From idea to creation, the work methods in TV-commercial production

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Contents

1 Abstract ................................................................. 3
2 List of abbreviations and definitions ................................ 3
3 Introduction ............................................................. 4
  3.1 Postproduction ....................................................... 4
  3.2 Stockholm Post Production ....................................... 4
  3.3 Aim of the study .................................................... 4
  3.4 Delimitations ........................................................ 4
4 Materials ................................................................. 5
  4.1 Softimage ............................................................. 5
  4.2 Nuke ................................................................. 5-6
  4.3 Photoshop .......................................................... 6
5 Methods ................................................................. 6
  5.1 Assignments ........................................................ 6-7
  5.2 Formats and file structure ........................................ 7-8
  5.3 Linear Workflow .................................................. 8
  5.4 Keying ............................................................... 8-9
  5.5 Rotoscoping ......................................................... 9
  5.6 Tracking ............................................................ 9
  5.6.1 Stabilizing Plate ............................................... 9
  5.7 Wire removal ....................................................... 9-11
  5.8 Modeling/Texturing ............................................... 11-13
  5.9 Image based lighting ............................................. 13
  5.9.1 VFX work on set ............................................. 13-14
6 Implementation ....................................................... 14
  6.1 Preproduction ...................................................... 14
  6.2 Choice of method ................................................ 14-15
  6.3 Projects and clients .............................................. 15
  6.4 Project deadlines ................................................ 15
7 Results ................................................................. 15
  7.1 The method used depends on shot, budget and deadline ... 15
  7.2 Concepts and tests are vital steps in preproduction ....... 15
  7.3 VFX supervisors task on set - aid director in visual aims... 16
8 Discussion ............................................................. 16
9 Acknowledgments .................................................... 17
10 References .......................................................... 18-19
1 Abstract
The objective of this bachelors thesis was to study the preproduction phase and the different methods used in TV commercial production to reflect upon why a certain method is chosen as is most appropriate.

Several projects at Stopp were used as a base for this report, however some details on projects has been excluded due to legal reasons.

In this study it was found that the methods chosen for a commercial production depends on factors such as the shot, the clients budget and the amount of time given to complete a project.

Keywords: Post Production, TV commercial production, VFX, Nuke, Softimage

2 List of Abbreviations and Definitions

VFX - Visual Effects
IBL - Image based lighting
FPS – Frames per second
HDRI – High dynamic range imaging
DPX – Digital Picture Exchange
OpenEXR – High dynamic range image format
8 Bit – image containing 8 bits of color info per channel
Plates – Footage from a camera that is transferred into a computer becomes a digital subset of elements
CG – Computer Graphics
Edgflow – A modeling technique for avoiding artifacts
Polycount – A way to measure an objects geometry

Softimage – A 3d graphics application
Maya – A 3d graphics application
Nuke – Node based Compositing application
AF – After effects, compositing application
Photoshop – Picture editing software
Shader – A node applied to an object to give it texture
Workflow – in what order the work should be carried out
Clean plate – Differs from the original plate in the way that it does not include the objects
3 Introduction

3.1 Postproduction
Postproduction is a general term for the work that is done once the principal photography/shooting has been completed. (Brinkmann, 2008) Motion pictures, videos, digital art or advertising typically always goes through some type of postproduction. Postproduction processes can include;
- Editing the picture or program
- Editing/creating the sound/soundtrack
- Adding VFX, CGI or other digital graphics.
- Transfer film to digital data

3.2 Stockholm Post Production, Stopp
Stockholm Post Production is Sweden's only end-end postproduction company, and specializes mostly in TV-commercial productions. Stopp is a full-service creative facility offering services within the areas of digital postproduction and interactive media. Including everything from concepts, 3d & visual effects, sound and grading to set supervision during shoots. Stopp's facilities also include Sweden's only film lab, attracting clients from all over the world. (Stopp, URL 1)

