ToonzPaperlessWorkflow

for ToonzHarlequin
& ToonzBravo!
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Introduction

Before Starting
The paperless animation process based on Toonz allows to produce the same quality as the traditional 2D process, while significantly cutting the costs. Such capability makes possible to produce series with a greatly simplified overall workflow.

This simplification results in the ability to keep all the production steps totally in house, an approach that would not be possible for a project of the same size and assigned to the same staff, done in traditional animation. As a consequence it is possible to have a much tighter control on the final product, both time-wise and budget-wise.

This guide contains the following sections:

• General analysis of the paperless animation production workflow.
• Tutorial about paperless animation.
• Case study where a specific paperless project is detailed through images and figures regarding the production.
Paperless Animation

Paperless Workflow
The following is an example of how a paperless animation production workflow can be managed by Toonz.

The steps described above are part of a standard implementation of the workflow, that should be refined based on the production characteristics and the way it is implemented in the studio.

For example, the library elements may be created with a different timing, and not necessarily before starting to work on the first episode; or traditional animation, with drawings on paper to be scanned and
painted, may be a solution for particular animations where the paperless puppet animation may prove not to be versatile enough.

**Preproduction: Concept**
Since the very beginning, when the original idea is being developed, it is useful to keep in mind the main characteristics of a paperless production.

Even if a paperless project can be run regardless of the script, the concept of a format with few settings and a fixed cast of characters will ease the arrangement of libraries to be prepared before the actual episode production.

**Preproduction: Graphic Design**
The graphic design of characters, props and location backgrounds is equally important, in order to find out a style that can fit well both with the puppet animation technique and with the software drawing features.

When designing characters you could opt to use very neat lines typical of Flash animations, that are easy to get when drawing with vectors; or you could develop a specific line style to apply to vectors, starting from those provided with the software; or you could take advantage of Toonz special FX to create more complex results, such as custom pattern and animated textures.

In particular for the main characters, you could consider a design where the skeleton structure is not easily detectable and it is hard to distinguish the puppet sections. A solution could be to disguise the pivot points under drawings features in order to hide the joint between two sections, for example the pivot point of a ponytail linked to the character’s head can be disguised under a ribbon. In this way the final look of the characters could be closer to that of traditional animation, even if the cutout technique is used to animate them.

The same comments can be done for props, the especially for those props that will interact somehow with the characters and for those that will have some animation.

As concerning backgrounds, the design of course may differ from that of the main characters, using any kind of technique, from watercolor to 3D rendered images.

**Preproduction: Storyboard**
For any type of animation we may consider, the storyboard usually is the tool used to plan the flow of the plot and the composition of the shots,
with additional information about dialogue, music, camera and other objects movements.

But in case of a paperless production it has an additional function: it is necessary to identify all the elements needed for the production of each scenes.

By examining the storyboard it is possible to list all the characters animations and poses, props and location backgrounds that are needed to implement the story. In this way the storyboard fully supports the production planning, sharing work assignments and planning the reuse of library elements.

Storyboard drawings can be done on paper or directly on the computer by using a graphic tablet. Drawings may also be assembles with the related information about shot description, dialogue, music and camera movements by using a third-party software.

Storyboard drawings are also the starting point to create the videoboard, and consequently are the basis of the layout step.

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Videoboard

The videoboard, or animatic, is basically a storyboard in action with soundtrack that can be created with Toonz or a third-party software.

Storyboard drawings are scanned and assembled, and they are repeated along the timeline to adjust the timing of the action and the different
cuts; if a soundtrack already exists, it can be imported to check synchronization.

Camera movements can be added, and some storyboard drawings can be manipulated to simulate some basic character animations, such as displacements and rotations.

The final result is a full check of the animation rhythm, extended not only to single scenes, but to longer stretch of animation, for example a whole series episode.

In case the videoboard is created with Toonz, it can also be used as starting point for the final compositing of each scene. Each scene can actually be singled out from the videoboard and saved to be used later for the setup of the scene layouts.

**Libraries**

Libraries collect all the elements composing the production scenes, such as characters, reference animations, props and backgrounds. This database is the core of the production and its overall quality will be very significant for the success of the final product.

The list of all the elements to be stored in the libraries comes from the storyboard examination that will point out, scene by scene, all the characters animations and poses, props and backgrounds that are needed to implement the story.
Most of the library elements are prepared by drawing directly in Toonz. According to the character designers skill, drawings can be also sketched on paper, scanned and then traced in Toonz.

Characters, even if sketched in a single drawing, are traced by decomposing on separate levels all the puppet sections that have to be animated. For example the character’s head will be one level, the torso another one, the right arm another one, etc.

These components are then rejoined through hierarchical links in order to define the puppet skeleton, that is how characters will be available to the animators.

