

NEP ART STREAMS

A study of art production workflow optimization within the Graphics department of NEP.

Version 1

*Graduation report
Saxion University of Applied Sciences
Rob van Schooten (313864)*

*Graduation report “NEP ART STREAMS”
Creative Media and Game Technologies (CMGT)
Saxion University of Applied Sciences, Enschede
Rob van Schooten
Student nr. 313864
R.van_schooten@hotmail.com
Company supervisor: Rosa van Wouwe
Graduation teacher: Taco van Loon*

Abstract

NEP is an international tele-production company that produces real-time 3D environments for live television using augmented reality technologies.

With multiple project kick-offs at a monthly basis, the team noticed that art productions took longer than necessary due to repeatable production steps and a lack of structure in the storage of art content. The team requested a solution that helps improve the production workflow of the designers.

This document covers the research into the development of a product that speeds up the art production workflow of NEP's Graphics department.

Through questionnaires and test sessions the product was iteratively adjusted to the needs of the team. With the gathered knowledge on methods and insights, the final solution was designed through prototyping, user testing and validation. 7 people from the Graphics department participated in the questionnaires and test sessions.

3 essential goals were determined: To create a structured and organized medium that allows the designer to gather resources from one location, to Improve the work speed of the designer by taking away a set of repetitive production steps, and to create an expandable and maintainable system that can improve over time. The solution was an art library that contains all required content for art production. The library is expandable and is structured to separately store content from Unreal marketplace and custom art. A workflow was designed to make sure that the library stays organized and gets expanded in the future, along with a quality assurance step for the added content. According to the answers from the test group, the prototype seems to be an effective solution to improve the general art production efficiency, successfully meeting the main goal of speeding up the production workflow. This implementation can be improved further with the use of an overview and organization guide, making sure that the product will stay clear and organized in the future.

Preface

When I started my graduation in February 2020, I was searching for an interesting and challenging company where I could develop myself as an aspiring 3D environment artist, and hopefully share my knowledge. I can honestly say that I found exactly that at NEP. The first thing I noticed is how open and inspiring every team member was, welcoming me as a true team member right away. With all the enthusiasm and positive feedback I got from the team, I was positively encouraged to give my best effort and step out of my comfort zone. Other than the many valuable lessons I learned while joining the production of 3D art, my graduation assignment has been a refreshing and interesting topic for me. It allowed me to get a broad knowledge on the workflow within the company and get a lot of valuable insights from both technical artists and designers. I am proud of the results of this research, and I couldn't have done it without the help of a few people.

I would like to sincerely thank Rosa van Wouwe, my internship supervisor, for all the valuable feedback, guidance and professional insights throughout my internship period. Roel Bartstra and Steff Kempink, for sharing their technical wisdom and patiently helping me with all my technical questions. Gerben Pasjes, for guiding me through my research and teaching me a lot about design through my internship. Furthermore, I would like to thank the entire Graphics team at NEP for the pleasant cooperation and teaching me so much about the industry.

Lastly, I would like to thank my teacher, Taco van Loon, for the countless skype calls, sharp feedback on my reports, guiding me through the graduation process and generally being a great inspiration.

Table of contents

| | |
|---|----|
| 1. Introduction | 4 |
| 1.1 NEP Group | 4 |
| 1.2 Reason | 4 |
| 1.3 Problem definition | 4 |
| 1.4 Research questions | 5 |
| 2. Methodology | 6 |
| 3. Theoretical framework | 7 |
| 3.1 What is a production pipeline? | 7 |
| 3.2 The Game development pipeline | 8 |
| 3.2 NEP Graphics production pipeline | 9 |
| 3.3 Differences between standard workflow and NEP | 11 |
| 3.4 Methods and tools used in the industry | 12 |
| 3.5 Determining product requirements | 13 |
| 4. Prototypes & Testing | 14 |
| 4.1 Initial questionnaire | 14 |
| 4.2 Solution proposals | 14 |
| 4.3 Workflow design | 15 |
| 4.4 Art streams | 17 |
| 4.5 Prototype & testing | 18 |
| 5. Results | 18 |
| 5.1 Problems in current art production workflow | 18 |
| 5.2 Requirements of an effective solution | 19 |
| 5.3 Integration in the production pipeline | 19 |
| 6. Conclusion & Discussion | 21 |
| 6.1 Conclusion | 21 |
| 6.2 Discussion | 21 |
| 7. Recommendations | 22 |
| References | 23 |
| Figures | 24 |
| Appendix A: Implementation plan & Planning | 25 |
| Appendix B: Initial questionnaire | 26 |
| Appendix C: Proposal documents | 28 |
| Appendix D: Test session questionnaire | 29 |
| Appendix E: Art streams workflow | 31 |
| Appendix F: Graduation products | 32 |

1.Introduction

1.1 NEP Group

NEP group is an international tele-production company, founded in 1984 in Scranton, Pennsylvania. One of their locations is NEP the Netherlands, based in Hilversum. NEP offers media production services for television broadcasting and is divided into several branches.

The Graphics Production services in NEP the Netherlands operate under the direction of Chief Operating Officer Nico Roest. The Graphics Department is separated in Design and Technical Art and provides augmented reality content for TV production. Internally, Design and Technical art work closely together in order to make their production planning manageable and realistic within the timeframe. Figure 1 illustrates the company outline.

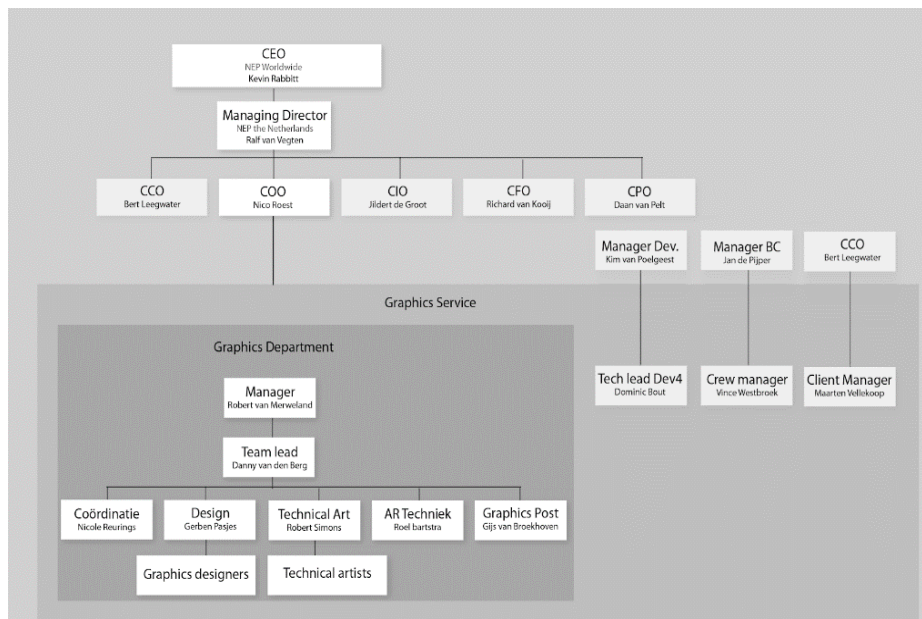


Figure 1: NEP the Netherlands COO company outline (R. van Schooten, 2020)

Part of the services of NEP the Netherlands, a location of NEP group based in Hilversum, the Netherlands, is the production of 3D environments for live television broadcasting. These 3D environments are foreground- and background Augmented reality elements that add to the real-life broadcast. These 3D productions are carried out by the Graphics department of NEP.

1.2 Reason

In February 2020, I joined the Graphics department as a 3D designer intern. Along with my graduation assignment, I would be assisting the art department with their 2D and 3D productions. NEP requested the implementation of a solution that helps improve the production workflow of the designers. The team encountered inefficiencies in their production workflow, ultimately taking unnecessary amounts of time. Examples were repetitive project organization tasks or simple production steps that always needed to be taken. Throughout my internship period I familiarized myself with the established production workflow of the Graphics department by joining the regular work activities. Through gathering first-hand experience of the work activities, insights were acquired of common inefficiencies and how the problem could be solved.