3.3 Aim of the study
The aim of this study is to treat different methods used in TV-commercial production. The aims are in detail:
- To study the methods used for different productions in order to see why they are chosen and most appropriate.
- To treat who decides the methods used.
- To study the pipeline – from preproduction to creation
- To study the VFX supervisors/teams responsibilities and function during a shoot

3.4 Delimitations
- Typically, Stopp, which is a full-house post production company, utilizes all the processes in postproduction (see 3.2), however, this bachelors thesis will be delimited to the VFX/CGI area of the production in advertising.
- Only methods used in the assignments will be treated.
- The pipeline will be described briefly and mentioned where necessary, but will not be a vital part of this report since the focus lies on production methods.
- The cg work and storyboard concerning Com Hem, ICA or Exponerad will not be mentioned in detail, since these productions at this date has not yet reached the public. However the Com Hem shoot attended will be the basis for treating the VFX-team's responsibilities and function on set during a typical shoot. Similarly, only the methods used for compositing the ICA Shots will be treated, not any details on cg work nor storyboards. For the project Exponerad, only the models will be used to emphasize the modeling and texture process, no storyboards or further production plans will be mentioned.
4 Materials

4.1 Softimage
Softimage is a 3d graphics application by Autodesk. It is used for modeling and animation, mostly within the film-, video game- and advertising industry. This software is Stopp's main tool for all cg work. The software is one among many similar programs, such as Maya, and 3ds Max. Maya is currently the industry and education Standard, Although Softimage is closing in (Softimage, URL 2).

![Softimage Interface](Figure 1, see ref.)

4.2 Nuke
Nuke is a node-based compositing program by The foundry. It is widely used in motionpicture and television post-production. Many recognized companies such as Weta Digital, Framestore, and Industrial Light & Magic use Nuke, hence the application has been the tool for creating productions such as Avatar, The Curious Case of Benjamin Button and King Kong.(Nuke, URL 3)

![Nuke Interface](Figure 2, see ref.)

Nuke and Flame - another compositing application, are the main compositing tools at Stopp. Most
VFX artists at the company can master both programs, since a project often can be sent between the programs depending on what is to be done to the shot. Even though the programs are equally strong, certain tasks need less node-work in one or the other, and by observation most projects have a very short deadline. This tool will be the main focus in this report, since the assignments given were mostly in the area of compositing.

4.3 Photoshop
Photoshop is widely used for both 3d and 2d artists and is a given image-editing tool in most post-production companies. In 3d, Photoshop is especially useful for creating textures, texture maps or mattepaints (Photoshop, URL 4). Stopp's 3d artists mostly uses Photoshop for these purposes.

5 Methods

5.1 Assignments
Throughout ten weeks at Stopp I have had the privilege to work on several TV-commercial productions.

Expert – The client wanted different technology items, a mobile, a coffee machine, a TV etc, created in 3d and animated onto a background portraying a flowery meadow. The items were to look like they were happy cattle on pasture. My part in this project was to model, texture and animate the TV.

ATG - Stopp got several shots of horses running down the beach. During the shoot these horses had been led in the right direction by markers and sticks in the sand, and ropes attached to their halters for the on set crew to steer them with. These markers and ropes had to be removed in post, an assignment that is not unusual. Most post production work requires some form of object removal. Four of these shots were assigned to me, and all of them required different approaches and methods.

Exponerad – (in production) This is an in house production directed by one of Stopp's own employees. For this production a camera, a camera lens and a tripod was needed. My assignment was to model and texture the lens and the tripod.
Com Hem – (in production) I attended as part of the VFX supervising team on set for the shoot.

ICA – (in production) I was assigned two shots in this production, requiring keying and stabilizing plates among many other things.