According to the storyboard analysis, the character may need only drawings for a standard view, for example a side view, or drawings for a full turn-around puppet. In the latter case a collection of models is built by drawing each puppet section as seen from different points of views: front, back, side and three-quarter views.

If to implement the story the puppet has to perform some specific movement that cannot be satisfied by the turn-around model, new drawings for the puppet sections involved in the movements will be done.

For elements that need several shapes, such as hands, eyes and mouth, the level referring to that puppet section will contain all the needed drawings, one in each frame.
As a result, each character will be defined by an xsheet containing a section of the puppet in each column, linked hierarchically to the other sections. Each section is an animation level done of all the drawings needed for any future animation: in this way when a specific drawing is needed, it can be easily retrieved by flipping through the frames of the related level.

When a puppet needs a different set of sections, for example to be dressed with different clothes, the original puppet and animations can be reused by replacing the required drawings, and saving the puppet with a different name.

In the same way for minor characters, for example a series of kids with different faces and clothes, it possible to generate several puppets by reusing the model of a similar character, and its animations.

Starting from this puppet, a test animation may be defined to check if the puppet structure is suitable for performing actions. This test animation may also be part of the library in order to be used as starting point for puppet animation to be defined in the scenes.

As the scene production goes on, the library may also be enriched by puppet animations created for a particular scene, for example a character’s jump, so that they can be available for re-use in case the same type of animation is required in other scenes as well.
Props and backgrounds can be drawn directly in Toonz as well, if the graphic design decided in preproduction fits the software drawing capabilities, or can be generated with third-party software, for example a 3D modelling software.

Props drawn in Toonz can be drawn, built and animated in the same way characters are, and can be stored in the library as drawings if made of single images, or as xsheets if composited with several animation levels.

Location backgrounds as well can be part of the production library. If a high rate of reuse is planned, they might be quite generic in order to be used in different contexts. For example they could be split in several layers, to be customized in different scene with the use of specific props. For example you can split a background for a scene that takes place inside a room by creating a layer for the interior, one for the landscape that can be seen across the window, and another one for the sky, so that any of this layer can be combined with some others to generate background images for other scenes.

**Layout**

The paperless layout step, which is considerably different from the layout in traditional animation process, consists in retrieving from the library all the elements that are necessary for that scene, and setting the key animation.
If the videoboard was created with Toonz, an excerpt concerning the current scene can be used as a starting point to create the scene layout, refining the animation timing and camera movements; otherwise storyboard drawings can be imported and used as reference.

Characters, animations, props and backgrounds needed for the scene are loaded from the libraries as sub-xsheets: in this way each element will be available as a whole by arranging the sub-xsheet column, or level by level by editing the sub-xsheet contents.

The layout artist puts in place all the scene elements, both in the xsheet and in the camera shot.

For the characters, he delete from the sub-xsheet all the columns and drawings that are not required for the animation, for example it eliminates all the elements of the front view if the front view is never visible in the scene. Then he creates the needed poses by operating on the puppet sections inside the sub-xsheet, and defines the key positions for this poses by operating on the cells of the sub-xsheet column. He also repeat key positions, by repeating the related cells, in order to control the timing of the animation according to the storyboard and videoboard information.

**Note:** For no reason the layout artist should modify or add new drawings, or modify the puppet skeleton, in order to preserve the character consistency. If some modifications are needed, he should ask the library operators to update the puppet stored in the library.

He sets the camera shots and movements as well, and if it required, he adds notes about scene joints, dialogues, effects that may be useful later on to animators and special FX operators.

From the production database point of view, at the end of the layout process, all the material needed for the scene is collected and the scene with all the needed files is ready.

**Animation**

During the animation step, the scene animated elements are edited to their final form.

The key animation defined in the layout is tuned up: while poses are preserved, some key positions may be discarded to be replaced by a series of keys in order to achieve subtler and smoother movements.

The new keys may concern the puppet movements, but also some slight deformations like stretching and squashing, that may help the animation to look more natural and fluid. The right speed for all the movements is
set as well, by controlling with the function editor the way the transformations are interpolated between defined keys.

When for some movements different drawings are needed for the puppet, for example when it is turning, they can be retrieved in the puppet sub-xsheet itself, as the puppet already has all the drawing instances for each of its section needed for this particular scene.

In the same way, animations that do not require movements, but only an editing of the sequence of drawings, for example when the character has to blink, or to speak, are done by picking the right drawings, for example the right eyes and mouth, from the puppet.

Usually no drawing is modified or added at this step as the material coming from the library, being based on the storyboard, already contains all the needed elements. In this way the animator can also have no drawing skill, as he only has to control the characters animation.

