# STUDY OF PRODUCTION PIPELINE IN 3D ANIMATION

**AT BIG ANIMATION, PUNE**

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09634002, (Animation (09-11)

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IDC, IIT BOMBAY

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# APPROVAL SHEET

The Summer Internship Project entitled "Study of production pipeline of 3D animation" by Geetanjali Barthwal, 09634002 is approved in partial fulfillment of the Masters of Design Degree in Animation and Film Design.

Project Guide: _____ T. Phani
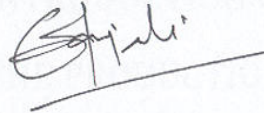(PHANI TETALI)

Date : 05/July/2011

Place: Mumbai

# DECLARATION

I declare that this represents my ideas in my own words and where other's ideas and words have been included. I have adequately cited and referenced the original sources.

I also declare that I have adhered to all the principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission.

I understand that any violation of the above will be cause for disciplinary action by the institute and can also evoke penal action from the source which thus not been properly cited or from whom proper permission has not been taken when needed.

Signature:

Name: Geetanjali Barthwal

Roll no: 09634002

# CONTENT

# OBJECTIVE

The Objective for the internship at BIG Animation is to study the pipeline of 3D Animation in a Production House and also to know why a Production pipeline is important in Production House.

Animation films are always a treat to watch .It's fantasy elements embedded in the  stories makes it worth to watch than the reality cinema .They are made to capture the hearts of the audience . It's for sure lots of money and effort is behind such great works but how it's been done is always a question for me .This project gave me the opportunity to work inside a Production House and to get the work insights straight from the big wigs of the industry.

# ABSTRACT

 The project aims to understand the production pipeline of 3D in production houses. Production is a very coordinate process where different teams of artist's work together towards achieving the common goal in the available time. Specifically in a 3d production, pipeline describes the workflow which shifts  from  one stage to another according to the hierarchy of tasks managed  from the top and stored in a central server  which is then shifted to other level of work. Though pipelines do vary in the way they're organized and executed they're all roughly the same on a macro level.  The big production houses have set up world-class state-of-the-art facilities equipped with hardware, software and big crew for the project.

 I observed in the production house how proper planning and the set up is organized which directs the flow of the work while utilizing optimum resources. In my whole project report I have discussed why a pipeline is important and how does it functions.  Going through each and every process in briefly, I try to discuss it with help of images from the examples of some artist's works or from famous movies like "Up, For the birds, and Monster's inc" etc.

Interacting with the people working in "Big Animation", Pune helps me to witness the ongoing production work and their experiences. In a production house there may be different projects going through at the same time like in films projects, VFX, or Advertisment films works, 2d as well as 3d work like "Little Krishna"etc in Big animation and Reliance media works production house.

# MY LEARNINGS

Great works need great planning!

Methods used by an individual to produce something is vastly different from the demands of a large team. Animation teams are no different in that many people work together with a good network of communication towards a common goal. Since animation is a creative profession each person working within the group has his/her own creative style and liking and there are many ways to approach a process. So the very important goal is to unify the creative style and production processes and methods that are followed so that a studio works like one unit, to one creative style and in one production process tree. This is the goal of a production pipeline. The pipeline encapsulates and unifies all production processes, methods, work flows, industry best practices & Technologies to ensure the proper flow of all production elements to the production processes in the prescribed specifications. Pipelines are different for different projects as it is very much depend on the budgeting for the project.

The principals to work as a team or in a Production house are:-

- Setting goals

- ➢ Which should be clear
- ➢ Measurable
- ➢ Achievable
- ➢ Creative but  realistic
- ➢ Timed

- Project management

- ➢ Carefully and systematically planned and organized.
- ➢ Effectively executed and precisely monitored.
- ➢ Fine-tuned so that contingencies and changes are accommodated.

- Ongoing development

- ➢ Recognize that project development is important and so is artist's also.
- ➢ Will help to gain experience and extend skills and create a visible system so to do.

# AKNOWLEDMENT

# AN INTRODUCTION OF THE PRODUCTION HOUSE

**BIG Animation(I) Ltd,** now called **Reliance Animation** is part of **Reliance Big Entertainment** – one of the largest entertainment groups in India. Big animation is one of the leading production houses of the country in 3D animation. With its latest state- of-the–art facilities equipped with hardware and software, production for Films, TV, animated shorts and logos etc the production house is creating commendable work in the field of animation.

## 3D Animation in BIG Animation:-

Location: - Pune

Big animation is one of the leading animation Production house in the country which is producing great works in the field of animation. One of India's most eagerly anticipated animated TV series, co created by BIG Animation & India Heritage Foundation, The 13 episode x 23 mins of world class animation quality on Indian screens. The series represents a seamless blend of Global standards of technology with creative excellence.

Big Animation's latest works in 3d animation are Big bees Jr., little Krishna, Ghost station, Bad eggs, other logo animations and TV Ads.

# THE PRODUCTION PIPELINE

## What is a pipeline and its importance?

The 3D animation process has 30+ stages with "one-to-many" Relationship. Before a production element moves over to the next production stage, it has to be validated both technically (technical requirements of a model like avoiding overlapping vertices, n-sided polygons, non-manifold surfaces etc) and creatively (aesthetics and usability) and approvals are taken to validate this. The pipeline ensures that all the process requirements are met before it allows the element to flow to the next stage.

In a crude example, without a pipeline a technically and aesthetically short asset element, obviously unapproved, can flow to the next process causing a lot of wastage of time and effort. In most cases work done in the next stage gets wasted. In the presence of the pipeline, this asset will not be available to the next stage at all. Though pipelines do vary in the way they're organized and executed they're all roughly the same on a macro level.

Animation production is a very coordinated process where different teams of artist work together while utilizing optimum recourses and achieving the initial goal in the time available. Production conceptualized in terms of a pipeline. What you produce flows through that pipeline. If your production is high, your pipeline is full and you make money. If it's low, your pipeline is down to just a trickle and you don't make money. Therefore it is important to make sure that you constantly have business lined up to flow through your pipeline. This in essence is one of the pipeline principles.

Pipelines are important for many reasons:-

- Each pipeline has a line producer who makes a checklist of the artists and the work flow update.
- Crew distribution is one of the main works done by the line producer along production timeline with respect to the interest of the artist. Pipeline is the backbone of any 3D Animation production.
- It is a proprietary tool which encapsulates all production processes, customized methods, work flows, industry best practices & Technologies to ensure the proper flow of all production elements to the production processes in the prescribed specs.