1.3 Problem definition

When a project is started, the designer starts by planning out the project. By following the company guidelines and based on what type of product the customer needs, the first steps toward a concept can be made.

With each project, a set of standard steps are always done, and relatively simple assets are created or manually extracted from previous projects. This means that a lot of work is unnecessarily done with each project. When gathering existing resources, there is no clear indication of what has already been made, if the available content needs to be changed and where it is stored. The problem definition can be stated as follows:



NEP's Graphics art production lacks a structured and organized workflow, leading to increased production times.

This is considered an inefficiency in the workflow by the art team, since most projects have strict deadlines and time could be better spent on the creation of custom art assets. Because of this, the art department is searching for new methods for creating an organized, structured and easy workflow so that production time could be spent more efficiently. Currently, a Perforce streams service is used by the Graphics department. Streams allow the version control system to automatically send resources to Unreal projects without the designer having to manually import them. This system is called “NEP Resources”. The system is set up to be frequently updated with new features and content, providing designers and technical artists with pre-set assets and settings/profiles when creating a new project in the Unreal Engine.

The main goal of this research is to find out how a similar system can be set up for art products, how this system would be implemented in the production workflow, what features need to be added or further explored, and how it can be made easy-to-use to essentially improve the art production workflow within the Graphics department.

1.4 Research questions

The central question of this research is as follows:



How can the current workflow in NEP’s art department be structured in order to improve production speed?

This question was divided into four sub questions, used for finding the answer to this problem.

1. How is NEP’s current art production workflow structured?

An analysis needs to be made of the current workflow of NEP’s art production. In this question, all the steps that the designer takes in production are analysed to determine in which step exactly the problem occurs. Further research is needed into how the solution should be structured and how it can be implemented in the production pipeline.

2. What are the requirements of an effective solution?

The answer to this question provides insight in how exactly the solution to the problem should look. With these answers further questions arise as to what the minimal conditions of satisfaction and technical limitations are.

3. Can existing resources or methods contribute to the solution?

For this question, information will be gathered on similar problems as encountered in the industry. Potential solutions by other companies might help to make choices for the solution of this problem. Further analysis of existing tools and resource libraries that are created to tackle similar problems will be explored to see if it can be suitable for this solution.

4. How can the solution be integrated in the art production pipeline?

With this question, insight will be gathered into how the solution can be made into a workable prototype that’s useful for the art production pipeline. The result should be a plan for a product that is manageable and can be expanded upon to ensure relevance in the future.

2. Methodology

This research was approached through mixed methods. Both quantitative and qualitative data collection methods were used, mostly to determine the requirements and measurable results of the solution. With the gathered knowledge on methods and insights, the final solution will be designed through prototyping, user testing and validation. In the attached Implementation plan, an overview is made of the research questions that were covered. For each sub question, the methodology for answering the question is explained.

Literature studies

In this research, literature studies were mostly used to substantiate choices made when analysing data. The theoretical basis was based on generic production processes in the industry, and how NEP's process differs from it. Furthermore, knowledge on similar problems, as encountered by other companies was collected, and potential solutions were analysed and gathered for testing in later stages.

Questionnaires

Initial knowledge was gathered by interviewing the Graphics designers and technical artists at NEP. By asking about the production process and their general idea of what improvements needed to be made, an initial set of requirements of the solution and an analysis on the current workflow could be made.

Experiencing the production process

The workflow was experienced first-hand by joining the production as a Graphics Design intern. Production steps were followed in conformity with the company guidelines, and insights could be gathered on the internal workflow and problem factors.

Solution proposal & test sessions

Based on the knowledge gained by doing interviews and experiencing the production process, a set of proposals were made and pitched to the team. This proposal showed a vision of where exactly the problem occurs and what the requirements of the solution were. After getting feedback, a visual proposal was made for the team in the shape of a presentation, showing a mock-up of the solution and how it would be structured. With the gathered insights, a testable prototype was made to validate if the product would be a useful addition to the workflow that solves the central problem.

Designing new workflow

With the knowledge of what the cause of the problem is and the requirements of the solution, a prototype of a new integration in the art production workflow can be made. The product will be made under the name "NEP art". The effectiveness of the prototype will be validated by test sessions within the team and questionnaires. Based on the results, potential changes can be made and a solid conclusion and recommendation for future development can be made.

3. Theoretical framework

3.1 What is a production pipeline?

In computer graphics, real-time productions follow a set of production guidelines for the team to manage and organize the variety of work. Usually video games, virtual reality and augmented reality productions are structured in a similar set of production stages to ensure visual quality, content management and work efficiency. The definition of a pipeline can be defined as follows:

“The pipeline is the glue that holds together the work of each artist involved in a production.” (Dunlop, 2014)

The team consists of several workers with their own specialization, each working simultaneously on their own task and handing it to the next. In the case of art production, the creative process consists of review cycles to ensure visual and technical quality of the product. Therefore, the production pipeline is constructed in such a way that a visual product can be made in early stages, and later refined to achieve desired visual quality, both boosting time efficiency and flexibility of the entire art production process. A general understanding of the production pipeline is essential for each team member, as it allows everyone to communicate choices to other team members and keep overview of the general production process. According to Dunlop et al., (2014). An efficient art production pipeline is set up to answer a set of questions that arise when a new project is started up.

- How many shots are there?
- How many tasks does that break down into?
- How many artists are needed to tackle them?
- Who is working on what?
- Where is their work being stored?

Answering these questions allows the team to determine what resources are needed, what is expected of each team member, how quality can be ensured and where the data is stored. Graphics production is both a technical and a creative process. It is essential that the production workflow is set up in a flexible way to ensure that each step can be evaluated and, if necessary tweaked for better results. The pipeline should be set up in an iterative, cyclic structure, where several iterations throughout production are followed up and reviewed by members of the team. Figure 2 (2014) visualises a cyclic workflow structure.

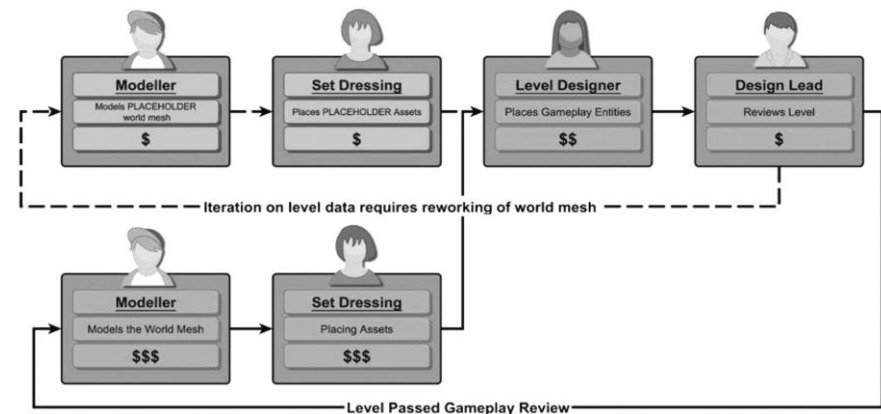


Figure 2: Evaluation loop from a game development pipeline, retrieved from Dunlop (2014). (<https://www.book2look.com/embed/9781317936220>)

Constant iteration is a good way to get a high-quality end-product but requires a lot of time in total. To manage time, first art iterations are mostly done by using placeholder assets. These are simple models that can be produced relatively quickly and stand in for finished versions during early production stages. This quickly allows dependent team members to use and test them. When the placeholder assets are redone in final quality, they only need to be updated, saving a lot of production time since team members can work simultaneously towards the end goal.

3.2 The Game development pipeline

NEP's 3D productions mostly make use of conventional technologies for real-time productions like video games. The Graphics department makes use of The Unreal 4 engine for building virtual sets and 3D assets, which are used as an augmented reality element for live broadcasting using Zero Density's Reality. To compare the workflow differences of NEP with conventional methods, an analysis is made of the conventional Game development pipeline.

In game development, production is typically divided in three stages:

- Pre-production
- Production
- Post-production

Pre-production stage

The pre-production stage is where every project begins. During this stage, initial choices are made. The team is usually quite small at this stage and activities mostly consist of determining the game story, mechanics, target audience and production planning. The stage can last between a week to a year, depending on the type of project, resources and available finances.