5.2 Formats and file structure
The image format DPX is also referred to as “Digital Moving Picture Exchange Bitmap”. This format is one of the most common formats used in the digital media- and visual effects industry, mostly because there is no loss of information or picture quality when transferring the images by a scanner into a digital medium (A.Okun, et al, 2010). This format is hence one of the most used formats at Stopp, along with OpenEXR, an observation made during the time spent there. OpenEXR, is similarly, a High Dynamic Range Image Format, which can store higher color information than the common 8-bit or 10 bit image formats. The ability to store higher color values is a great advantage in the visual effects industry, especially in compositing and other post production processes, where as much digital information as possible is required for changing these values to a preferred result (OpenEXR, URL 5). Through the projects mentioned in (5.1) the formats used though, are no higher that 8- or 10bit DPX, this because the clients were aiming towards airing these commercials only on TV, were a less quality is needed than in a theater. This simply because more value information is required for a good result when presenting media on a larger screen or monitor. Another format used through these projects is TGA, a commonly used format, although it does not store as much information as the DPX or OpenEXR formats (.tga, URL 6).

An example of how the DPX format stores and calculates color values becomes evident when comparing these two images where the same process has been applied- only, one has been processed in a 8bit sequence, and the other in a 32bit sequence (understanding color processing, URL 7).

8bit sequence processing;

(Figure 4. see ref.)

32bit sequence processing

(Figure 5. see ref.)
A higher bit-depth clearly shows that more color values are stored rather than in a lower bit-depth. Still, as mentioned earlier, for these projects (5.1), a higher color depth than 8- or 10bit is not needed.

To have an organized structure and naming files accordingly is everything when working at such a big company. This because every department shares the same files and folders over the local network. There are folders for every department, and for every step in the post production process, but sometimes a group of people are working on the same project, and using files in the same folder, which makes naming files correctly essential. The file structure used for most the Softimage projects at Stopp is very straight forward. There are separate folders for each part of the cg work. Folders for textures, modeling files, and references etc, and every file often consists of several versions. In order to know what project it is, and who's been working on it, the naming of the files have to be very specific. First the clients name, which shot it is, the artists initials, and what version of the file. A typical Nuke composition naming example, from the ATG project; Akestam_sh16_ce_v01.nk

5.3 Linear Workflow
A linear workflow is essential for any big postproduction company, and so also at Stopp. To work in linearly means to work with the correct values of gamma. It is a fact that all stored images have built in gammas of 2.2, to be seen correctly on a monitor such as a TV or computer. This however means that if these images are transferred without modifications to a RGB image in any compositing application, they will appear over-exposured (Brinkmann, 2008). This can be prevented by always telling the program you are using what type of image it is.

For every texture and image used in the Softimage project Expert, telling the program whether it be a linear on nonlinear image, was essential.

5.4 Keying
Keying is a process were an object is extracted from its background to be composited together with another background. A keyer works in the way that a matte is created where white is solid and black becomes transparent. (Brinkmann, 2008) Keying was used in one of the ICA shots for this purpose – an object had to be extracted from its background and placed onto another. There are a lot of keying methods, such as;
- Luma keying – one of the most simple keying processes, where a key is generated by luminance.
- Difference keying – uses two pieces of footage, and produces the difference between them
- Chroma keying – a color from one of the images is removed revealing the other image (Shultz, 2006).

The method chosen for the ICA shot was a chroma keyer, since the green color in the background could be chosen and tweaked so that almost no green spill was left in the sequence. The few imperfections left after the key, were simply removed using garbage mattes. Which method to choose for keying depends on the artist, keying difficult shots requires great knowledge in the different keying tools. Thankfully there are powerful plugins for Nuke, such as Keylight, to help with the keying process for more difficult shots. (Keylight, URL 8)
5.5 Rotoscoping
Creating mattes on a frame by frame basis by hand (Brinkmann, 2008).
Rotoscoping can be a tedious process just because it often needs frame by frame alteration.
Rotoscoping was used in the ATG projects, where rotos were needed to extract mattes from the
image. (see shot 1 in 5.7) Rotos were also required in the ICA green screen shot,

5.6 Tracking
Tracking is a vital part of match moving. By following certain points movements you get the
motion patterns. The points, or features, are selected because they are noticeable spots easily
followed (bright/dark) by the tracker. Edges or corners are often chosen as points to track for this
reason. (Brinkmann, 2008) Tracking was used for most projects mentioned in 5.1. Tracking is a
powerful tool that can be used for several purposes. In the ICA project, tracking was used to
stabilize a plate (see 5.5.1) and in the ATG project tracking was used for copying its movement to
the rotopaint patches (see 5.7).