- Tight integration between all the software(s) used in the production like Maya, Renderman, Nuke etc) and production processes like modelling, Animation, Lighting etc.
- The pipeline is a governing software that prepares the production elements, versioning of all stages, automating changes on the assets / elements to reflect across the floor.
- The pipeline also preprocesses and optimizes the elements to flow into the next process smoothly according to specifications and checklists.
- The pipeline also works by consolidation and separation of the various stages / elements like BGS, Props, Characters, Layouts, Animation, Lighting & Rendering etc, thus creating SOC (Separation of concern). What this means is an error created at one stage does not percolate or affect any other stage. Once the trouble stage is fixed, all stages reflect the corrected item automatically.
- Customizing the workflow to suit client's requirements. This is achieved by the modularizing the various stages. The significances are process insertion / removal / reuse.
- versioning and tracking assets and variants and global distribution of changes made in any/ all of the processes
- Pipeline also automates the process and refines 3D software elements into compatible elements ready to be automated.
- Pipeline also deals with asset validation, management, production control and tracking tools.
- pipeline is also a tool that creates experience embedding and people training to a known paradigm.
- The floor issues on a production without a pipeline can be as huge as 10 times (1000%) and above as opposed to one with pipeline.
- Approvals are taken; rules and regulation are made to work.
- Hand work is done before software process based work.
- Checklists are made which helps to keep an update about the progress of the project.
- Reflecting changes across the production pipeline.
- Assembling and dissembling of all the modular's and process of the pipeline.
- It must avoids work conflicts /approach conflict.
- Each Plan in a network has an owner with overall responsibility, but each person in a Plan has their own copy in which they manage their own part of the work.
- Integration of 3d authorizing tools and technology, ex= Maya—Max

Stage A → Stage B → StageC

Final Out put
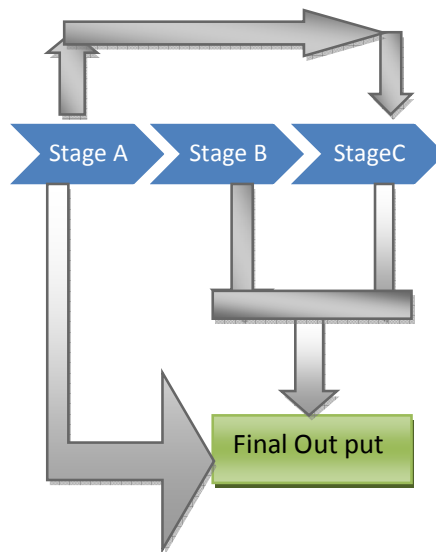
❖ In an ideal modular process,
   a)    Each stage must ideally connect to any other stage.
   b)    Each stage has a specific expectation /format as a result
   c)    Designing element to be independent of each other.

The blue color shows the liner process where A is assumed to be parent process to B. Delay in A causes unnecessary delay for C. In this way the down time risk is high. This is a generic process on any production line not specific to animation.

The black arrow process tells about the Modular process where each stage is ideally connected to any other stage.

Each studio is likely to have a custom pipeline determined by the type of project they are currently undertaking. Other than this there may be any reason for having different pipeline in different production houses.

## PRE PRODUCTION PROCESS

```
                              IDEA
                  │                      │
                  ▼                      ▼
             CONCEPT                  SCRIPT ──────────────────┐
                                                              │
                        DESIGN TEAM / ART                     │
            ┌──────────────┼──────────────┐                   │
            ▼              ▼              ▼                    ▼
    ROUGH SKETCHES    COLOR, STYLING,   NO OF CHRACTERS,
    AND CONCEPTS      BACKGROUNGS       BG'S AND           VOICE
                                        INTERACTIVE PROPS   CASTING
                            │
                            ▼
                      STORY BOARD ──────────────▶           TRACK
                            │                               RECORDING
                            ▼                                   │
                   STORY REEL/ANIMATIC                          ▼
                            │
                            ▼
                     TRACK READING
                            │
                            ▼
                  CONTINUTY CHECK UP/
                       HOOK UP
                            │
                            ▼
              FINAL ANIMATICS / BOARDOMATIC
```
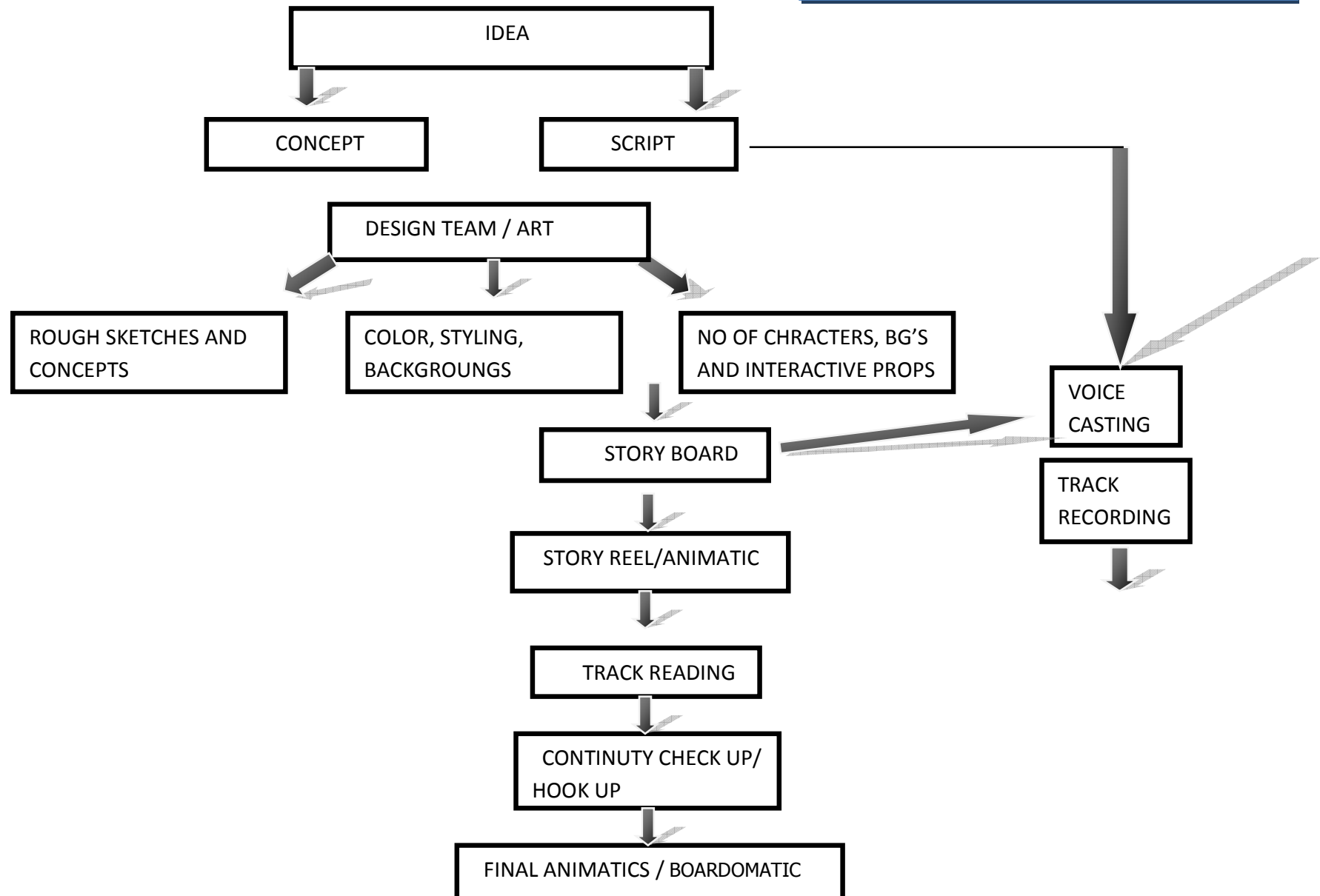
# PREPRODUCTION:-

The first stage in the Animation content is development cycle, and also one of the most important, is pre-production. It begins with the main concepts which are initially turned into a full story, and then, once the story has been finalized, other things such as the script, character design, background layouting and animatic is created. During the development stage, typically, the story is developed from a concept or an idea into a complete script with a provisional screenplay. The commercial viability of a creative concept is evaluated carefully by way of market segmentation, market research and use of sophisticated revenue forecasting models. Some major components of pre production are discussed below from "Pixar production -UP".