Concept creation

During concept creation, the look and feel of environments, objects and characters are defined. Usually at this stage a level brief is made, describing the story and gameplay elements. This document is then presented to the concept artist. The concept artist creates the visual basis through sketches and concept art, making a visual guide to the overall look and feel for the team to work from. In this stage, the essential plan for the overall look and feel and design is gathered in the form of a Game Design Document (GDD)

Game design document

The Game Design Document (GDD) is a continuously updated document used to communicate the greater vision of the project to the team.

The GDD includes all the necessary information, like the concept, genre, story, game mechanics, level- and world design, and monetization strategies. Since the scope of a project can change throughout production due to technical or financial limitations, the document is frequently updated and refined throughout production. Other than that, the document serves as an overview of the general scope of the project and can be used to manage expectations. In smaller studios, team members often take on a more generalist role where in larger studios people often specialize in a particular aspect of production. Therefore, smaller teams may choose a more agile technique, focusing more on production and less on process documentation.

Prototyping

During prototyping, early tests are done to check functionality, user experience, gameplay, mechanics and art direction. At this point, nothing is definite yet and decisions are made in what direction the functionality and layout of the game will move forward. In this phase, the artist often makes a test version of the level by using primitive 3D shapes, often referred to as "block out". These are basic, low detail 3D models that are used to define the scale, placement and functionality of the level. The goal of a prototype is to quickly test if the team's vision works and what potential challenges are being faced in production. Placeholder assets can be used too, which are often assets bought from an online marketplace and are only used to define where final assets will be placed.

Production stage

Production is the longest and most labour-intensive stage of production. This stage can take up to several years to finish, and usually the entire production team is working on it. The story, assets, props and environments are created and refined to their final quality level. The technical department writes the codes for the game and provides all functionality. In this stage the cyclic nature of a production pipeline as shown in figure 2 (2014) is important, as through an iterative approach the game gets continuously tested and refined.

Production milestones

Throughout the development process, the team works towards a set of deadlines. These are often called milestones, and define the stage the game is in. According to (Stefyn, 2019), These are the milestones in game development:

Prototype

The initial test of the game. In this stage a lot of ideas are tested and most never hit production.

First playable

A more defined version of the prototype. The general idea and look & feel of the game are clearer and assets of higher quality are added.

Vertical slice

A fully playable sample of the game, often consisting of a few minutes of gameplay. The vertical slice is often used to pitch the game to studios or investors.

Pre-Alpha

Most of the content is developed in this stage. At this stage, big decisions are made as to what content will be in the game and what might need to be removed.

Alpha

Once the game is in the Alpha stage, the main features have been added and the game is fully playable. QA testers will test the game for errors.

Beta

In the beta stage, all content and assets are integrated. At this point the team mostly focuses on optimization rather than making new content.

Gold Master

The final stage of the game, ready for public release.

Post-production stage

Once production has finished and the game has been released, the game development continues in the form of maintenance like bug fixes and patches. To improve the production in the future, a debrief can be done in which the team discusses the what went well and wrong. All documents, assets and code are finalized and stored in case they will be needed later.

3.2 NEP Graphics production pipeline

NEP's 3D productions are mostly made using conventional technologies for real-time productions, with a few exceptions. The Graphics department makes use of the Unreal 4 engine for building virtual sets and 3D assets, which are used as an augmented reality element for live broadcasting using Zero Density's Reality.

Pre-production

In NEP's graphics department the pre-production phase is the kick-off of any project. The new project is initiated with a creative brief and planning. In this stage the client's wishes are documented, and the requirements and insights of the teams are discussed. A requirements list is made that shows the deadlines, the required assets functionalities, and task division. Priorities are determined with the use of the MoSCow prioritization method. (Clegg, 1994).

Production

NEP's virtual sets are made for real-time streams and television production. In many cases, the virtual 3D decor will be an augmented element to a real-life studio. Therefore, it needs to be adjusted to the and scale and placements of the studio. The studio consists of a green box that can be keyed out and often other physical objects like chairs and desks where a person will be standing.

To keep these factors in mind, the designers use a set of reference objects like a green box placeholder model and 3D reference persons to define scale and placement. Figure 3 shows the green box used in studio 4, one of NEP's locations. Another important step is the placement of cameras in Unreal. The design of the set needs to be adjusted to physical limitations of the cameras that will be used, like the maximum height the camera can reach, and the type of lens used. Using this information, a close-up, medium shot and wide-angle shot are made.



Figure 3: Studio 4 Hilversum, retrieved from <https://www.nepworldwide.nl>

Concept phase

When the initial information is gathered, the production starts with concept creation. This phase is often started before the project is sold to the client, and the main priority is to convey the idea and look-and-feel of the product.

The concept artist delivers the style and design guidelines for the product. With this information the Graphics designer can create initial 3D concepts in the Unreal engine, using basic meshes and placeholder materials. Since this phase is used to focus on the look and feel of the product, structuring and optimization of the Unreal scene is not important here.

Block-out phase

When the concept of the set is approved, the production can begin. In the block-out phase, the definitive location and structure of the set will be defined and improved upon iteratively through frequent communication with the client and feedback from team members. The project is organized and structured following a set of rules documented in the company's guidelines. When it is required, the designer builds the assets in a modular way. In the end, the block-out shows a clear indication of the design of the set, the placement of objects, textures used and lighting setup.

Production phase

During the production phase the finalized version of the virtual set is created. The designer is required to use references when creating content to create realistic and accurate content. The designer needs to make sure that the added content is optimized and reviewed by team members. The company's documentation has a checklist of asset review guidelines that the content needs to meet, like polycount, correct UV maps and lightmaps, naming conventions, and correct PBR values. The team needs to make sure that guidelines for optimization are followed, since it is crucial for later stages where the product is used live. Within the Graphics department, designers and technical artists make use of a Perforce stream called "NEP Resources". This service provides the designers with essential blueprints and functionality, both reducing production time and ensuring stability. One of these additions is a "master material", a material that designers use as a base for PBR materials.

3.3 Differences between standard workflow and NEP

The art production pipeline of NEP's Graphics department consists out of the same essential phases as in the conventional game development pipeline, where development is done through an iterative approach from concept to finished product. The most important difference is the type of products that are produced at NEP. Different client wishes and different limitations require an adjusted workflow at NEP's art production pipeline.

Software

NEP's virtual sets are made for the purpose of live broadcasting. The graphics are handled by the Unreal 4 engine. However, additional software is needed to allow the graphics to be added to live broadcasting as an augmented reality element. Zero Density's software "Reality" is used for keying out the green screen from the camera feed. It is a modified version of Unreal 4 that add the graphics as an augmented reality element. When certain elements need to have a controllable functionality, Cube is used. Cube is a software created by Development at NEP, which communicates directly with the Unreal engine and allows the operator to control interactive blueprints or visual effects during filming. Figure 4 shows an augmented set during live broadcasting.

Before the Unreal level can be used, the technical artist compresses all contents into one file, referred to as a "cook". Because of this, it is essential that all guidelines for art production are accurately followed since a faulty set up can result in errors during the "cooking" process.

- All files need to be properly organized and included in the version control system.
- Blueprints are made and validated by authorized team members

Furthermore, the virtual set needs to be made with real-life limitations in mind, like the size of the studio, the type of equipment used, the height of the lamps and cameras in the studio and the placement of objects and persons.



Figure 4: PHIA live broadcasting on set, NEP documentation

Project setup

In a game studio, the team typically works on one large production at a time, with a scope of several years production time. NEP has several clients, where the team typically works on several smaller productions simultaneously. Productions typically take a few weeks to a few months rather than years. Because of this, a lot more productions will be started up at a year's basis and inefficiencies in the production workflow could quickly increase production costs. Optimization of each step in the workflow is therefore very beneficial to the company.

3.4 Methods and tools used in the industry

Physically based rendering

NEP uses Physically based rendering (PBR) materials for their productions. PBR is described as *“a method of shading and rendering that provides a more accurate representation of how light interacts with surfaces”*. (Eilers, 2019).