5.6.1 Plate Stabilization
Stabilization is the process of removing or easing the bounce or jitter caused by the camera from a
clip. (Brinkmann, 2008) This process was needed in one of the shots from ICA, where the image
bounced dramatically, which had to be removed. Nuke was used to track the sequence, and then
with the tracker set to Stabilize, a scale transform node was used to scale up the image slightly. The
image then centers around the tracker which gives the illusion that the sequence has no bounce or
jitter. This is only one of many methods, but a fast and easy way, sufficient enough for this shot.

5.7 Wire removal
Wire removal is a visual effects technique for removing wires or ropes from a shot that has been
used for stunts, rigs or guidelines etc. This is a typical process and not an uncommon task for
postproduction companies since most motion pictures or shots need some form of object removal
(Brinkmann, 2008). There are several methods for removing wires and unwanted objects in a shot,
and sometimes several methods are combined for a desired result. Some methods are;
– The wire can simply be painted away frame by frame, especially if the shot consists of few frames, otherwise it might be a risky and tedious process, as well as potentially causing the painted areas to seem as though they are flickering.

– A clean frame from earlier in the shot can be masked and used as a patch over the wire, this however works best on static moving cameras.

– A rotopainted clean patch by cloning from areas around the wire can be used to hide it, as well as follow the motion of the wire using trackers. This however only works if the areas used for cloning doesn't change appearance, causing the patch to change as well.

– Furnace - furnace is a plugin for Nuke, and consists of pre-built nodes designed especially for wire removal. (Wireremoval, URL 9)

Some of these wire removal methods were used in the ATG project at Stopp. The entire project consisted of about 20 shots, three of which will be discussed here. The supervisor came with suggestions on how to solve these shots, and inputs where needed. However the final method chosen is up to you - what method is found most comfortable, gives the best result and takes the shortest amount of time. The final approval then comes from the VFX supervisor, and the client. The deadline for each of these shots were limited to a day.

Shot 1. A halter needed to be removed from a 113 frames clip where the horse's head isn't static, and the areas around the wire constantly changes color. This issue ruled out the paint frame by frame method, since it would require an extensive amount of accuracy to get the changes in light correctly. Instead a combination of clean frame patches and tracked roto clone patches were used. The rotos also needed much frame by frame work, but proved giving the best result.

(Figure 7&8. see ref.)

Shot 2. Halters from two horses needed to be removed from a 54 frames clip where the horses' heads move dramatically. This clip required another approach, because of the heads movements no patch method would get desired result. Since the clip is a little over 2 seconds, which is short for a shot, the method chosen was to paint frame by frame. This because possible flickering is not easily noticeable by the eye in such a short clip with so much movement. For the last few frames a tracked rotopaint could be used, shorting down the amount of frames that needed frame by frame painting.
Shot 3. In this shot markers and sticks that had been used to guide the horses in the right direction needed removal. Since these objects were in the static background, and not on a moving object, a patch was the given method. A clean painted frame was masked and used as a patch using a frameHold node, which freezes a certain frame from the image sequence, and then tracked to follow the movement of the camera.

5.8 Modeling/Texturing
Modeling and texturing is fundamental processes in computer graphics. Modeling is the process of creating a representation of an object in a 3d computer environment, and texturing is a method that makes it possible for a 3d object to be represented in 2d. This 2d representation, or referred to as UV, is needed when you have to map a certain texture to certain parts of your 3d object (Rydberg, 2009).