## A) IDEA, CONCEPT, AND RESEARCH AND DEVELOPMENT STAGE:-

IDEA:- **"**Up" is a story of the big adventure of an old man and a school kid.

CONCEPT:- **"**Up" takes audiences on a thrilling journey where the unlikely pair encounter wild terrain, unexpected villains and jungle creatures**.**

## B)STORY DEVELOPMENT/STORY, SYNOPSIS AND ONE LINER:-

SYNOPSIS: - Carl Fredricksen spent his entire life dreaming of exploring the globe and experiencing life to its fullest. But at age 78, life seems to have passed him by, until a twist of fate (and a persistent 8-year old Wilderness Explorer named Russell) gives him a new lease on life.

STORY BOARDS: - Following the final script, the animators create a series of storyboards. Once all storyboards are created they are joined up to form a comic book, showing all the ideas for the animation. Following this, once the storyboards are approved, the drawings are digitally enhanced, to form a "story reel". Pairing this in real time with music, sound effects and dialogue is called an Animatic. After a certain stage the design team cease further explorations on the project and start with the blue printing of characters or finalize the work to be done for production.

## C) CHARACTER DESIGN, SETS, AND PROPS:-

In parallel to the above work of animatic the number of Character designs, sets, props and Bg's or sub-bg's are also in process of making and sketching. This part is headed by a design team who finalize the character design and props for to start with 3d Asset development so as to parallelly start with 3d Production. Some of the examples of characters from up movie are:-



Charachter's from "Up"





" Ratatoullie "    and    "Toy story"    have  great character designs.

## D) VISUAL DEVELOPMENT:-

BG'S (LOOK AND FEEL, VISUAL STYLES FINAL LAYOUTS):- Once the story reel has begun, the visual department develop the tone, style and effects to every frame.

### Artist " LOU ROMANO'S"  work of "UP" fame  :-



Here are some art works of artist LOU ROMANO'S work. The above were the inspirational photos of Venezuela's Tepuis Mountains which became the part of the film later on.



The artist worked on different styles and different mediums. The above one are done in Gouache. His observation while drawing these flat top mountains that rise out of jungle-basin are that they are so tall that only certain species of plants and animals will exist.

## A DAY IN THE LIFE

        Explorations of old age and loneliness created in the art work by different mediums. The idea was to keep Carl isolated within the frame and suggest loss with composition & light. The film deals a lot with loss and letting go of the past.



The final look and feel of the movie .

# E)CASTING :-

As the storyboards are drawn, characters and sets are possessed further in the pipeline, so now need to find voices for the characters and start recording their lines. Actor's voice is recording before the actual animation starts. It's the team of art director or other people who decides the casting of the film according to the requirement of the character most fitted.
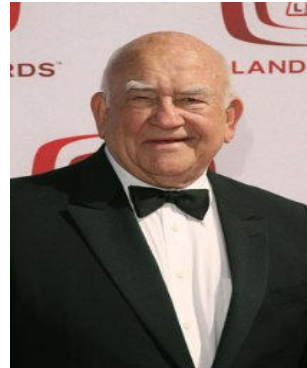


"**Edwars Asner**" as Carl Fredricksen



"**Jordan Nagaias**" as Russell

First temporary 'scratch' voices are recorded by Pixar artist from the storyboard reels. Later, when the story and dialogues are finalized, professional actors began recording the character's voice reading from script and improvising .Actors must record lines several different ways the best reading is eventually animated. Sometimes the scratch voices are so good that they are not replaced.

**PRODUCTION**

(PRE-PRODUCTION STAGE ) STORY

NO. OF CHARCTER

NO. OF BG'S

NO. OF INTERACTIVE PROPS

MODELING

TEXTURING AND SKINING

RIGGING

UV MAPPING

3D BOARDOMETRICS

PRE- VISUALISATION /VFX

ANIMATION

PRIMARY

SECONDARY

LIGHTING

RENDER

COMPOSITION

At every level of pipeline there are quality checks by director itself, or a team of 2 or 3 people director, co–produce etc. The teams of members at one or the other level for quality check of the work so as precede the production further. It is always good to strengthen the preproduction part for to avoid further complications in the production process.

# PRODUCTION:-

Now that the storyboard has been approved the project enters the production phase. It's here that the actual work can start, based on the guidelines established during preproduction. Some major parts are modeling, texturing, lighting, rigging and animation.

## A) AUDIO BREAK DOWN OF LIPSYNC:-

At this stage the audio break down is down for sync in animation and dialogues. The modeler creates the blend shapes with respect to the audio lip sync for the characters. Blend shapes are mostly used for facial expressions, in order to animate them, a set of library of facial expressions are created for all the possibilities in use. Blend shape deformers let you change the shape of one object into the shapes of other objects and also into the shapes of other surfaces. In character setup, a typical use of a blend shape deformer is to setup poses for facial animation. Unlike other deformers, the blend shape deformer has an editor that controls all the blend shape deformers in the scene. The editor is used to control the influence of the targets of each blend shape deformer, create new blend shape deformers, set keys, and so on.
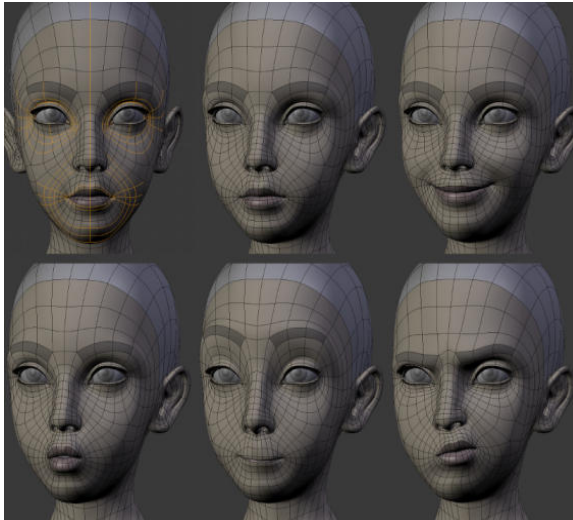
# B)MODELELLING :-
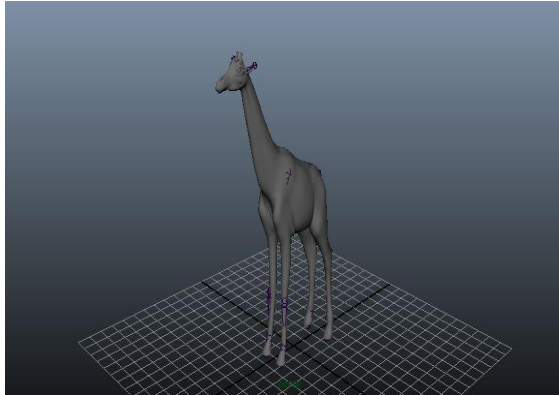


In 3D computer graphics, 3D modeling is the process of developing a mathematical representation of any three-dimensional surface of object (either inanimate or living) via specialized software. 3D models represent a 3D object using a collection of points in 3D space, connected by various geometric entities such as triangles, lines; curved surfaces, etc. 3D models can be created by hand, algorithmically, or scanned. Modelers may be split into two or more departments. Whilst organic modelers tend to have a sculpture background and specialize in building the characters and other freeform surfaces, hard-surface modelers often have a more industrial design or architectural background, and as such they model the vehicles, weapons, props and buildings. Working closely with the Art Directors, Visual Effects Supervisors and Animation Supervisors, modelers turn the 2D concept art and traditionally sculpted maquettes into high detail, topologically sound 3D models.