In short, a correct PBR material helps assures that the material looks realistic and accurate in a PBR renderer. PBR exists in several types, but in the common workflow the material needs to have the following texture maps.

- Base colour
- Roughness
- Normal map
- Ambient occlusion
- Metallic

Texture maps that are based on grayscale values, like ambient occlusion, roughness and metallic can be combined into one texture map. The engine reads the value from the RGBA channels. In Unreal, ORM (Occlusion, Roughness, Metallic) maps are used.

The Graphics department wants to make sure that the used materials are correct. In order to ensure this, the team needs to make sure to either use validated materials or validate it themselves.

Quixel Megascans

Since NEP's art usually needs to be photorealistic, NEP Graphics prefers to use Quixel Megascans content for material creation. Megascans is a material library based on real-life surface scans. Quixel founder Bergsman describes Megascans as follows:

“Artists need to spend a lot of time just to get a basic palette of materials done, either painting, sculpting, photo sourcing, custom scanning/processing or procedurally generating. By being able to rely on a realistic, high quality, standardized and physically based library of scanned assets, in conjunction with highly streamlined production tools to fully customize and integrate the scans, many headaches go away” (Bergsman, n.d.)

The surfaces are accurate to real-life and set up for PBR, meaning that realistic results can be easily achieved. The advantage over creating procedural textures in Substance Painter and designer is that production speed is much higher. However, the use of Megascans causes two inefficiencies in the workflow of NEP's art production:

Proper tileability

The content provided by Megascans is highly realistic and textures set up in a tileable way. However, since the content is made from real-life references, the textures often have very distinctive characteristics. This means that if the texture is repeated often in a tileable setup, the specific details easily become obvious. This is usually not the case when making procedural textures using Substance software suites.

Naming conventions

The naming conventions and file formats are not set up the same way as in NEP's production pipeline. Also, Unreal uses ORM maps for optimization purposes, which are not included in the Megascans library. When using the content of Megascans, the artist often needs to save the file in a different file type and make sure the naming conventions are correct, along with creating the right texture types from the reference file.

Modular set up

Part of the system could be the addition of ready-made, modular 3D art as standard resources. Working with an existing modular setup with automatically assigned materials could save a lot of production time, since these would only have to be placed in the engine. Intel's paper on modular concepts for games (2018) lists some of the following challenges and limits in modular building.

- Extra planning time is required to work with modular set ups
- Can look repetitive, boxy, or mechanically aligned
- Artists need to be known with the available resources
- Asset amount should be kept limited to maintain a clear, readable library

3.5 Determining product requirements

In order to propose a solution that successfully meets the team's wishes, a method for setting up and prioritizing the Conditions of Satisfaction was required.

Customer satisfaction

When a product is developed, an analysis needs to be made of required features and priorities. Using the Kano model (Sauerwein et al., 1996), Service- and product requirements can be analysed further and prioritized for achieving customer satisfaction. This method divides requirements into three categories:

1) Must-be features

These features are the absolute necessities of a product. If these are missing, the client will not be satisfied, making the product fail its purpose. These features have the highest priority when developing a prototype.

2) One-dimensional features

According to these requirements, customer satisfaction is proportional to the needs of the level. These requirements are typically the functional requirements that a customer expects there to be. Lack thereof still makes the product functional, but does not fully satisfy the customer.

3) Attractive features

Attractive features can be seen as "extra" functionalities, that neither are urgent nor expected by the customer. Addition of these features makes the product very attractive and increases the customer satisfaction. These features can be considered after evaluating the functional product when the high priority requirements are met. All three feature types can be seen in figure 5 (Sauerwein et al., 1996)

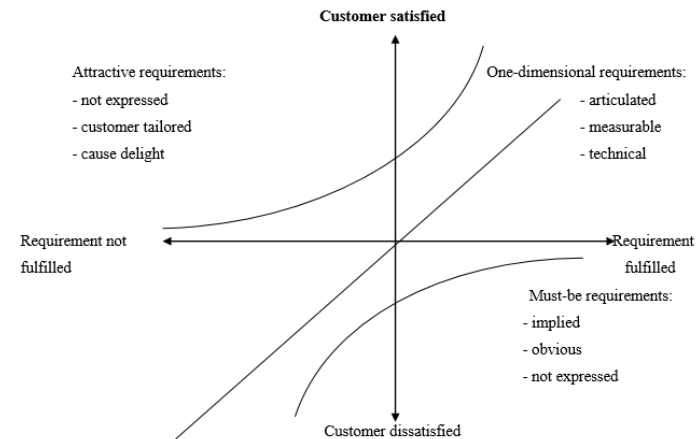


Figure 5: Kano model of customer satisfaction

An initial questionnaire was made to analyse the exact cause of the problem and the team's wishes for a solution to the problem. Using the Kano model, this information could be prioritized based on essential functionality and attractive requirements.

Must-be features:

- The system must be easy-to-use
- The system must speed up the production workflow

One dimensional feature:

- Expandability of the system

Attractive features:

- Aesthetically pleasing overview

4. Prototypes & Testing

4.1 Initial questionnaire

After joining the regular art production activities and analysing the production workflow, an initial questionnaire was made. The goal was to address the general art production workflow at NEP and how individual designers think inefficiencies could be improved. The Art department, consisting of 4 people was asked to answer the questionnaire. The questionnaire consisted of 9 questions that focused on the team's thought process during production, their individual workflow, and their vision for the requirements of a potential solution to the problem. With this information, the exact cause of the problem could be determined. The results showed an emphasis on the need of a new structure, where the designer has a clear overview of NEP's art resources and can easily import them in the project. This eliminates the need to look through older projects and having repeat the same production steps. The solution would come in the form of an art library.

4.2 Solution proposals

First proposal

Using the information of the initial questionnaire, a proposal for a new implementation was made and presented to the art department. In this document, the cause of the central problem was addressed and the team's wishes for the solution were presented. The purpose of this document was to validate the answers of the art team, to see if it corresponded with their vision of the problem solution. With the gathered information, a list of requirements was made that roughly summarizes the team's wishes. The feedback was that the amount of content needs to be kept minimal at this point to avoid using too much storage size.

Second proposal

In the second proposal the designers were shown a more refined version of the solution, under the name "Art resources".

The solution was presented as an asset library in Unreal that automatically gets included in the root folder through Perforce (Version control system).

The goal of this product was to present the team an impression of the end solution, how it would look and what functionalities it would have. The document was presented to seven people, both designers and technical artists. The attendees were asked to critically look at the proposal and see if it would meet their wishes and if this looked feasible to them. The answers indicated that the proposed content looked useful and could help solve the problem. Technically, it needed a different structure to ensure expandability in the future. For this, an expert consultation with the Senior Technical Artist was done and a third proposal was made with this vision. The full document of the second proposal can be found in Appendix C: Proposal documents.

Third proposal

After the feedback gathered from the second proposal, it became clear that the structure of the art library needed to be changed. After several expert consultations with the senior technical artist, it was decided that the product needed to be structured in a different way to ensure expandability and future relevance of the product. The main problem with the initial setup was that the NEP art folder was only allowed to contain a minimal amount of content since it would be included in every new project, quickly increasing the storage size required for each project.

Art resources can be kept as a central "stream" in Perforce, that can be used to import specific content into an Unreal project. When a lot of content needs to be made, it is often faster to gather assets from online platforms like the Unreal marketplace or Quixel Megascans. The system needed to be structured in such a way that both online content and custom art can be stored. Two types of "Art streams" were introduced to separate the content: Unreal marketplace streams and NEP art streams. The idea of "Art streams" added the advantage of giving the user the ability to add a lot more specific content, with the option to select everything in the form of "asset bundles". By making these bundles optional, the system can be expanded to store a wide range of assets, making the end solution more expandable and versatile. See Appendix C: Proposal documents.