Note: For no reason the layout artist should modify or add new drawings, or modify the puppet skeleton, in order to preserve the character consistency. If some modifications are needed, he should ask the library operators to update the puppet stored in the library.

If an animation defined in a scene is needed in any other production scene to be creates, it can be saved in the library, from where it can be
loaded again and again. This integration enriches the library, that will be integrated with new assets as the production proceeds.

**Special FX**
When the animation is completed, special FX can be inserted in the scene. Toonz provides users with a wide and powerful set of special FX, sparing users a lot of work in visual effect post-production, as a lot of tasks can be achieved directly in the software.

A good compositing skill may be required, because the most impressive results can be achieved by combining separate images and special FX. Basic special FX, like blurs, glows or color corrections, can be directly applied to scene elements.

Other effects, like mattes or particles, may need animation elements, for example masks or particle image, that can be drawn directly in the scene, or prepared with third-party software and then imported in Toonz. For more complex visual effects, like reflections or casting shadows, some animation elements may be duplicated or modified.

**Render**
When the special FX compositing is completed, the scene is ready to be rendered. After this process all the animations, transformations and visual effects will be composed in the output you need, such as a
QuickTime movie, or a sequence of frames in the image format you prefer.

The camera resolution and the output settings can be verified, to check that all the render options are consistent with the production.

Then the scene can be rendered directly from Toonz, or in batch mode, that is to say it can be added to list of tasks to be executed in background while you are not attending, or you are performing other works on your computer.

Toonz Harlequin also allows you to render the scene added to the batch list by using a render farm, that divides the rendering jobs in chunks and distributes it to a series of computers connected on the network.
Tutorial

Before Starting
This tutorial guides you through the steps of a paperless production, starting from the creation of puppets, to the layout and the final compositing of a scene.

The tutorial material is stored in a folder named Paperless Tutorial. This folder contains different projects for the different steps of the workflow. The material can be used with both Toonz Harlequin and Toonz Bravo.

To use the material copy the Paperless Tutorial folder in the PROJECTROOT defined during the Toonz installation (for details see the Setup Guide).

Creating a Library

Drawing a Puppet
The drawings needed to create a character puppet usually are based on the character model sheet, that can be sketched either in Toonz or on paper.

The model sheet should be analyzed to understand which is the best way to split a character in sections in order to allow the puppet to perform all the actions needed for the animation. Animators that are going to use the characters’ puppets may be involved and give advice in this process.

Usually once the sections a character’s puppet is made of are defined, the same structure will be used for other characters as well, in order to simplify and uniform the creation of library elements.

The model sheet can be traced directly in Toonz. In case the model includes different points of views, such as front, back, side and three-quarter views, you can draw one view at the time in separate drawings. In case a full turn-around puppet is needed, of course only half turn-around has to be drawn, for example front to left side to back, as the puppet can easily be mirrored.

If while proceeding with the storyboard examination some sections need new drawings, for example the arm need a special animation, they can always be added later in the related animation level of the library puppet.
You can start tracing each section on a separate layer from the beginning, or you can trace all the sections on the same drawing, intersecting one another, and later on cutting and pasting the sections into separate layers.

Before starting to draw, set the 01 Library project in the Paperless Tutorial folder as your current project.

When your drawing session is completed, save your work by saving the scene file in the 01 Library\scenes folder: the drawing will be automatically saved.

If you want to check the final result of the drawing process you can load the scene Mozart drawing.tnz.

To draw the front view of the puppet:
1. Load and import the model sheet Mozart Model.jpg available in the Paperless Tutorial\Library\Models folder. To have an idea of how the character should look, see the Mozart Sketch.jpg available in the same folder.

   **Note:** The Mozart model contains details about the sections and joints the puppet has to be made. This work can also be done directly in Toonz by using some sketches as a reference.

2. Scale and move the model image so that the sketch of the front view is placed at the center of the work area.

3. Select an empty column in the xsheet and start tracing the drawing considering the following guidelines:
   • Set a similar thickness for the Brush and Geometric tools, so that lines done with the tools will have similar appearance.
   • Trace irregular shapes with the Brush tool.
   • Trace more regular shapes with the Geometric tool.

The exploded view of the Mozart puppet, showing all the sections it is made of. Some outlines are made with a transparent color (such as the upper part of the arms) so that the area can be filled while the outline is invisible.
• Especially in limb sections draw circles whose center is where joint points are supposed to be: they will help you to set the hook positions later on.

• Model the lines you drawn with the Pinch and the Control Point Editor tool.

• Connect as many open lines as possible with the Autoclose tool to define closed shape that will be easier to paint.

• Draw all the lines needed so that puppet sections can be separated on different layers, and once separated they are still made of closed shapes that can be painted.

