this setup would not apply correctly anymore. The animation needed to be manually adjusted (R).

[After Effects] Animation 3 Chip development
Animation 4 Development Houdini

[Houdini] Figure 28.a: Animation 4 Particle setup

[Houdini] Figure 28.b: Animation 4 Particle setup
[Houdini] Figure 29: Animation 4 (Particles) Copying the cells onto the particles
[Houdini] Figure 30: Animation 4 (Particles) PopForce to add the swirling in the motion of the cells
[Houdini] Figure 31: Animation 4 (Particles) PopGrains
[Houdini] Figure 32: Animation 4 (Cell Explosion) Deformation tool to add secondary animations
[Houdini] Figure 33: Animation 4 (Particles) Randomizing the scale of the cells
Particle Simulations

Creation of the elements
- The cells could be created with the modeling shelf tools or a 3D model could be imported. Here by attaching a Transform node and another type of deformation nodes the user could change and also animate the shape and size of the blood cells. (E) (C)

Animation of the elements
- Particle simulation was used to simulate the movement of the cells this requires a complex set-up of multiple nodes (T) the number of particles and other characteristics that influence their motion could be controlled easily (E)
- In order to display the blood cells instead of the particles alone, Copy to points node was used to copy 3D objects onto the particles. The cells could be replaced with any other element and the set-up would function properly (R)
- The animation of the cells was calculated procedurally where the data (velocity, position and size) attached to them is updated every frame, this provides a natural and real-time animation (T)
- However the amount of particles used, drove the time needed for the user to preview the animation, the more particles were used, thus more details, the more time the program required to calculate the behaviour of the animation (T)
- Because the cells were floating close to each other they managed to collide and intersect, lowering the aesthetics of the animation. The user tested two different methods to prevent the intersection (C):
  - Pop collision detection and Pop grains. With the latter one the user has more control over the way the particles collide, moving apart from each other in a more realistic manner whereas with the first one the particles might still intersect or might explode (A). Moreover the user had more control over the acceleration of the cells with the pop grains (E) (C)
  - The user could direct the particle motion through at least two ways (C):
    - POP force: a node that applied external forces to the particles which made them move in arcs/swirls, the user could control the size, amplitude and shape of the swirling of the particles (E)
    - For more manual control of the animation the user could use a curve which was drawn, this curve drove the direction and the swirling pattern, exactly (E) This would enable more life-like and intricate movement of the cells (A)

[Houdini] Animation 4 Particles development
Animation 4 Development AE

[After Effects] Figure 34: Animation 4 (Particles) Shape layer texture square

[After Effects] Figure 35: Animation 4 (Particles) Puppet tool does not work
[After Effects] Figure 36: Animation 4 (Particles) 3D shape layer does not work
Creating the blood cell

- This was tested by using particles simulation, CC particle. The user could test how to change the particles and control their movement (E).
- This tool provided the user with different types of 3D particles however they are basic elements such as spheres and cubes. For 2D particles the range is a bit wider. (E)
- The user created a main composition with the particle behaviour and another sub composition linked to the main one, where the user tested different aesthetics.
- The particle type was set to Textured square. Which allowed to change the texture of the particle to any layer created by the user. (C) To create the blood cell: the user tested multiple possibilities. (E)
  1. A composition with a 2D blood cell: blood cell was created as a shape layer additionally it was convert the 2D shape layer in a 3D layer and extrude until the desired look for the blood cell is achieved and by animating the path of the shape layer creating a deformation animation. This method worked but aesthetically it did not look pleasant. (C)(T)(S)
  2. The puppet tool was tested as well to see if the user can animate the blood cell in a faster manner: an element (a shape layer and a cc sphere) was created and then animated. Unfortunately the main composition did not get updated so it could not be viewed as a particle simulation (C). The user tried to test the 3D spheres as representations of the cells, but as they did not have secondary motion attached to them and the user could not implement it due to time and knowledge limitations, the animation looks unnatural. (S)
- Every time the user changed the layer the particles should have updated as well but it did not with 3D elements. (T)(S)

 Animating the blood cells

The user could control the position of the particles and their size in the Producer tab. Jet Sidewise was chosen for the type of animation.