4.3 Workflow design

With the implementation of art streams, a solution was required to structure all the stored data, making sure that it was used properly. The goal was to create a system in which all frequently needed assets are stored and organized properly in art streams. Useful content from Unreal marketplace content should be available and updated as a stream and new content can always be added to the appropriate stream when it is considered useful. The content that is available in either streams should be validated through a quality assurance step to make sure that all the added content meets the company guidelines for asset production. To make sure that art streams are properly used and expanded in the future, a workflow was designed. With the purpose of reducing production time in mind, the workflow was divided in three main stages: Pre-production, Production and Post-production.

Pre-production

The purpose of the Pre-production phase is to give the designer a quick step list to collect required content. With this information, the designer can quickly analyse what they need to deliver, what existing content can be used, and what needs to be custom made. This saves production time where the designer would otherwise spend more time searching and collecting assets or having to re-make content. Figure 6 shows the Pre-production phase of the workflow.

Quality assurance

To save production time, large amounts of specific art content can be collected from online resources where possible. To make sure that the collected content is still suitable for production, a quality check needs to be done when content is downloaded from online platforms. When a specific asset or asset packs are downloaded from online resources, the designer evaluates where it is from. When content is downloaded from Unreal marketplace, the designer can do a quick quality check to see if the quality is acceptable and if the files are properly set up. If the content is acceptable, it can be used for the project as is. If the content needs to be changed, the designer only picks the specific assets and makes the necessary changes to them. This way, the amount of required work is still minimized.

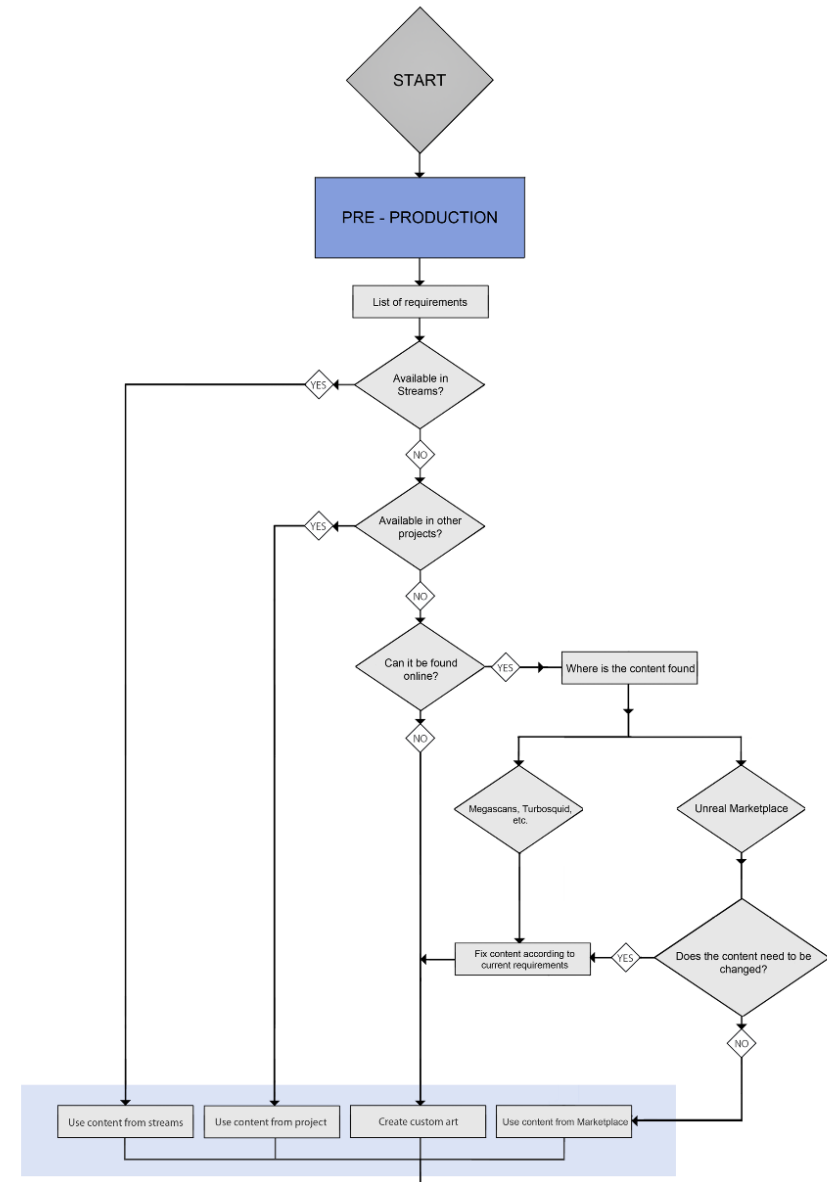


Figure 6: Art streams workflow, pre-production (R. van Schooten, 2020)

If the content is found on a different online platform, like Quixel Megascans or Turbosquid, the content always needs to be changed to requirements. When content is changed, it will be considered “Custom art”. Figure 7 shows the workflow for using online content.

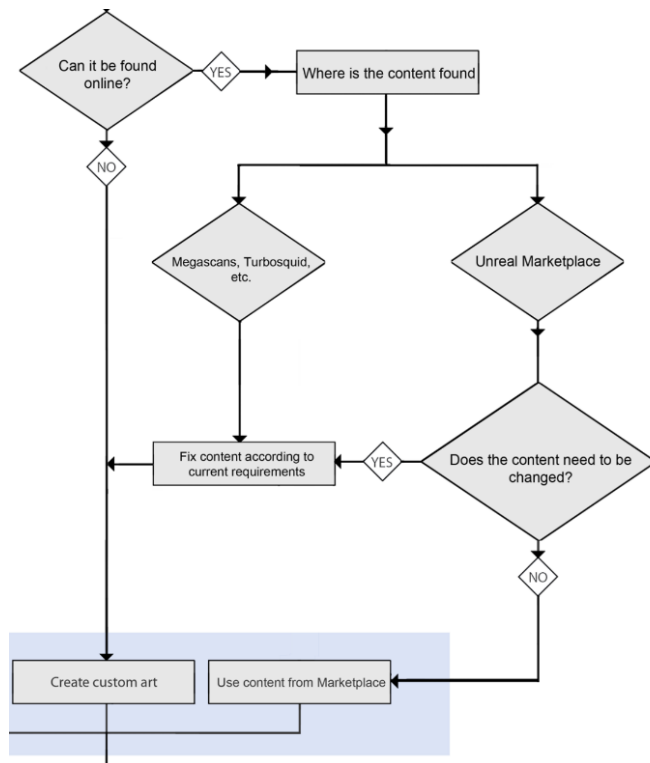


Figure 7: Art streams workflow, online content (R. van Schooten, 2020)

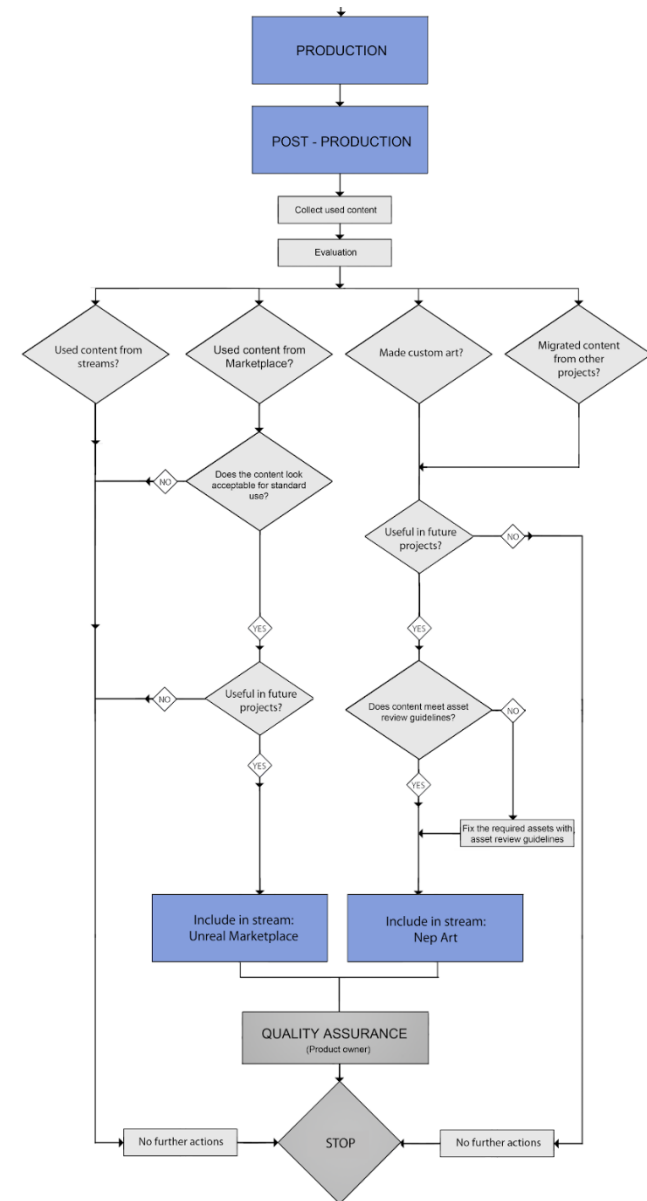


Figure 8: Art streams workflow, post-production (R. van Schooten, 2020)

Post-production

The purpose of the post-production phase is to evaluate on the project after production is done. In this phase, the designer collects the assets used and evaluates if the content could be suitable to place in an Art stream.