To draw the other views of the puppet:

1. Create some guides in the work area as reference to align the different views of the turn-around, so that the vertical axes of the body will remain the same.

2. Move the model sheet so that the sketch of another view is placed at the center of the work area.

3. Select the following cell of the column where you drawn the previous view, and trace the drawing. In this way you will have a level containing all the view of the character.

To split a view in several levels:

1. Select the lines you want to use as a new drawing, for instance the ones defining the character’s hand, and cut them.

2. Select a cell in the xsheet.

3. Paste the cut selection: automatically a new drawing will be created containing only the cut selection.

4. To better manage the puppet during the animation, consider the following guidelines:

• Create one animation level for each section, containing all the views of that section. For example use a level named arm that contains as frames all the drawings for the different view of the right arm. In this way it will
• If different mouth drawings are required, create a separate animation level for the mouth.
• If different face expression are required, create a separate animation level for the eyeballs, the sockets and the eyebrows.

**Note:** You can also use Cells → Clone to clone the turn-around puppet, and preserve only the needed sections in the cloned level.

**Painting the Puppet Sections**

To paint the puppet sections, first you have to create colors in each section palette. Colors can be picked from a color model, or from a palette stored in the studio palette in order to assure consistency in the puppet.

Once the sections are painted, and therefore become opaque, you may need to rearrange the column order in the xsheet, or to split a column into two different columns, to have the right layering of the different sections in the turn-around. For example for the Mozart character the right arm cuff has to be in front of the body in the front view, but has be behind the body for the other views.

Before starting to paint, set the 01 Library project in the Paperless Tutorial folder as your current project, and load the scene you saved after the drawing session.
When your painting session is completed, save your work by saving the scene file in the `01 Library\scenes` folder: the painted drawing will be automatically saved.

If you want to check the final result of the painting process you can load the scene `Mozart painted.tnz`.

To paint the character’s sections:
1. Load in the scene the file `Mozart Color Model.tif` available in the `Paperless Tutorial\Library\Models` folder.
2. Select the section you want to paint, and add the number of colors you need in the palette.
3. Use the Pick RGB tool ( ) to pick colors from the color model you loaded.
4. Use the Fill tool ( ) to paint the section drawings.

Note: It is also possible to load the image as color model and create automatically a palette containing all the character’s color, then save the palette in the studio palette, from where needed colors can be retrieved with standard copy and paste operations.

Defining a Puppet
There are two ways to connect the character’s sections: by using the column centers, or by using hooks.

A puppet based on column centers is simpler to create: it has some limitations, because the pivot points positions in the skeleton are fixed, but it is suitable for most of the cases of cutout animation.

A puppet based on hooks requires one step more for its definition, i.e. setting the hook position, but it is more versatile: the pivot points can follow the animation of puppet whose sections are animated levels themselves.

In this tutorial you will use hook as the Mozart character has full turn-around views, and column centers would not fit this kind of puppet.

Defining Hooks Positions
Hooks have to be placed for all the puppet sections; they will be used to set the pivot points and the joints of the puppet. For example, a trunk may have five hooks, one for the head, two for the arms and two for the legs; a forearm may have two hooks, one that will be the pivot point for the elbow, and one for the wrist.

In some case you may need to add ghost elements, that is to say element that are not visible but useful to create a more versatile puppet skeleton. For example for the Mozart character hooks are created for a puppet split in an upper part (whose parent section is the trunk) and a lower part (whose parent section is the pelvis), that are connected by a ghost element. In this way it is possible to animate the two main parts independently, for example to squash the upper part without involving the lower part.

If you have drawn the puppet sections in place, and you want to keep that position, it is very important that hooks that have to be linked, for example the upper hook of the right arm, and the right hook of the body, are overlapping. In this way the puppet will maintain its appearance with no section being shifted, and the puppet definition will be easier.
Before starting to create hooks, set the 01 Library project in the Paperless Tutorial folder as your current project, and load the scene you saved after the painting session.

When the hook definition is completed, save your work by saving the scene file in the 01 Library/scenes folder: the hook information will be automatically saved.

If you want to check the final result of the hook definition process you can load the scene Mozart hooks.tnz.

**Note:** For the Mozart character hooks are created for a puppet that is planned to be split in an upper part (whose parent section is the trunk) and a lower part (whose parent section is the pelvis), that are connected by a using a ghost element. In this way it is possible to animate the two main parts independently, for example to squash the upper part without involving the lower part.

**To set hooks on the character’s section:**

1. Select the section you want to define the hooks for, and use the Hook tool ( ) to define the hooks where you want the puppet pivot points and joints to be. For example for the level of the Mozart body five hooks have to be set: one to join the jacket, one for the tie, two for the two arms, and one for the head.