Once the model is approved, it will be made available for UV mapping, rigging and texture paint departments, who complete the final stages in preparing the model for animation and rendering. With luck, the model will move through the production pipeline without coming back for modeling fixes, although some amount of fixes are inevitable –in which case problem comes it is send back to be fixed.

Every 3D scene has some kind of structure in it, which is modeled from a plan, design or just an idea .These include vertices, edges, faces, polygons and surfaces.
Almost all 3D models can be divided into two categories.

- **S**olid -  3d models that have volume are called Solid Models. These solid 3d models are actually used in engineering models and have a mathematical component to them.



- **Shell/ boundary** - these models represent the surface, e.g. the boundary of the object, not its volume (like an infinitesimally thin eggshell). These are easier to work with than solid models. Almost all visual models used in games and film are shell models. Shell 3d models serve a purpose that a solid 3d model cannot. The shell 3d model focuses on the visual representation of an object. Video games are a great example of where shell 3d models are implemented.

There are five popular ways to represent a model:

- POLYGON  modeling

- NURBS modeling

- SPLINE & PATCHES modeling

- SUBDIVISION SURFACES

A modeler must keep in mind of many things during the work:-

i.   Understanding of form and function, and how those elements interact
ii.   Effectively interpret concept art (and other source material) into first-rate 3D models for use in a real-time 3D environment. Because there may be chances that the blue print of models may not be detailed.
iii.   A developed and proven understanding of UV mapping techniques, and how they are best applied to 3D models for games,
iv.   to deliver a consistently high level of quality output across both high and low resolutions,
v.   to communicate effectively and with confidence with tight deadlines,



**"Up" art work**

Modeling is one of the first stage of Post production. A team of modelers has to model all the 3d objects which are in required in the SETS, CHARACTER DESIGNS and PROPS ETC. From the blue print of layout, our modelers will construct the digital 3-D model which will further move in the pipeline for texturing etc. Final set modeling and dressing. Additional textural detail will be added later with shading. Organic sets such as this one tend to be more challenging than man-made sets (e.g. buildings) because the shapes are more complex and difficult to design in a pleasing way that also looks natural. Note that most of the leaves of the plants face camera. This was a design choice to keep the vegetation simple and graphic.

A scene from **"Up"** movie after modeling of the forest shot.

# C) UV MAPPING:-

After finishing character model, interactive props, or set designs it will be UV'd before texturing. Efficient UV mapping is a very important step before texturing of any 3d model begin, and will inevitably affect every other stage of your workflow, from blocking normal maps, all the way to performance, rendering, and frame rate . The process of UV Mapping transforms the texture map onto the 3D object. In contrast to "X", "Y" and "Z" Cartesian Coordinates, which are the coordinates for the original 3D object in the modeling space, another set of coordinates is required to describe the surface of the mesh, so the letters "U" and "V" are used. UV texturing permits polygons that make up a 3D object to be painted with color from an image. The image is called a UV texture map, but it's just an ordinary image. The UV mapping process involves assigning pixels in the image to surface mappings on the polygon, usually done by "programmatically" copying a triangle shaped piece of the image map and pasting it onto a triangle on the object. UV is the alternative to XY, it only maps into a texture space than into the geometric space of the object. A good way to approach UVs is to block out the full geometry, and then go in and detail it piece by piece.
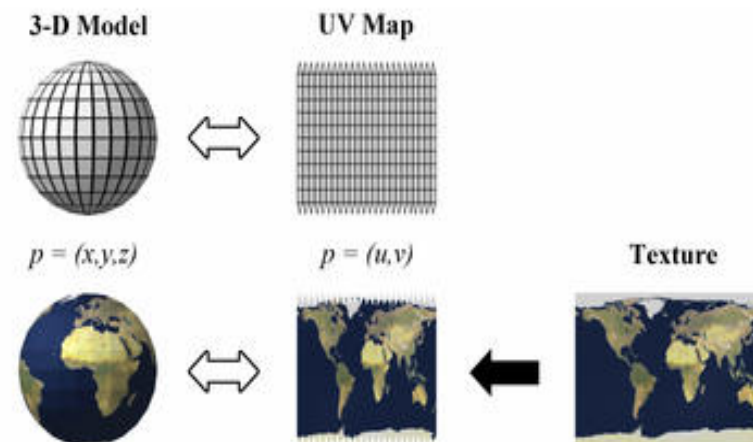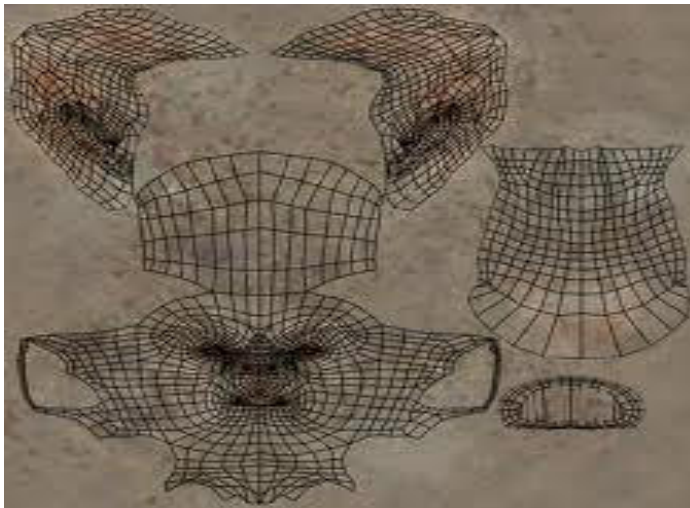
UV mapping challenges:-

➢ Unwrapping of the  model into 2d canvas
➢ Less distortions,
➢ Good use of texture space,
➢ Cleverly hidden seams,
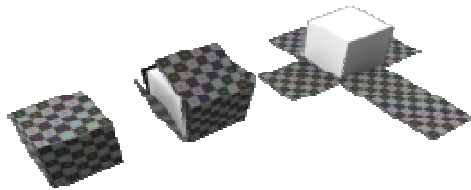
A  UV map can either be generated automatically by the software application, made manually by the artist, or some combination of both. Often a UV map will be generated, and then the artist will adjust and optimize it to minimize seams and overlaps. The UV Mapping process at its simplest requires three steps: unwrapping the mesh, creating the texture, and applying the texture.

# D) TEXTURING:-

Whether creating a texture from scratch or through editing an existing image, Texturing Artists are responsible for writing shaders and painting textures as per the scene requirements. Working hand-in-hand with the surfacing and shading departments, textures are painted to match the approved concept art and designs which were delivered by the art department. These textures are created in the form of maps which are then assigned to the model.