Using this workflow, the designer can evaluate which content they used and what further steps can be taken. Any assets that can potentially be used in future projects, are placed in Art streams. The designer needs to do a quality check to see if it meets with the asset review guidelines, then it can be placed in the appropriate Art stream. From here it will need to be approved by the product owner before it can be released as a new update. Figure 8 shows the workflow for the post-production phase.

4.4 Art streams

An “Art stream” bundle is a stand-alone folder that contains all the necessary resources for the assets inside, therefore eliminating dependencies of other folders within the Art library. This enables the designer to individually import a bundle into the Unreal project, without the risk of missing resources due to broken links. Additionally, the artist does not need to make changes to the content or create extra content like materials before using it. However, “Nep resources” needs to be available in the project, since some of the bundles in the art library are dependent on resources included in this stream. Figure 9 shows an example of asset bundles from Art streams, as they would appear in the Unreal project root.

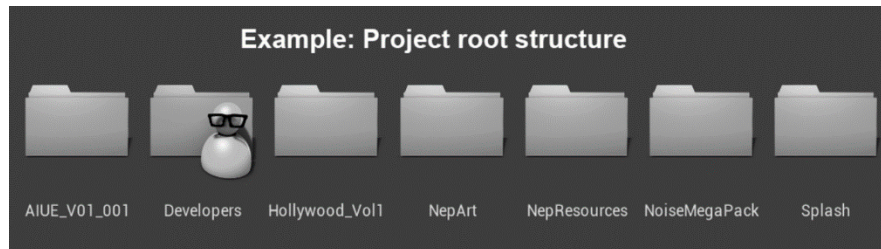


Figure 9: Art bundles imported in Unreal project root. (R. van Schooten, 2020)

Unreal marketplace stream

The Unreal marketplace stream consists of asset packs that are downloaded from the Unreal marketplace platform. Before they are added to this stream, a quality check is done to make sure the content is suitable for future use as is, meaning that nothing needs to be changed to production guidelines. It is important that the marketplace pack stays unaltered since it is set up so that updates can be automatically implemented without the product owner having to manually reorganize folders within the stream. Figure 10 shows the Unreal marketplace “stream” as located in the version control system.

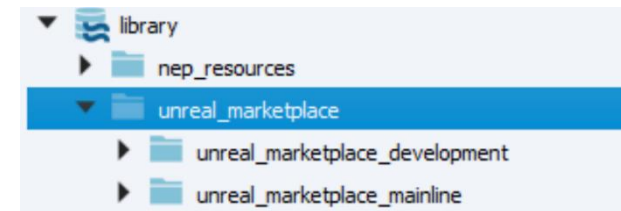


Figure 10: "unreal_marketplace" stream in Perforce. (R.van Schooten, 2020)

Nep art stream

The Nep art stream is used for all custom art produced by NEP that can be relevant for future use. The folder can be expanded indefinitely, based on what the team needs in the future. However, the amount of content per sub folder should be kept reasonably small to limit required data and to keep a clear overview.

The “NepArt” folder consists of subfolders that are all optionally imported in the project. These subfolders are categorized on type of assets. All subfolders are independent of each other, meaning that one folder can be imported, and every required resource is available. The sub folders contain all textures and materials that the included assets require, making each folder a stand-alone asset bundle that can be independently added to the project. Figure 11 shows an example of a set of optional subfolders within Nep art, with all required content inside.

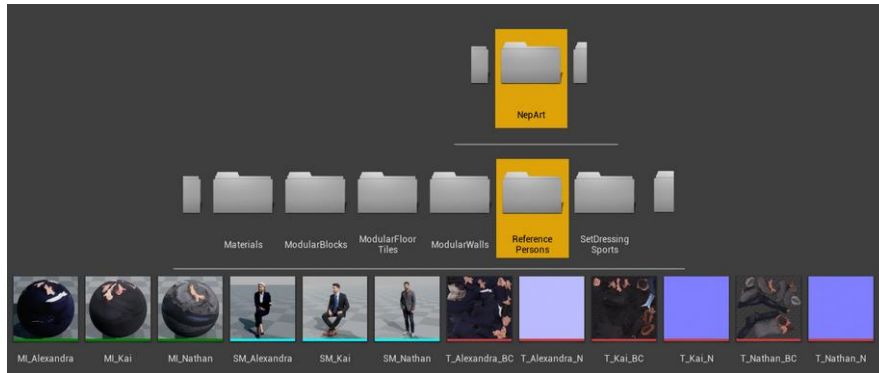


Figure 11: Nep Art subfolder contents. (R. van Schooten, 2020)

With Art streams imported in the Unreal project, specific content can be selected by category and is ready for immediate use. Figure 12 shows an example of reference models, modular blocks, a set of PBR materials, decals and set dressing models placed in an Unreal scene using only Art streams.



Figure 12: Nep Art example scene. (R. van Schooten, 2020)

4.5 Prototype & testing

Based on the feedback gathered from the proposals, a prototype was made for Art streams.

The workflow for Art streams was introduced to the team, along with a prototype for the users to test. The prototype was a test scene in Unreal with the folder structure of Nep art and some Unreal marketplace packs. This resembles a scene where these resources would be implemented from Art streams. The prototype was made to provide the art team an example of what the final product could look like, and how it would function in their own projects. The Art streams guide can be found in Appendix C.

To validate the functionality and relevance of this product, the users were asked to test the product and fill in a questionnaire. Appendix D shows the questionnaire used to validate the prototype usability and relevance.

5. Results

The central problem of this research topic, as stated in chapter one, is that “NEP’s Graphics art production lacks a structured and organized workflow, leading to increased production times.” In order to solve this problem, an art library needed to be created that meets the team’s wishes. The product was tested by the target group, the designers of NEP’s Graphics department.

5.1 Problems in current art production workflow

The exact cause of the problem in the art production workflow needed to be found. Four people from the Art department were asked to answer a questionnaire. Eight open questions were asked about the designer’s thought process during production, their individual workflow, and how they think the workflow could be improved. The questionnaire can be found in Appendix B. The most frequently mentioned problem with the current workflow is the fact that resources are missing or spread throughout older projects, meaning that it takes more time to gather required content due to lack of structure. Further specifications pointed out that the importing of these resources required extra work as well, like changing settings and adjusting to naming conventions. The team required a clear folder structure that was readable and logical to the user. The content in the library needed to be automatically included in the Unreal project and ready to use, without the need to make changes to the content first.

5.2 Requirements of an effective solution

To make an art library that successfully improves the art production workflow, it needs to meet three main goals.

First goal: Creating a structured and organized medium that allows the designer to gather resources from one location, without having to search through other locations in the company storage.

Second goal: Improve the work speed of the designer by taking away a set of repetitive production steps.

Third goal: Make sure that the system is expandable and maintainable to make sure the product stays relevant in the future and can improve over time.