2. For the other view of the same section, correct the hooks position for the different drawings in the different frames by dragging them to where
the pivot points and joints are supposed to be. In this way the puppet will be consistent even if drawings change during the animation.

Setting up the Puppet
Once the puppet sections are drawn and the hooks are put in place, you can define the puppet skeleton by using the Skeleton tool ( ). For each section you have to define the pivot point, and the parent section to which it is linked.

Usually it is simpler to start working from the parent section, in this case Mozart’s body, then link the other sections one by one, following one limb at the time.

If the position you defined for the hooks that have to be linked is overlapping, the puppet definition is very easy, because a special button labeled Link is displayed letting you link automatically the related sections with a single click.

If the hook position is not overlapping, you first have to set a hook as the pivot point for the selected puppet section, then link it to another section. In this case when the pivot point is set, the section shifts to the center of the area; when the link is set the section shifts so that the two linked hooks are overlapping.

Before starting to create the puppet, set the 01 Library project in the Paperless Tutorial folder as your current project, and load the scene you saved after the hook positioning.
When the puppet is completed, save your work by saving the scene file in the 01 Library\scenes folder.

If you want to check the final result of the linking process you can load the scene Mozart final.tnz.

**Note:** The hook number (H1, H2, etc.) is just a label to identify hooks, and it is not relevant when performing links.

**To link a section to another section having overlapping hooks:**
1. Select the Skeleton tool [ ].
2. Select the section you want to link by clicking it: the hooks you created for that section are highlighted, and any hook overlapping a hook of another section has a button labeled Link.
3. Click the Link button displayed close to the overlapping hooks you want to link.

Building the right arm skeleton with overlapping hooks: select the arm [1], and click the link button on the shoulder [2]; select the forearm [3]...
To link a section to another section not having overlapping hooks:

1. Select the Skeleton tool ( ).

2. Select the section you want to link by clicking it: the hooks you created for that section are highlighted.

3. Click the label of the hook you want to be the pivot point: the section shifts to the center of the work area, centered on the hook you clicked.

4. Click and drag the dot at the top of the handle to the section you want to be parent: the section you drag to is highlighted by displaying its bounding box and all its hooks.

5. Drag toward the hooks you want to link the section to: the hook is highlighted by displaying an external circle.
6. Release to set the link: the section shifts so that the two hooks are now overlapping.

Building the right arm skeleton without overlapping hooks: select the arm, and click the H1 button to set it as pivot point (1), the arm shifts to the center (2)...

...click and drag the dot at the top of the handle towards the hook H3 of the right shoulder on the body (3) and release to set the link (4).
To break the link between the selected section and its parent:
Click the grey dot at the middle of the graphical link between the linked section and the parent one.

The final skeleton and the related stage schematic.

**Animating a Puppet**

When the puppet is defined, it’s a good practice to do an animation test to check if the puppet fits the requested animation. In this case you will define a side walking cycle for the Mozart character.

The first step is to define key positions for the action the character has to perform. These key positions can be figured out by sketching on paper how you want the movement to be.

Usually the first element to be animated is the puppet parent section, that is to say the part of the puppet to which all the other sections are linked. Key positions are defined for all the frames the animation has to last and the speed of the interpolated movement is controlled with the curves in the function editor.

For example if the trunk of a character is the element from which the whole skeleton depends, it will be animated first. Then the legs, arms and head will be animated considering the key positions of the trunk.

With the Skeleton tool ( ) you can select and set positions for the puppet sections. You can also activate the Inverse Kinematics option to move the puppet considering the skeleton articulations, so that if you
want to move the end of a limb to a particular position, all the rest of the sections belonging to that limb will move consequently.

Every time a position for a section is set, a key position is automatically generated for the xsheet column where that section is exposed, at the current frame. Keys and interpolations you define in this way are displayed in xsheet columns, where they can be managed directly, and in the function editor.

Before starting to define the animation, set the 01 Library project in the Paperless Tutorial folder as your current project, and load the scene you saved after the puppet definition.

When your animation is completed, save your work by saving the scene file in the 01 Library\scenes folder.

If you want to check the final result of the puppet creation process you can load the scene Mozart animation.tnz.

**To define Mozart walking cycle:**

1. Figure out, even with sketch on paper, how you want the walking movement to be.

2. Delete from the xsheet all the cells containing drawings that are not required for the side walking movement; only drawings at frame 3 should be preserved.
3. Repeat all the cells for all the frames you want the animation cycle to last.

4. Select the Mozart parent section, that is the ghost element to which the upper and lower part of the body are linked, and use the Edit tool (A) to set the key positions at the different frames the animation. Usually these key positions define an up-and-down waving movement. After using the Edit tool, in each key frame click the set key button (B) at the bottom of the viewer in order to set a key for all the object transformations (i.e. position, rotation, size and shear), and not only to the one you are editing. In this way this reference animation will maintain its consistency even when new keys are added when editing it in a real scene production.