While texturing the things to keep in mind:-

- to adapt and work across a diverse range of artistic styles,
- A developed appreciation for surface texture, light and form – and how those elements relate to and interact with one another,
- to effectively interpret concept art (and other source material) into first-rate textures for use in a 3D environment,
- to deliver a consistently high level of quality output at both high and low resolutions,
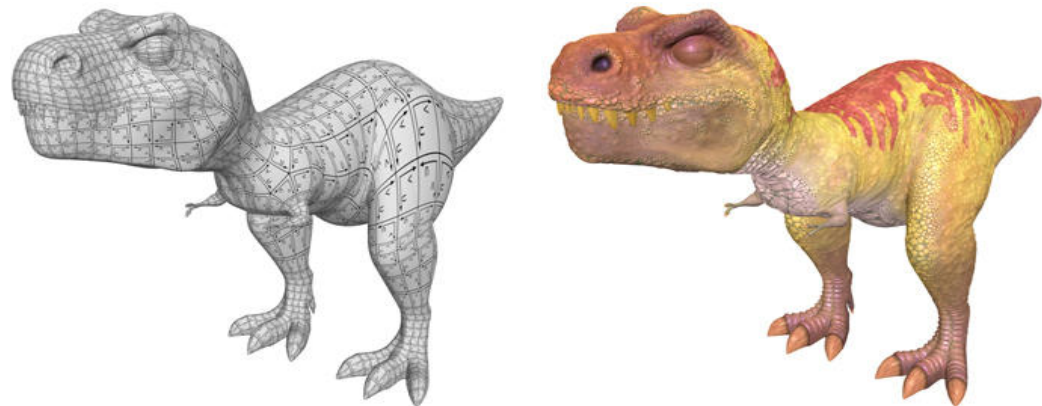
Example-Below Russell, Carl Fredricksen, This shows the final shading (material textures) for the set. All of the surfaces have texture, color, patterns, and material properties that will respond appropriately when later lit by the Lighting Department. For example, the broad leaf plants have shiny leaves that will also be translucent when backlit. The textures in Up are stylized to have larger patterns that sometimes resemble painted brush strokes. They are not made to literally look "real" but do have the complexity of objects found in nature and that makes Carl and Russell's world believable.

# E) RIGGING:-
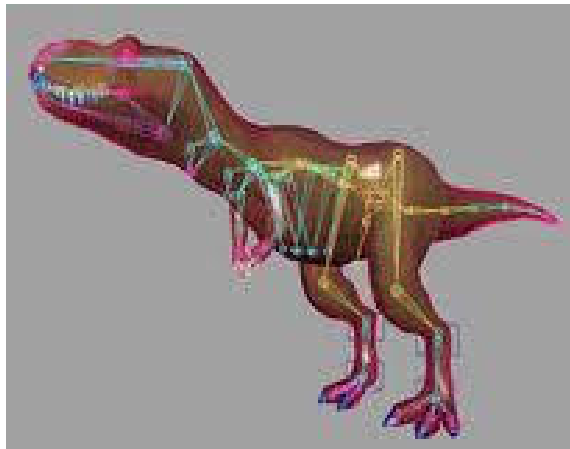
Rigging is the process of adding bones to a character or defining the movement of a mechanical object, and it's central to the animation process. It involves setting up an internal skeleton that affects where your character's joints are and how they move. This is when the modelers start with this wire frame sculpture that is called an armature that breaks down the design and allows us to "rig" the figure, which will give the animator the ability to move our 3-D figure in whatever way is necessary to get the movement which is needed. The first step in rigging is to defining the centre of character required before bone placement. A point is placed called centre control just below the navel on the character to provide a starting point to which all subsequent bones will be linked The importance of the centre control is that it is an overall pivot point for the body, as many movements originate in this area. Once positioning of the centre control is done one can start creating several bone chains to form the skeletal structure . A bone chain is a series of bones that are created at the same time and are automatically linked to form a hierarchy. With the hierarchy the whole bone structure of the body is connected so as to make it movable for animation requirements.

The rigging department is also involved in developing cloth simulation – so as well as making a character able to clench their fist or rotate their arm, the rigging and cloth department is responsible for making their costume move in a believable manner. A good rig can make the difference between having to concentrate on your character's performance and having to fight with the controllers to make your character move. While a bad rig can often create more problems that what it solves, a good rig will save you a lot of headaches during the animation stage.

A Rigger helps in :-

- providing user interface for animators to control the animation.
- providing expansion control interface.
- providing options in  muscular controls.

Techniques of rigging:-

A. Skinning(binding)- Skinning is the process of binding the character mesh to the skeleton to be deformed by the working of the movement of skeleton parts. Mesh can be bound with the
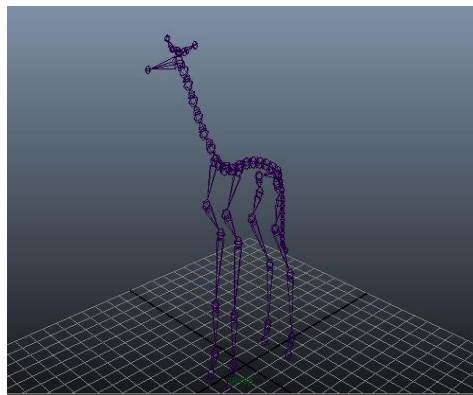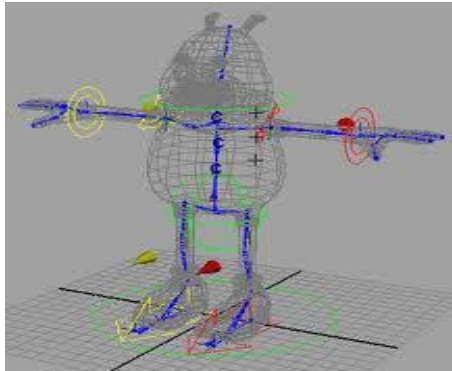
skeleton basically two ways Direct and Indirect skinning.

**Direct Skinning** – methods involves the use of rigid skinning and smooth skinning.

Rigid Skinning- It is an old method of binding the skinning to the skeleton where vertices of the mesh stick to the skeleton parts in values of One or Zero. There cannot be any other value .so it's called Rigid skin. Under smooth skinning, Vertices of the character mesh are bound to the Skeleton parts in the values ranging Zero to one (0,0.1,0.3.etc) .Or its adds the flexibility to the deformation hence called smooth skinning. **Indirect skinning** –is not to bind the character mesh directly to the skeleton but deformers like lattices, wrap or others which can further influenced or driven by smooth or Rigid skin.

B. Paint weighing - Weighting is the process of defining how much each joint influence the CVs in a smooth skin. This method "paints" an influence map of joints to Control vertices.

C. Inverse kinematics-is a method of animating that reverses the direction of the chain manipulation for the animator. Rather than work from the root of the tree, it works from the leaves. To animate the arm using inverse kinematics, you move a goal that positions the wrist. The upper and lower arms are rotated by the IK solution which moves the pivot point of the wrist, called an end effector, toward the goal.