Animation behaviour and speed was tested in the Physics tab. (E)

To have complete control over the behavior of the particles, through research, the user found that the particles can follow a curve, similar to H. (E)

[After Effects] Animation 4 Particles development
Animation 5 Development Houdini

[Houdini] Figure 37: Animation 5 (Cell exploding) n3D animation

[Houdini] Figure 38: Animation (Cell exploding) Setup of the blades interacting with the cell; the cell will simulate a cloth deformation
[Houdini] Figure 39: Animation (Cell exploding) The animation broke when pushing the blades too hard

[Houdini] Figure 40: Animation (Cell exploding) Rig with controller for second deformation
Creation of the elements:
Using the shelf tool with 3D objects and positioning a sphere in the viewport; The user used sculpting tools to make the sphere resemble a blood cell, this required manual control over the details.

Animation of the cell:
To anticipate the explosion of the cell the build up energy was showcased by making an animation of the cell getting squeezed. (A)
To achieve this the user tested the following tool:
Vellum was used to simulate how soft bodies react to the collision with external elements (in this case the Cell reacting to the Plane colliding with it, to resemble how the cell gets squeezed).
- This node simulates the deformation based on the constraint type the user chooses. The constraint type drove the type of deformation the element simulated. For instance the element could inflate and deflate. This provides a realistic deformation (E)(A)
- Other tools could have been used, such as: Grains or FEM. However after researching it was found that because this node has a more efficient way of calculating the deformations it is simpler to control and is fast (C)(T)
- The cell and the plane could be replaced with any other element and the set-up would function properly because the calculations are procedurally made based on these two elements. (C)(R)
- When the cell was colliding with plane, if the plane would get pushed too hard, closer into the cell, the cell would explode and the setup would not work anymore; The user had to invest time into testing the right position of the plane (T)

To make the explosion of the cell the following tools were tested they were easy to comprehend and use (T)
- Boolean fracture: This mode requires an object to be fractured and a cutting surface. In this case the cell and a 3D plane;
- Exploded view was used to visualize the cell exploding by using the two parts away from each other.

[Houdini] Animation 5 Cell exploding development
Animation 5 Development AE

[After Effects] Figure 41: Animation 5 Puppet tool and CC sphere
[After Effects] Figure 42: Animation 5 Puppet tool
Scene 1 Iterations

Figure 43: Scene 1 (n3D Morphing) Last frame as the trace and previous frame as the fill

Version 1
Figure 44: Scene 1 (n3D Morphing) Using the shape layer and animating the path Version 1

Figure 45: Scene 1 (n3D Morphing) Feedback implemented by changing the scale of the logo Version 2
Scene 2 Iterations

**Figure 46: Animation 2** Elements interacting *Version 1*

**Figure 47: Scene 2** Initial single cell *Version 2*
Figure 48: Scene 2  Implementing the feedback by adding multiple cells Version 3 first stage
Figure 49: Scene 2 Final scene with particles, ground and materials Version 3 final stage
Scene 2: Material Iterations

Figure 50: Scene 2 Material 1

Figure 51: Scene 2 Material 2
Figure 52: Scene 2 Material 3

Figure 53: Scene 2 Material 4
Scene 3 Iterations

Figure 54: Scene 3 Chip Version 1

Figure 55: Scene 3 (Chip) 2D smoke added Version 2
Scene 3: Material Iterations

Figure 56: Scene 3 (Chip) Material 1

Figure 57: Scene 3 (Chip) Material 2
Figure 58: Scene 3 (Chip) Material 3

Figure 59: Scene 3 (Chip) Final Material 4
Scene 4 Iterations

Figure 60: Scene 4 (Particles) Lights Version 1

[Houdini] Figure 61: Scene 4 (Particles) Camera animation Version 2
Figure 62: Scene 4 (Particles) Vignette and additional particles added in AE Version 2

Scene 4: Material Iterations

Figure 63: Scene 4 Material #1
Figure 64: Scene 4 Material #2

Figure 65: Scene 4 Material #3
Figure 66: Scene 4 Material #4 the one chosen

Figure 67: Scene 4 (Particles) Material ToonShader
[Houdini] Figure 68: Scene 4 Material  ToonShader
Scene 5 Iterations

Figure 69: Scene 5 (Cell exploding) Lights and camera setup Version 1 additional iteration

Figure 70: Scene 5 (Cell exploding) Lights and camera setup Version 1
Figure 71: Animation 5 (Cell exploding) the way cell disappeared was changed Version 2

Figure 70: Scene 5 (Cell exploding) Additional bloom and particles Version 2 additional iteration