For the project Exponerad, several objects needed to be modeled and textured for an in-house production – a camera, the camera lens and a tripod. This set of objects were actual objects at Stopp, that needed to be created in Softimage as realistically close to the originals as possible. The object in focus here will though only be the tripod. The first step in the modeling and texture process is to take reference photos, preferably at least a top-side- and front view for modeling. These references are then used as blueprints in Softimage to get the exact scale and proportions of the tripod. Closer reference photos on details are needed if creating realistic textures. However in this stage of production, only shaders were assigned to the object, textures will be added later on top to give it a further realistic result. For the shaders to be presented as accurate as possible several lighting techniques were tested, to see how the shaders reacted when exposed to different lights. Preferably for creating realistic objects, and especially objects with reflecting materials, it is common to use image based lighting (see 5.9), which means that you through an HDR image of an environment use it to emit light and reflections onto the objects in the scene (Brinkmann, 2008).
Modeling and texturing this type of object is very straightforward, even though there are things that need to be considered. Since the tripod consists of many different forms of geometry, the edgeflow becomes important, in order to avoid artifacts. Also the polycount needs to be kept as low as possible, although for this production not a requirement, but in general it is good to keep the polycount as low as possible to avoid heavy geometry, which can cause problems later in the workflow. Furthermore a lot of tweaking has to be made to the materials in order for them to look as realistic as possible. Thankfully, there are lists available on the web that describes color and reflection values etc for many materials. These can be very helpful when creating materials in 3d applications such as Softimage.

Another project that involved another kind of modeling and texture technique was Expert, where a TV created in 3d was to look like it was happily out on pasture on a flowery meadow. It was to be modeled and animated onto a background delivered by the client. The client sent a picture portraying the front of the TV, and this image was then used as the reference in Softimage during modeling. Since this image had to be mapped onto the finished model, the object was UV mapped and textured with this image.

This project was different in the way that not many references were given for the modeling process. In order to get as close to the real TV as possible, a lot of own research had to be made, and reference pictures acquired, to get a realistic model. The TV was not supposed to be shown from a
different angle other than front though, so a very detailed model was not needed.

5.9 Image based lighting
Image based lighting is a technique used for lighting objects in a 3d environment. An image, (preferably HDR's) are mapped onto a sphere. The computer then calculates the light emitted from the image, and the object's materials inherits reflections directly from the surrounding, creating a very realistic result (Image based lighting, URL 10). This method was used in the project Exponerad, where realistic lighting and reflections were required. (see 5.8)

(Figure 16. see ref.)

A less modern method of creating a HDRI photos, (though still in use), is to place a chrome ball in the planned surrounding and take pictures of the ball from all angles, getting a 360 degree representation of the surrounding. These images can be merged to a HDRI picture in a program such as HDRshop (HDRShop, URL 11) and Photoshop for further editing. There is however a more modern way of creating a nd capturing HDRIs - by using only a camera, that takes pictures from around its center in 360 degrees. By experience at least four, (but preferably eight) different angles are required to get a decent final HDR result. This method for capturing HDRI was used during the Com Hem shoot, (see 5.9.1).

5.9.1 VFX work on set
The Com Hem commercial (currently in production) involves a lot of CG and post production work, which required that a VFX team from Stopp supervised the set during the shoot. Based on observations made from this shoot, consisting of one shot which took half a day, these conclusions are made of what a VFX supervisors task is, and his function, on set. The supervisor, is responsible for guiding the director and producer on set, solving and achieving their visual creative aims for the production. The VFX supervisor is to make sure all material needed for postproduction is gathered. This includes clean plates, which means that another plate (apart from the original) without the subject is shot. This is needed for post, if for example the subject has to be separated from the plate in any way when cg is added. Another task is to gather light references, taking the camera measurements needed, or angles. When adding cg to an environment the exact light from that location is needed for a realistic lighting in a 3d application, which is why a VFX supervisor also makes sure that HDRI photos are taken in 360 degrees around the location. These pictures are later merged together and mapped onto a sphere in a 3d application and used for lighting the cg objects. (see Image based lighting, 5.9) For these tasks mentioned, the objects needed for a shoot is most commonly a camera, a tripod and a computer. The computer is useful when reviewing shots or photos from set to see whether the solutions for post will work, as well as to store the gathered information on.