D. Forward kinematics- The default method of manipulating a hierarchy uses a technique called forward kinematics. Let's take the example of a human arm. To animate an arm using forward kinematics, you rotate the upper arm away from the shoulder, and then rotate the forearm, the hand from the wrist and so, on adding rotation keys for each child object.

The basic principles employed by this technique are:

- Hierarchical linking from parent to child ,
- Placement of pivot points to define the connecting joint between linked objects
- Inheritance of position, rotation, and scale transforms from parent to child.
- In forward kinematics, when a parent object moves, its children must follow.
- If the child wants to go off on its own, the parent remains behind. For example, in a hierarchical linkage of a human figure, when the torso (the parent) bends over, the head (the child) moves along with it, but you can turn the head without affecting the torso.

## F) BLOCKING:-

Blocking is the lay outing by the artists which tells where the shot is happening in which background and what will be the character positions. It tells which set piece is needed, which camera angle is applied and the movement of the camera. It is actually is like a 3d representation of an animatic. This rough layout or animatic is the process from which the team also determines character placement, spacing, lighting, geometry and scene timing. At this stage a 3d board-o-matic is prepared which is actually an animatic in 3d. Only after this stage animation is applied to the characters .This also helps to tell which animation character is required with which set piece with what time.

The blocking pass will also allow the director to see a version of your shot that can be easily modified before a great deal of time has been spent on a scene.

Here is a short example from **"Boundin"** from Pixar's short. A scene where, how the character is introduced, the camera movement, and the animation of characters will happen adding others elements in the scene.


1


2


3

**5**



**6**
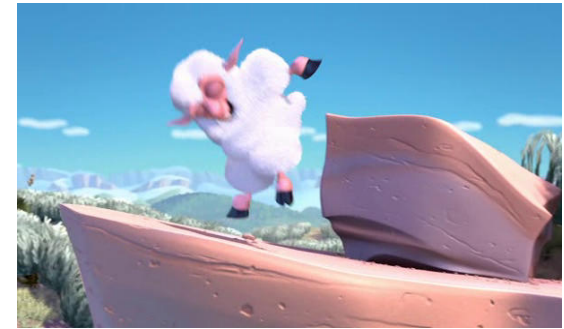


**4**



**7**

**8**



**9**
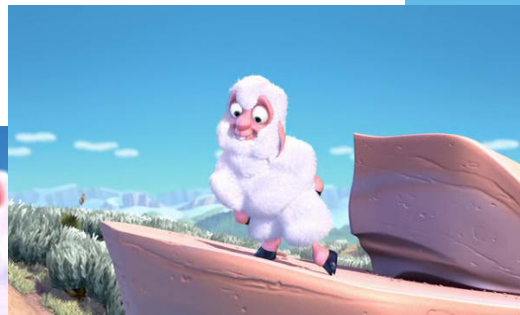


In this example first character have been blocked with reference to the respective movement of the character and the camera movement which is essentially important. Till this stage the character modeling texturing and rigging is all done which was parallelly done at the stage of preproduction got over. Blocking is also called as Staging or 3D Board metrics**.**

## G) SET ASSEMBLY:-

Set requirements, reused, mattes, cards planes etc. In this stage mattes and other set requirements are to be done. These may be reused from the earlier works.

## H) ANIMATION:-

 Animation can begin once the blocking of the scene is approved. Anything that a character interacts with, such as ground plane, or props, should be modeled prior to the start of animation. The computer animator breathes life into the character by imbuing with personality and giving them the ability to move and interact. The same principals of animation mechanics, acting and timing apply for this role, except that the computer animator must also be able to use the computer as an artistic tool. Once the static elements have been set, the 3D artist applies motion to them. This process, called animation is performed by setting key frames.

In order to animate a ball falling, the animator would set the first key frame at say 0th second with the balls position at the initial top position. Then set the next key at say 5th second with the balls position touching the ground. The 3D animation software interpolates the balls falling action between the 0th and 5th seconds. The animator can customize the interpolation behavior using graphs or by setting intermediate keys. Animators choreograph the movement and facial expression in each scene.

In Character animation, similar principles are applied. The skeleton will be animated by the animator and the 3d mesh skinned to the skeleton gets animated automatically. Character animation is often aided by plug-in tools (e.g.: biped) that has been created specifically for creating character animation sequences like walking or running cycles. The various scene elements, cameras and lights are animated using basic key-frame animation, based on the storyboard requirements.

Animation is often divided into two categories: Primary animation is about the character animation. Its acting, walk, dancing, fighting or any other specifics etc. The primary animation is done by lead animators. This work is also goes for quality check to the director or a team of animators for approvals. In this example Primary animation is of the characters only and the other environment animation s done by the secondary animation artist team.
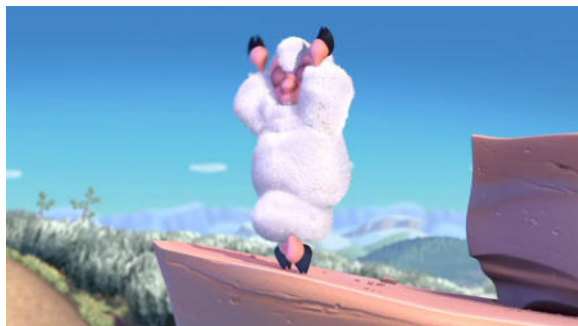
**"Boudin"**

**"For the Birds"**

**"Voa Presto "**

2- Secondary animation involves facial hair movements, tail movement, feathers etc. It is majorly depends on the character requirements involved in the scene so this animation is being given to another team to lessen the work and fasten the animation production.

Secondary animation is for the hare's ears.

Animation is planned scene by scene which is subdivided into shots. Later on with the help of blocking stage the animator animates it. In this stage the audio breakdown is down into phonemes. Hence the dialogues and acting are easily figured out. Hook ups are the important thing to be assured during the animation stage.

# I) PRE-VISUALIZATION: - VFX Movements
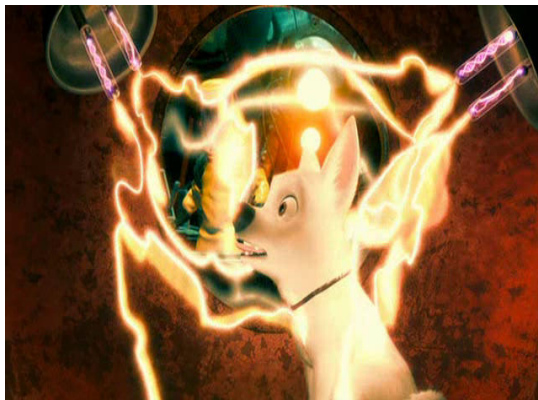


**Pre visualization is** the use of digital technology to explore creative ideas, plan technical solutions to production problems or communicate vision and creative intent to the broader production team. The use of interactive technologies on set to produce real-time visualizations that can help the director and other crew members quickly evaluate captured imagery and guide performance. Pre visualization is defined as any technique, whether hand drawn or digital, that attempts to visualize movie scenes before filming begins for the purpose of planning. Its primary purpose is to allow the director "to experiment with different staging and art direction options such as lighting, camera placement and movement, stage direction and editing – without having to incur the costs of actual production". Pre visualization is an early production process and can be placed after layout /blocking.