5. Go to the first frame and with the Skeleton tool (C) set a key position for all the puppet sections. Every time you set a position, click the set
key button ( ) at the bottom of the viewer in order to set a key for all the object transformations.

6. Move to the other frames where keys were defined for the parent section, and set key position for the other sections as well.

7. Scrub the current frame cursor or use the Play button to check the animation.

To use the inverse kinematics when animating:
1. Select the Skeleton tool ( ) and activate the Inverse Kinematics option.

2. Click the center of the section you want to stay fixed: it turns from round to square to indicate it is fixed.

3. Click any point of any section [but the fixed one], and drag to the final position.

To refine the animation:
Consider the following guidelines:
- Limit the number of key positions you define, as it is better to control the movement by calibrating the interpolation speed, than by defining too many keys. Note that the Mozart animation.tnz scene is 27 frames long and contains only 7 key positions.
- Set the key positions for the sections at the same frames of the parent sections keys. You can also shift keys one or two frames up or down in
order to create a small delay in specific sections movement that makes the animation more natural.

- Activate the onion skin to check how the key positions are interpolated. You can also extend the onion skin to all the puppet sections by right clicking the current frame cursor and selecting Extend Onion Skin to Scene from the menu that opens.

- Calibrate the key interpolation by moving the arrowheads between key icons in xsheet. In this way you can control the movement speed, and avoid sudden changes of movement at key positions, for all the section transformations in the same way and at the same time (i.e. rotation, squash, position, etc.).

- Calibrate the key interpolation by modelling curves in the function editor. In this way you can control the movement speed and avoid sudden changes of movement at key position for each single transformation, independently from the others.

- In case during the movement a change of view is needed, for example the character has to turn from the front to a side view, switch drawings where a key position is: in this way the abrupt passage from one view to another, based only on one or two drawings, will look more natural.

- Use the guides in the work area as reference to align movements and animations.

**Layout**

A scene layout is created by importing all required elements from the library. Usually the storyboard sketch related to the scene is loaded as reference for positioning elements and guiding the camera movements.

Backgrounds and props are put in place, and puppets are cleaned up from drawings not necessary in that specific scene. For example if the character has to run to the right, leave only the drawings for the puppet facing right.

As concerning the xsheet, the following should be arranged in order to achieve the animation requested from the storyboard:

- The scene timing has to be taken from the storyboard.

- The layering order of the scene elements has to be set: for example if a character has to move in front and at the back of a prop, the related levels are exposed in the column under the prop, then in those on the top.

- Some rough masks can be created if some elements have to be hidden.
• Poses for the different characters involved in the scene are defined in order to give an idea of how the animation will take place. Poses usually are not interpolated, but just exposed as they are for all the required frames.

Before starting to define the animation layout, set the 02 Layout project in the Paperless Tutorial folder as your current project, and create a new scene.

When the layout scene is completed, save it in the 02 Layout\scenes folder.

If you want to check the final result of the layout process you can load the scene sc_N2_layout.tnz available in the 02 Layout\scenes folder.

Importing Backgrounds and Props from the Library

You can start loading the storyboard sketch referring to this scene, and the needed background and props, that can be positioned according to the sketch.

To load the storyboard sketch, the background and props:
1. Navigate with a browser to Library project by using the Load Level command.
2. Load the image sc_N2 sb1.jpg available in the Storyboard Sketches folder; when prompted, choose to import the sketch that will be saved in the extras default folder of the Layout project.
3. Load the image sc_N2_bkg.tif available in the Location folder; when prompted, choose to import the background that will be saved in the extras default folder of the Layout project.
4. Load the levels piano.pli, stool.pli, stand.pli and score.pli available in the Props folder; when prompted, choose to import the images that will be saved in the drawings default folder of the Layout project.

Importing Character Puppets

The Mozart puppet now can be imported in the scene as a sub-xsheet. You can also load the puppets for Mozart’s father and sister, and animate them, or you can load the scenes sister animation.tnz and father animation.tnz containing the two puppets already performing the action requested in this scene.

To load the Mozart puppet:
1. Navigate with a browser to Library project by using the Load Level command
2. Load the scene Mozart final.tnz available in the scenes folder as sub-xsheet; when prompted, choose to import the scene whose
drawings will be saved in the drawings default folder of the Layout project.

Note: If in the Preferences the Create Sub-folder when Importing Sub-xsheet is activated, the drawings will be saved in a sub-folder named Mozart final in the drawings default folder of the Layout project.

Note: If you saved your own Mozart puppet, you can load it as well.