There are a few guidelines for both VFX team and others on set which needs to be followed during
a shoot, and these became evident especially during this particular shoot;

– To be professional, you are working closely to a team of directors and producers who depend on you to achieve their visions of the production.

– To work quickly and efficiently, so that you are not holding up the production. On the Com Hem set, the information needed was gathered after the shots with the actor, apart from the plates where a stand in was needed as well. That way no valuable time is taken from the film crew, who needs to relocate to other sets for new shots.

– To be quiet when camera is rolling, this shoot had a very tight time-schedule and therefore any unnecessary interruptions can hold up the production.

– To prepare and gather any data possible ahead of time. To calibrate the camera before taking the HDRI images is a must, and would be unnecessary to do while on set. As well as looking at the shooting location and figure out if there is anything to prepare beforehand.

– To always keep an eye on the shoot. Producers or directors sometimes try to shoot a visual effects shot without a VFX supervisor, without the expertise of whom, the postproduction will most likely be a harder process (A. Okun, et al, 2010).

6 Implementation

6.1 Preproduction

Through observations during the bachelors thesis, it has become evident that a lot of work is required also before the actual production, this may be important to know in order to get an understanding of the whole production, as well as why certain methods are used. Not only the described processes such as set supervision (see 5.9.1) are important, but also tests and concepts of the ideas – these decide what method fits best for each production. The preproduction of course varies from project to project, depending on what is to be done to the shot.

The preproduction stages of a production can be;

– the client gets in touch with the postproduction company with an idea or work
– the idea, work and methods for solutions are discussed with the client
– the client (most often) record the material to be used, either alone, or with the help of a VFX supervisor, and give it to the postproduction company.

The ATG projects were already recorded shots sent to Stopp mostly for wire removal. It is not unusual for Stopp to get this kind of work, since most productions need some form of object removal. The Expert project involved preproduction as well, since the best solution for the 3d models and the entire vision of the commercial had to be discussed between the artists and the clients.

6.2 Choice of method

In every production a different method was used. For the ATG projects the supervisor suggested different methods for the shots given, however, it was the artist who finally decided to take the advice, or go with another method that felt more comfortable to work with. Since the deadlines were short, the main goal was simply to make the shots look perfect in the shortest amount of time. For longer productions, such as Exponerad, different methods could be tested and compared before choosing the final approach. Sometimes, like in the Expert project, the client asks for work that only have a solution, which makes the process very straight forward. Another point, is that for productions such as Exponerad, where the purpose was to achieve a realistic object, the most logical
way to approach the lighting, was to use image based lighting, which calculates and reflects light better than artificial lights in Softimage. Methods such as keying was used in the ICA shots, because objects needed to be extracted from the green screen and merged onto another background. Using tracking, different goals could be achieved for different shots. The ICA shots needed tracking in order to create a stabilized plate (see 5.6.1), and the ATG shots needed tracking for copying the motion to the rotopaint patches.

6.3 Projects and clients
In all of the projects mentioned, the client was always communicating with the artists and the VFX supervisor for alterations, improvements, or new ideas. Similarly, in every change to the project, the client needed to be notified and the changes approved before continued production. In the ATG projects for example, the clean plated shots needed to be approved by the client before the next step in the postproduction process could take over. (A typical next step can be to add text or sound, which Stopp also performs). In the end, it is also the client that gives the final approval of a shot. After all, it is their visions postproduction companies are trying to achieve.

6.4 Project deadlines
The deadlines of the projects varied extensively from project to project. The ATG shots were preferred to be completed in a day or two, depending on the difficulty of the shot. The shots composited for ICA took two days, basically because the client suggested many alterations during the production, which held up the final delivery of these shots. Had a preferred deadline been set for these two shots, it would have been half a day for each. This because this projects overall time deadline was tight, and needed to be finished as soon as possible – This concerned the Expert project as well, where the whole production deadline was set to under a week, which meant that the TV needed to be modeled, textured and animated in a maximum of two days. The Exponerad project didn't have an exact deadline, since this is a personal production, and is though to be completed between other productions. Typical for long productions, is that much more details are created, maybe more than necessary, simply because the time permits it.