For the most part, visual effects are created through a close collaboration between effects animators and technical directors. An effects animator generally moves objects by creating key frames, while a technical director uses computer rules or algorithms(such as dynamic simulation) to procedurally define motion. Visual effects are instrumental in creating a mood and atmosphere. Analogous to their counterpart in traditional animation , 3D CGI effects animator s are responsible for designing and creating all non- character related animation. Their artwork includes items ranging from furniture to vehicles (also known as props) to natural elements such as shadows, mist, fog, wind, fire and smoke. Similar to models, the visual effects are tested. The effects are developed in unison with the lighting to ensure proper integration with all elements. Once the scene is completed for lighting and effects, it is inserted back in 3D workbook and is viewed. For visual effects animator a good understanding of software programming is helpful. These positions can be highly technical .Previous experience in traditional effects animation and desire to explore new technology are highly advantageous for this job.

The following is a common hierarchy for the visual effects department:

- Visual effects supervisor(s)
- Visual effects animator(s)
- Visual effects breakdown artist(s)

Virtual Moviemaking technology provides significant benefits to live action and Animation movies production. The technology can be used to immediately visualize how the shot will look after post-production. Camera moves can be planned and tested in real-time and both creative and technical

aspects of the shoot carefully evaluated and tested.  The director can see and understand the full context of the shot including the visual effects that will be added later, enabling him, or her, to direct performance.  Another application is using Virtual Moviemaking to design and explore virtual movie sets before they are built by the construction crews in live action or in 3d animation which benefits to be cost effective in a film production.





Special effects used in **"Finding Nemo and Bolt"** the Pixar animation.

# J) LIGHTING:-



Not only does a Lighting Artist have to think lighting the individual scenes, they also have to consider how to bring together all of the elements that have been created by the other departments. In most companies, lighting TDs combine the latest version of the animation, the effects, the camera moves, the shaders and textures into the final scenes, and render out an updated version every day.

Lighters have a broad range of responsibilities, including placing lights, defining light properties, defining how light interacts with different types of materials, the qualities and complexities of the realistic textures involved, how the position and intensity of lights affect mood and believability, as well as color theory and harmony. They are required to establish direct and reflected lighting and shadows for each assigned shot, ensuring that each shot fits within the continuity of a sequence, all the while aiming to fulfill the vision of the Directors, Production Designers, Art Directors and VFX Supervisors. The Lighting Department is responsible for integrating all of the elements (characters, set pieces, special effects, cloth animation, etc.) to create the final imagery. The lighting is achieved by placing virtual light sources in the scene which illuminate on the characters, set and special effects. Many dozens of lights are often required as well as lighting effects such as the shafts of sunlight.





"UP movie shorts"

**"Up" short**

# K) RENDERING:-



Rendering is the process of computing the final image that makes the movie. Before Compositing, several layers of various scene elements like background elements, foreground elements, characters, props etc are rendered. On top of this, various layers representing each item like diffuse, shadows, beauty passes, highlights, ambient occlusion etc are rendered. The rendering software computes the geometry, textures, shaders and lights to produce the image that constitutes the film. Rendering is the least interesting and most technical and ultimately the most important, part of the CGI animation process. This is where all the polygons, shaders, lights effects and cameras work come together in the final animation .In fact ,the most of what has been covered over the last few pages cannot exist without the rendering engine. Once the scenes are animated, it will undergo a process called rendering, in which the 3d representation is converted to a video format, which can be read and further edited using professional video editing software. The production houses have high end software's and computers in which all the work is assembled for rendering layer by layer. These computers are all networked together to form what is known as render farm. The machine share the task of rendering the sequences by each working on a different frame at a time, until the job is done so it takes less amount of time. The computer has to make thousands of complex mathematical calculations to create single image as the animation is going to contain hundreds or thousands of these images. Rendering a single image or an animation is essentially the same time-consuming process. Depending on the complexity, a scene may require hours or possibly days before it can be fully rendered. All the information pertaining to the scene, be it models character, props, environment, textures, lights, and camera is already decided, hundreds of small images are rendered, the size depending on your destination format –film, PAL or NTSC video. This shots from  "Finding Nemo" a Pixar's feature is rendered as a still for use in printed material at 4000*2440 pixels, where for videos it would be around 1920*1080pixels (depending on the format).



**Finding Nemo**



**For the birds**
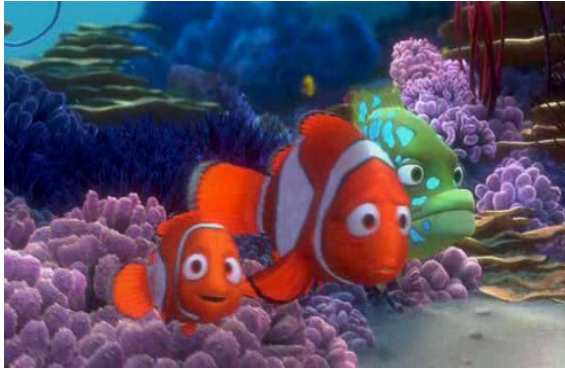
# L) COMPOSITION:-



At this stage the scene is broken up into separate elements and then layered back together in preparation for the final film or video output .During compositing a scene may go into many changes, including being recomposed and having its depth of field altered and its color tweaked. The individual responsible for combing all of the elements is called a compositor.

The compositor should be able to troubleshoot as necessary and have the aptitude for creative problems solving in order to assemble the final shot. A background in computer graphics and strong drawings skills are helpful for this position. A final composite on a scene should be seamless- the viewer should not be able to distinguish between the different mediums used for the shot.

The compositing department brings together all of the 3D elements produced by the previous departments in the pipeline, to create the final rendered image ready for film. Compositors take rendered images from lighters, a particular shot, the animation involved and other 3d objects are layered with the visual effects prepared by the VFX artist if involved in the scene. The compositing software's used in production houses are Nuke, after effects, Maya composite, Eyeon Fusion, Blender etc. While doing the composition color correction is one of the important processes so that each scene looks to be married with the other one even if the lighting changes from day to night or due to some artificial lighting effects reflected on the character.





" Finding nemo                              and                              For the birds"

POST PRODUCTION PROCESS

```
AFTER  PRODUCTION
        |
        v
      EDITING
        |
        v
```

| BACKGROUNG SCORE | FINAL OUTPUT WITH MUSIC | DIALOUGES | FOLEY SOUND |

```
        |              |              |              |
        v              v              v              v
```