Creating the Scene Layout
In this scene the Mozart character has to be sitting on the stool at the piano, and play some music.

First the puppet has to be optimized, so that only necessary drawings are preserved, then it has to be posed on the stool as if playing the piano. Therefore the piano and the stool will be moved inside the Mozart sub-xsheet so that you can check how the puppet interacts with the props.

To clean up the puppet from unnecessary drawings:
1. Enter in the puppet sub-xsheet.
2. Put the frame cursor at the frame displaying the puppet with the side view; in case of the Mozart final.tnz puppet, it is frame 3.
3. Select the cells in all the column at any frame but frame 3 and delete them.

   **Note:** If any drawing is required later on, it can be retrieved from the level strip of the related level.

4. Delete any empty column resulting from the clean up process, and move the remaining cells from frame 3 to frame 1.

**To move the stool and the piano inside the xsheet:**

1. Move to the main xsheet and cut the columns where the stool, the piano, the stand and the score are exposed.

2. Enter in the puppet sub-xsheet and paste the copied columns.

   **Note:** You can copy the storyboard sketch as well to use it as reference inside the sub-xsheet.

3. As the puppet is facing left, flip the props with the Edit tool (keyboard) by setting an horizontal scale of -100, as if the storyboard sketch was flipped, and arrange them.

![Image of puppet and piano]

**To set poses for the puppet:**

1. Repeat the cells for as many as the poses you are going to define. In this case for 8 frames, even if we will create only 3 poses.

2. Select frame 1 to define the first pose.
3. Right-click the Mozart character, and choose the puppet parent section ghost-mozart (the one before the Peg2 item) from the menu that opens.

4. Use the Edit [A] to move the character on the stool by moving the parent section.

5. Use the Skeleton tool [H] to select the skeleton section and rotate them to the desired pose, considering the following guidelines:
   • To select a section click on it with the Skeleton tool [H]; to rotate it, click and drag anywhere.
   • To select any element in the puppet, right-click a drawing to select an item from the list of the objects hierarchically linked to the column containing the drawing, from the first one up to the table and current camera.
   • To select hidden sections, for example the right arm, hide the columns where upper sections are exposed by using the camera stand toggle [G].
   • If you want to move a limb as a whole, for instance an arm, activate the Inverse Kinematics option, and click and drag the section at the end of the limb.
6. Select frame 4 to define the second pose, then frame 8 for the third pose. The puppet positions in the inbetween frames will be automatically interpolated.

To expose the poses in the main xsheet:
1. Close the sub-xsheet, and delete all cells from the sub-xsheet column, but the first one.
2. Flip the sub-xsheet with the Edit tool by setting an horizontal scale of -100, so that it matches the storyboard sketch.
3. Repeat the sub-xsheet cell numbered 1 for as many frames as you want the first pose to be repeated.
4. Double click the cell where you want the second pose to start being exposed, and type 2: the second sub-xsheet frame will be displayed in the work.
5. Repeat the sub-xsheet cell numbered 2 for as many frames as you want it to be repeated.

6. Do the same with the remaining frames. If you want to create a cycle, select the cells defining the cycle and repeat them.
To finalize the scene:
1. With the Edit tool ( ) resize the sub-xsheet, the background and the camera so that they fit the storyboard sketch.
2. Select the cell where the background is exposed, and repeat it for all the required frames.

**Animation**

When the layout is completed all the elements of the scene are in place, and the animator can start redefining the scene animation.

For each character or element that has to be animated, the animator starts from scratch to set new key positions using the layout poses as reference. In case the character or element to be animated is a sub-xsheet, the animation is done inside the sub-xsheet and then is exposed in the main xsheet.

The animation technique is basically the one used also to achieve test animations, and the guidelines provided in Animating a Puppet on page 26 apply also in this case.

Apart from defining key positions for animated puppets and elements, the most important job of the animator is defining the way key positions are interpolated by using curves and key icons on xsheet columns. The richest and more natural animations usually are achieved more by controlling properly the interpolation than by setting a lot of keys.

Poses defined in the layout usually are not reused, but are taken only as reference for the final animation. They can also be preserved at the top of the xsheet to be retrieved or checked at any moment, and the animator starts working not at the first frame, but some frames after the ones where layout poses are exposed.

Before starting to define the animation, set the 03 Animation project in the Paperless Tutorial folder as your current project. As a starting point, import the layout scene from the 02 Layout project.

When the scene is completed, save it in the 03 Animation\scenes folder.

If you want to check the final result of the animation process you can load the scene sc_N2_animation.tnz available in the 03 Animation\scenes folder.