5.3 Integration in the production pipeline

Based on the requirements, a prototype was made of the art library. Usability tests were done by 4 people of the art team by reading a written guide of the new workflow and testing the prototype. A questionnaire of 16 questions was then filled in to validate the usability of the prototype and collect feedback for further improvements. In these questions, the user could give the project a score where 1 is lowest and 5 is highest. The questionnaire can be found in appendix D. Concerning the first goal, most respondents found the structure of the art library clear and easy to navigate through. (figure 13) However, the folder structure could be improved with a more consistent folder naming structure and possibly colour labelling of the folders.

In question 3, all users gave the ease of finding assets in the prototype a high score (figure 14). With this, the first goal of the solution was met.

1. Does the folder structure within nepArt look clear and easy to navigate?

4 responses

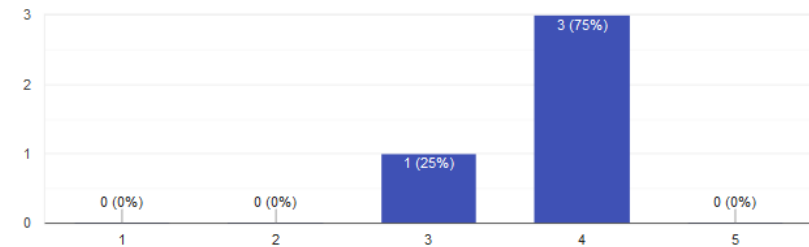


Figure 13: Test session, question 1. (R. van Schooten, 2020)

3. Was it easy to find the assets you were looking for?

4 responses

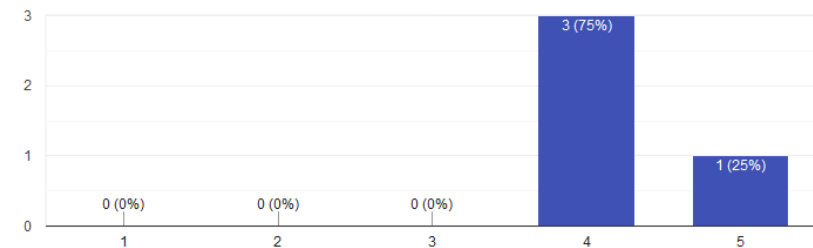


Figure 14: Test session, question 3. (R. van Schooten, 2020)

Concerning the second goal, all respondents gave a high score on improvement of efficiency and work speed in their workflow. (figure 15 & 16). At this point, this is a subjective answer, and true effects on the efficiency and speed of the workflow will need to be validated when the product gets integrated in the production pipeline.

5. Do you think Art streams would improve your work speed?

4 responses

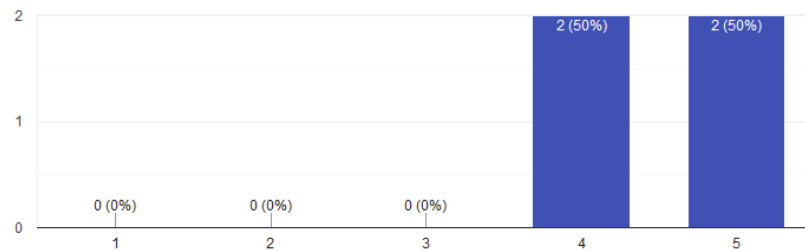


Figure 15: Test session, question 5. (R. van Schooten, 2020)

7. Do you think this would make your work activities more efficient?

4 responses

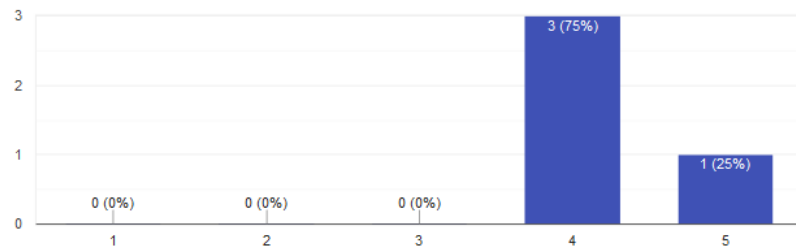


Figure 16: Test session, question 7. (R. van Schooten, 2020)

According to the answers from the test group, the prototype seems to be an effective solution to improve the general art production efficiency, successfully meeting the main goal of speeding up the production workflow. Additional feedback was that the naming structure should be improved, possibly by making a guide for the naming conventions of categories for art. This way, the product will stay clear and readable as future expansions will be made. Furthermore, notes were given on the structure of the workflow chart. In the case that online content is used for production, the budget does not always allow for the use of buying content. In this case it should be considered if buying the content is less expensive than the amount of production hours that would otherwise be used. Also, when using free content, there should be a check if it is suitable for commercial use.

6. Conclusion & Discussion

6.1 Conclusion



How can the current workflow in NEP's art department be structured in order to improve production speed?

In the early stages of a project, an overview of available content can speed up the initial stages of planning the production activities. In the current workflow, a clear inventory of available content is missing, creating extra production time of collecting content and repeating production steps. To structure the workflow at NEP's art department, an art library that contains all often-needed content needs to be implemented in the production pipeline. The art library should be a categorized collection of assets with a clear, consistent naming structure. Added content needs to be quality checked by a product owner to make sure that it can be used in any project. Each collection is optional and can be imported in the Unreal project. It needs to be a stand-alone folder that has no dependencies of other folders within the art library and contains essential art resources that can be expanded when needed. To improve production speed, the art library should have a separate folder structure for content gathered from online platforms. These two folder structures exist in the form of Perforce Streams that keep a categorized collection which can be imported into a new Unreal project. To make sure that the system stays organized, the workflow chart for Art streams should be implemented in the production pipeline. The workflow chart provides a guide for the designer to evaluate whether new additions can be made to the Art streams. With this, the system can eventually get expanded and finetuned when needed.

6.2 Discussion

The end solution was made for the designers of the Graphics department at NEP. 4 designers and 3 other people from the Graphics department were involved in the development of this product. Since the tests are only done for a small group, the data from the results is limited and more data could have been gathered from larger test groups. However, since the product will only be used internally, the most important factor is that the team is satisfied with the results.

Furthermore, the results of the solution are based on the opinion of the team, and at this point the impact on the general production speed of the designers could not have been measured within the scope of this research. In order to accurately validate the effectiveness of this product, a new test session should be done when the product is integrated in the production pipeline, where the duration of the pre-production phase of the current workflow is compared with the new implementation.

At this point, the solution has not yet been integrated in the production pipeline. Currently, plans are made to create an import-tool that can be used to directly import asset bundles from Art streams into an Unreal project. At this point, the effectiveness of this tool cannot be confirmed yet. Some respondents expressed their concerns about the improvement it will bring to the production pipeline, since the team is required to use a different software tool, adding an extra step to the pipeline. The effectiveness and ease-of-use will need to be validated before it gets integrated in the production pipeline.

7. Recommendations

In the first steps in the new workflow, the designer looks through the art streams to see what is available. To speed up the workflow, an overview should be made that shows the inventory of the Art streams. Furthermore, as set of guidelines should be written down to make sure that content is properly organized with the right naming conventions. The guide should be set up in such a way that it stays relevant as the product expands, meaning that a certain system should be found to label all categories within Nep art.

The product owner needs to make sure that the content placed in Nep Art meets the asset review guidelines. If changes are made in these guidelines, the content in the Art library should be checked for improvements.

A PBR validation method could increase the workflow for art streams in case the designer needs to add materials to the library. The guidelines state that Materials need to be PBR correct. Since PBR validation requires a method to measure the colour values based on an index, the workflow could be sped up by providing the designer with PBR validation blueprint, included in NEP Art.