FINAL MIX

```
        |
        v
```

CREDITS

```
        |
        v
```

TEXTLESS /SUBTITLES FOR

```
        |
        v
```

RELEASE PRINTS

```
        |
        v
```

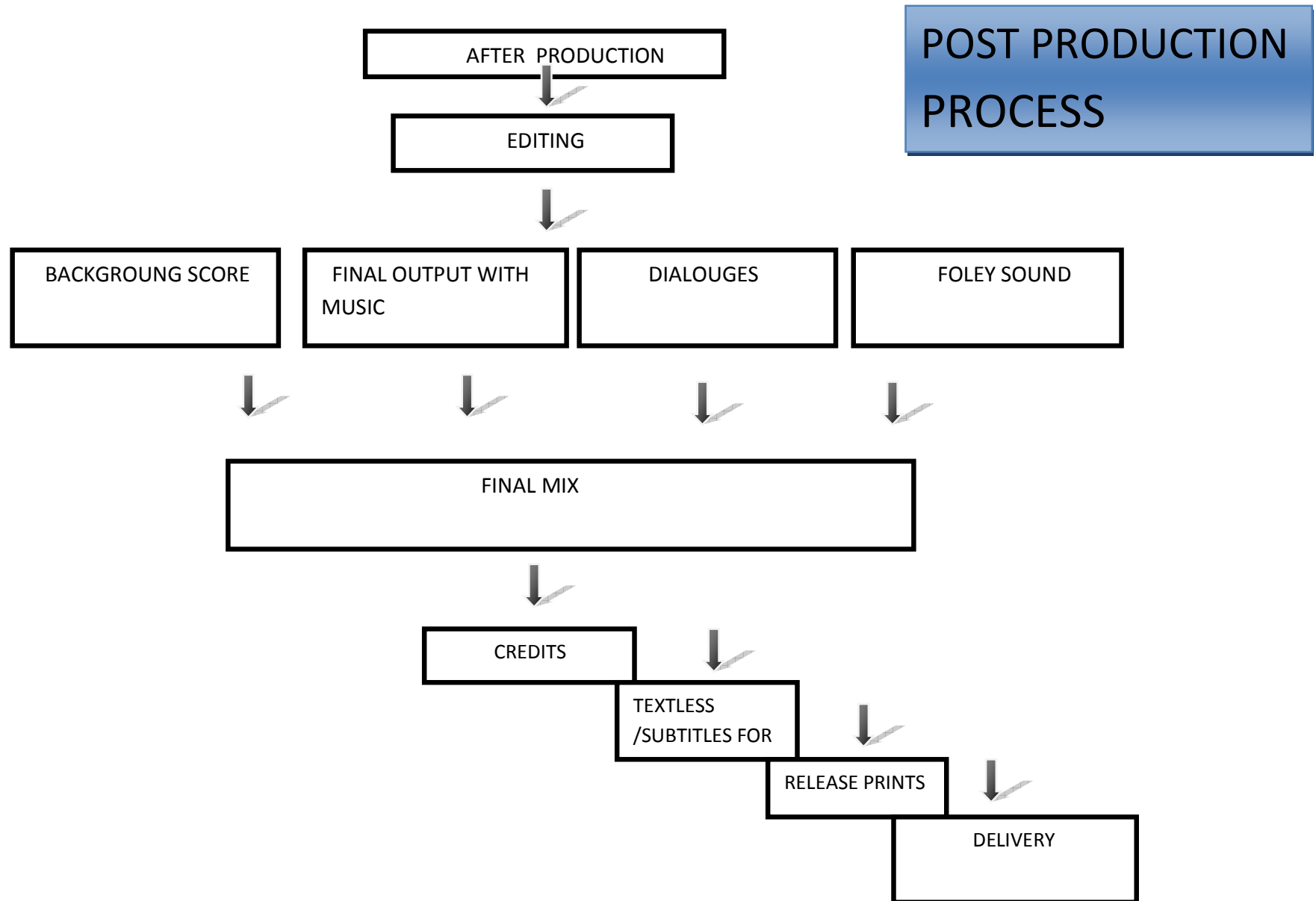DELIVERY

# THE POST PRODUCTION:-

### Final Animation output

Post-production is the third and final step in film making, and it refers to the tasks that must be completed or executed after the production ends. Reaching the post –production stage is a huge milestone for the producer. At this point in the process, the picture is basically locked, and what remains to be assembled are the final visual and audio elements needed to create and deliver the finished product. The projects' schedule, final delivery format (film and video) , and its audio requirements determine the post production steps ahead.

## M) EDITING:-

Editing is done after all the composition is done shot by shot and the film is ready. In this stage the editor edits the movie adding fade in, fade outs and dissolves etc putting in the timeline. This is the most important stage of film making as it joins all the parts together stitching the movie scene by scene. Big production houses have their own editing software's or the general editing software's like Final cut pro ,Avid and Adobe Premiere etc.

## N) AUDIO POSTING:

In the sound session, every scene is evaluated from the point of view of how audio can best be used to enhance and help tell the story. During this session the director and producer determine specifically where music and sound should be placed. During the production of the movie, the picture editor builds "temp" audio tracks that contain the original dialogue tracks, temp music score, and temp stock effects. While the sound spotting sessions is in progress, the current temp track is used as a template.

Music plays a central role in animated projects. It creates mood, atmosphere, pacing and momentum. By hearing the score, the viewer should be able to define the show in terms of its genre (thriller, musical, comedy, etc). On features, the composer's primary goal is to capture the essence of the film and create an original score. After the score has been recorded, the music editor typically oversees the mix and edits the score to picture. Sound effects can range from

animal calls to spaceship zooming by.  They help to convey emotions, sense of drama, and comedy. The background sound or atmospheres (or ambience tracks) ongoing sounds are edited to picture. Using the cue sheet as a guideline, the sound effects editor selects sounds and syncs them to picture.

# O)  COLOUR CORRECTION:-

The adjustment of color on film or video in terms of its contrast, hue, tint, brightness, saturation and density is referred to as color correction. Whenever the source material is film, many factors can play into making the color inconsistent .These include the film's temperature, age, exposure, and stock. In order to have color balance in a scene and between scenes, color correction therefore becomes a necessity. Projects that are delivered on video go through telecine for the purpose of color correction. Based on the project's color complexity, key scenes are selected and modified to match the intended color. Saving these scenes for reference, the colorist adjusts each scene one at a time. Throughout this process, the director or the specific team is present for giving inputs.

# P)  CREDIT LIST:-

The credit lists all talent and production staff who has worked on a project. A list of names, tittles, and facilities used is compiled and kept up to date throughout the course of production by the associate producer or production manager.

# Q) TEXT LESS VERSION :-

Textless versions are necessary for foreign distribution, as each country /territory has very specific distribution regulation and specifications. Additional scene may also need to be provided. If subtitles have been used in a scene, a textless version will need to be made so that non- English – speaking countries can burn in their own translation of the description .In addition , certain countries may require a text less version of scene that include any signs integral to the story, such as "Happiness."

## R) FINAL DELIVERY

All projects undergo this procedure so that it can be determined whether all audio, video or film materials meet the delivery requirement. Typically, the producer or director is responsible for overseeing this process.

## S) RELEASE PRINTS:-

The release print is a 35 mm positive print of the picture that includes the credits and the final sound track. This version of the picture has been color- corrected, has undergone final quality control, and ready for distribution.

## T) RELEASE:-

At this stage, the project is finally ready to be aired, mass – produces on videotape, or released in theaters. In addition to the final product itself (that is, the composite answer print or 35mm release print 0 and the Digi Betacam tape (D-1tape), a number of other items should be delivered. Depending on the format, these include the final script; the negative, interpositive , duplicate negative and low –contrast print; the text less background; the work print the magnetic master composite mix: the music and effects track; music cue sheets; song lyrics; and the composer's score.

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2. Ratatouille .................................(16)
3. Toy story.................................(16)
4. Finding Nemo.........................(33,39,40)
5. For the birds...........................(33,39,40)
6. Boudin................................(31,32,33)
7. Bolt........................................(22,35,36)
8. Monster's Inc.........................(27,37,39)
9. Enchanted.............................(33,35)