7 Results

7.1 The method used depends on shot, budget and deadline
The conclusion drawn from the bachelors thesis projects, is that the choice of method for a production depends foremost on what type of shot it is, and how the client wants it to be altered. It also depends on any tests or concepts made and discussed in the early stages of production. Some productions require very straight forward methods, such as keying or tracking, while other productions need a combination of methods and several tests to reach the desired visual aim for the production. In commercial production, other factors that must be taken into account are budgets and deadlines. The postproduction company is working closely to a client with a limited budget and often a tight deadline. These factors also affect the end result. With a limited budget and deadline, a less good method might be used to solve certain shots in time. What method is to be used can also be decided from the supervisor, if a certain method is needed for the solution.

7.2 Concepts and tests are vital steps in preproduction
Since decision of method is so important for the rest of the production pipeline, the preproduction stages become even more so important. Ideas, concepts and tests stand for the basis of method decision. Many projects are already planned and recorded when sent to a postproduction company, but when dealing with a production from the very start, methods best fitted for that production has to be decided.
7.3 VFX supervisors task on set - aid director in visual aims
The way a VFX supervisor functions on set is that he is responsible for guiding the director and producer on set, solving and achieving their visual creative aims for the production. The work includes gathering all materials needed for postproduction, such as clean plates, light references, camera measurements, angles, and HDRI photos. The supervisor is responsible for making sure the material needed on set is brought. Some materials needed for a shoot are a camera, tripod and a computer. The computer will come in handy when storing the shots or reviewing them, discussing solutions to visual effects. It is important for the production company to ensure clients that a supervisor in needed on set because of his expertise, otherwise shots may contain unnecessary amount of work for the postproduction team, or in worst case, might not be usable at all.

8 Discussion
Working in TV commercial production means that you have to have an understanding of many areas, especially when constantly working with new projects requiring different work methods. To have a general knowledge, be flexible, and finding solutions to problems is a must in this business, when constantly working towards clients and deadlines. It is also important to be as efficient and quick as possible, especially when working with clients that comes with new ideas and changes in the middle of a production, where the deadline remains the same. Furthermore it is important that the client understands the postproduction process as well as what is required from them. If the client shoots the material incorrectly without a VFX supervisor, the material can end up unusable, or at least give poor end results.

Working with these projects has been rather problem-free, although probably because Stopp is such an established postproduction company who are familiar to possible setbacks, new work methods and close relationships to clients. Working with such experienced people is a privilege, and perfect for snapping up new workflows and better methods for difficult shots.

These projects have given a better idea of how to think when deciding on methods to use for productions. An important knowledge is to always discuss the shots thoroughly, and preferably always test methods before choosing on a final approach for the best result.

It has become obvious that having a greater understanding of workflows and the production stages at Stopp, everything from concepts, shoots, cg work and later stages, gives a better understanding for postproduction in whole. Not the least what your obligations are to the rest of the production pipeline as a VFX or CG artist.
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Figures;

Figure1 - from work at Stopp, Exponerad

Figure2-(URL [http://www.techgearx.com/wp-content/plugins/wp-o-matic/cache/21b86_nuke-avatar.jpg] 2011-05-20)

Figure 3 – from work at Stopp, ATG

Figure4&5- (URL[http://blogs.adobe.com/VideoRoad/2010/06/understanding_color_processing.html]. 2011-05-22)

Figure6-(URL[http://2.bp.blogspot.com/_m2_pU_Ji3aA/S886qCq8hNI/AAAAAAAADo/qtPugF-ijWA/s1600/300_comparison.jpg]) 2011-05-20)
Figure 7-12 – from work at Stopp, ATG

Figure 13&14 – from work at Stopp, Exponerad

Figure 15 – from work at Stopp, Expert

Figure 16 - (URL [http://www.creativecrash.com/shake/marketplace/training-videos/c/ibl-image-based-lighting-introduction]) 2011-05-21)