References

- Clegg, D. (1994). *MoSCoW prioritization*. Retrieved from <https://www.productplan.com/glossary/moscow-prioritization/>
- Dunlop, R. (2014). *PRODUCTION PIPELINE FUNDAMENTALS FOR FILM AND GAMES*. Taylor & Francis Group.
- Eilers, H. (2019). *Validating PBR Materials in UE4*. 80.lv. Retrieved from <https://80.lv/articles/validating-pbr-materials-in-ue4/>
- Eilers, H. (2020). *Validating PBR Materials in UE4*. 80.lv. Retrieved from <https://80.lv/articles/validating-pbr-materials-in-ue4/>
- Epic games. (2020). *Asset management*. Retrieved from <https://docs.unrealengine.com/en-US/Engine/Basics/AssetsAndPackages/AssetManagement/index.html>
- Failes, I. (2016). *OK, what is this Megascans thing?* vfxblog. Retrieved from <https://vfxblog.com/2016/08/23/ok-what-is-this-megascans-thing/>
- Garth, J. (2017). *Tweaking Megascans for games*. Retrieved from <https://80.lv/articles/tweaking-megascans-for-games/>
- Heimer, D. (2019). *'Middle-earth: Shadow of War' : Asset Pipeline Growing Pains*. Retrieved from <https://www.gdcvault.com/play/1025199/-Middle-earth-Shadow-of>
- Intel. (2018). *Modular Concepts for Game and Virtual Reality Assets*. Intel. Retrieved from <https://software.intel.com/content/www/us/en/develop/articles/modular-concepts-for-game-and-virtual-reality-assets.html>
- Manning, R. (2018). *Project file management*. Retrieved from <https://www.youtube.com/watch?v=i6lyufPdVQk>
- Perforce. (2013). *About streams*. Retrieved from https://www.perforce.com/perforce/r13.1/manuals/p4v/streams_overview.html
- Perforce. (2019). *What is Perforce Streams?* Retrieved from <https://www.youtube.com/watch?v=HaRsCvLNoxA>
- ScholarArticles.net. (2011). *Kano model : how to satisfy customers?* Retrieved from <http://scholararticles.net/kano-model-how-to-satisfy-customers/>
- Stefyn, N. (2019). *How Video Games Are Made: The Game Development Process*. Retrieved from <https://www.cgspectrum.com/blog/game-development-process>

Figures

| | |
|---|----|
| Figure 1: NEP the Netherlands COO company outline (R. van Schooten, 2020) | 4 |
| Figure 2: Evaluation loop from a game development pipeline, retrieved from Dunlop (2014). (https://www.book2look.com/embed/9781317936220) | 7 |
| Figure 3: Studio 4 Hilversum, retrieved from https://www.nepworldwide.nl) | 10 |
| Figure 4: PHIA live broadcasting on set, NEP documentation | 11 |
| Figure 5: Kano model of customer satisfaction | 13 |
| Figure 6: Art streams workflow, pre-production (R. van Schooten, 2020)..... | 15 |
| Figure 7: Art streams workflow, online content (R. van Schooten, 2020)..... | 16 |
| Figure 8: Art streams workflow, post-production (R. van Schooten, 2020)..... | 16 |
| Figure 9: Art bundles imported in Unreal project root. (R. van Schooten, 2020)..... | 17 |
| Figure 10: "unreal_marketplace" stream in Perforce. (R.van Schooten, 2020) | 17 |
| Figure 11: Nep Art subfolder contents. (R. van Schooten, 2020) | 18 |
| Figure 12: Nep Art example scene. (R. van Schooten, 2020) | 18 |
| Figure 13: Test session, question 1. (R. van Schooten, 2020) | 19 |
| Figure 14: Test session, question 3. (R. van Schooten, 2020) | 19 |
| Figure 15: Test session, question 5. (R. van Schooten, 2020) | 20 |
| Figure 16: Test session, question 7. (R. van Schooten, 2020) | 20 |

Appendix A: Implementation plan & Planning

Implementation plan

https://docs.google.com/document/d/1oE9KzL0zxEdD_jVNctzProxHYtrKnWODwOdYoT5V7Fs/edit?usp=sharing

Graduation planning

<https://docs.google.com/spreadsheets/d/1RYoZbJzdVShgNOUCBrpmS7VXRQQwg360cY118dFwX8l/edit?usp=sharing>

Appendix B: Initial questionnaire

<https://forms.gle/Pj7JcyvTZx9xwJzaA>

Questions art production

Beschrijf kort hoe je bij het maken van een Unreal set/concept je werkzaamheden uitplant om zo snel mogelijk te kunnen werken. Kom je hierbij terugkomende problemen tegen?

Your answer

Welke problemen loop je vaak tegenaan bij het opstarten van een nieuw project?

Your answer

Welke stappen in het productie proces kosten te veel werk? (denk aan structureren van een Unreal project, verzamelen van resources)

Your answer

Hoe bepaal je welke content (meshes, materials, profiles) gemaakt moet worden in een Unreal scene?

Your answer

Hoe bepaal je welke bestaande assets hergebruikt of gekocht kunnen worden welke problemen kom je tegen met het ophalen hiervan?

Your answer

Om een duidelijke inventaris te maken wordt gekeken naar een opzet voor art libraries. Wat zou je verlangen van zo'n systeem om het duidelijk, gebruiksvriendelijk en overzichtelijk te houden?

Your answer

Is er specifieke art content (Bijvoorbeeld bepaalde standaard assets/materials/IES profiles of decals) die je erg nuttig zou vinden om standaard in een Unreal project te importeren?

Your answer

Welke problemen kom je tegen bij het hergebruiken van assets? (Bijvoorbeeld verkeerd opgezet, aanpassingen moeten maken aan de mesh)

Your answer

Hoe gemakkelijk is het om een material te maken met de huidige master materials? Missen er standaard aanwezige base materials om sneller mee te kunnen werken? Moet er veel aangepast worden bij het hergebruiken van materials?

Your answer

Appendix C: Proposal documents

First proposal

https://docs.google.com/presentation/d/1Sq0-u5ySjPqM-plWUmuShy_1ewwJ2aCnB3fnmS-fdJI/edit?usp=sharing

Second proposal

https://docs.google.com/presentation/d/1s5vgkGQe6qYZzCclBiQrHg_eoyOv-amkvdSRLuITsDYM/edit?usp=sharing

Third proposal

<https://docs.google.com/presentation/d/1jfQEISFo74-zeG2m2Kuxtk7pJ6FrjLFrjTaXPLGSChs/edit?usp=sharing>

Art streams guide

https://docs.google.com/presentation/d/1zr8PoG-FzqWFFY_iQn7iYISuIE5D4GF9Vp_ZHWep9E/edit?usp=sharing

Appendix D: Test session questionnaire

Test sessions were done between June 2nd and June 5th, 2020. Attendees were asked to fill in the questionnaire after the product was tested.

<https://forms.gle/2tQCMSAmpPerWvbZ9>

NEP art streams - test session

1. Does the folder structure within nepart look clear and easy to navigate?

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Not at all ☐ Very much ☐

2. If it is unclear, why? What could be improved?

Your answer

3. Was it easy to find the assets you were looking for?

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Not at all ☐ Very much ☐

4. If the assets were not easy to find, what could be improved?

Your answer

5. Do you think Art streams would improve your work speed?

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Not at all ☐ Very much ☐

6. If not, why?

Your answer

7. Do you think this would make your work activities more efficient?

1

2

3

4

5

Not at all ☐ ☐ ☐ ☐ ☐ Very much

8. If not, why?

Your answer

9. Is the workflow chart easy to understand?

1

2

3

4

5

Not at all ☐ ☐ ☐ ☐ ☐ Very much

10. If the workflow chart is unclear, why? What could be improved?

Your answer

11. Do you think it would take a lot of time to get used to this workflow?

☐ Yes

☐ No

12. If so, why?

Your answer

13. Would you use this workflow in your next project?

☐ Yes

☐ No

14. If not, why?

Your answer

15. Do you have any concerns or uncertainties about the workflow or the art streams setup?

Your answer

16. Is there anything you would like to add?

Your answer

<https://drive.google.com/file/d/1169xRLR5p8A7H0kKM-4frFDbO3Vps51T/view?usp=sharing>



Appendix F: Graduation products

Professional product (current status)

<https://drive.google.com/file/d/1fyj6rleEsMwy0bsQg4zkw9GSvxVDOXOT/view?usp=sharing>

Internship productions

https://drive.google.com/file/d/1GYIi6LYgtGBFhFzFrPhpH4K6eVYKAz_U/view?usp=sharing