To setup the animation for the Mozart puppet:
1. Enter in the puppet sub-xsheet.
2. Analyze the layout poses and figure out, even with sketch on paper, how you want the animation to be.
3. Copy all the cells at frame 1, and paste them in another frame, for instance frame 10. In this way the layout poses are always available for reference.

4. Repeat all the cells for all the frames you want the animation to last.

5. Follow the guidelines provided in Animating a Puppet on page 26 to define the puppet animation.

To retrieve different drawing for puppet’s sections:

1. Choose the Skeleton tool [ ] and select the section you want to change the drawing for.

2. Click the label with the level name close to the Skeleton tool handle, and drag up or down to flip through following and previous frames. For example, click on the hand section label to flip through the different hand drawings.
3. Release to set the drawing for the current frame.

To expose the animation in the main xsheet:
1. Close the sub-xsheet, and delete all cells from the sub-xsheet column, but one.
2. Do one of the following:
   • If the whole animation is made in the sub-xsheet, use Xsheet → Resequence to expose the full sub-xsheet, and then delete the top frames (those where the layout poses were exposed).
   • If the animation is a cycle and in the sub-xsheet you defined a single cycle, expose in the closed sub-xsheet column the cells referring to the
cycle, then repeat them with Cells -> Repeat, or with copy and paste operations.

- If the animation needs different references to the sub-xsheet content, for example you want the character to stay still for a certain number of frame, edit the sequence of cells of the closed sub-xsheet column as if it was a standard column.

**Saving an Animation in the Library**

An animation defined for a character in a specific scene may be needed for reuse in other scenes as well. For this reason it is possible to save an animation contained in a sub-xsheet as an independent xsheet that later on can be imported in other scenes.

As usually the library is a Toonz project different from the one where final animation scenes are saved, the sub-xsheet has to be saved in the animation project first, and then imported in the library project.

To save the sub-xsheet animation in the library:

1. Enter in the sub-xsheet you want to save.
2. Use the Xsheet -> Save Sub-xsheet As to save the sub-xsheet in the scenes folder of the current project.
3. Set the library project as the current one.
4. Load the saved scene from the other project, automatically importing it in the library.

**Applying Special FX**

Even if the animation is complete, the scene can still be enriched by adding special FX, for example to add light effects, or doing color correction for some elements.

Special FX may be already planned in the storyboard, but in some cases it is the special FX operator, according to his experience and skill, that decide how to intervene in a scene.

Usually during this step the scene can also be cleaned up from unused elements, and its elements may be rearranged in order to apply special FX properly, for example a mask may be redrawn in order to be more precise, or some elements may be duplicated to create effects like reflections or shadows.

In this scene you will change the lighting by adding some dark shapes, and you will add some body shadows to the characters in order to achieve a better atmosphere.
Before starting to add special FX, set the 04 Special FX project in the Paperless Tutorial folder as your current project. As a starting point, import the animation scene from the 03 Animation project.

When the scene is completed, save it in the 04 Special FX\scenes folder.

If you want to check the final result of the special FX process you can load the scene sc_N2_specialFX.tnz available in the 04 Special FX\scenes folder.

**To change the lighting of the scene:**

1. Insert an empty column over the background column, and select the first cell.

2. Use the Geometric tool ( ) to draw a polygonal shape on the left top angle and another on the right bottom angle of the shot. Draw also some ellipses under the characters. Fill the areas with the black color, as they will be used to simulate some shadows in the background.

3. In the FX schematic select the column containing the dark shapes. Right-click and choose Insert FX from the menu that opens to see the FX list.
4. Go in the Blur folder, select the Blur effect, and click the Insert button. The blur effect will smooth the shape outline.

5. Go in the Layer Blending folder, select the Transparency effect, and click the Insert button; then select the Multiply effect, and click the Insert button. The transparency effect will make the shape semi-transparent, while the multiply effect will allow the background to become darker without losing the original hues.

6. Double-click the Blur node you inserted, and in the FX Settings set a blur value. Use the preview area to check the result.

7. Double-click the Transparency node you inserted, and in the FX Settings set a transparency value. Use the preview area to check the result.

8. Link to the down input port of the Multiply node the node of the background image.

9. Activate the preview in the work area, and calibrate the different special FX to optimize the result.

10. Repeat the cell with the dark areas for all the frames of the animation.
To insert body shadow to the scene characters:
1. In the FX schematic select the column containing the Mozart puppet. Right-click and choose Insert FX from the menu that opens to see the FX list.
2. Go in the Light folder, select the Body Highlight effect, and click the Insert button. The body highlight effect will be used to create a body shadow.
3. Double-click the Body Highlight node you inserted, and in the FX Settings set the following values:
   • Set the Color to black, so that the highlight will be dark, that is to say a shadow.
   • Set a negative X and Y Offset, as the light is coming from the top right corner of the shot.
   • Increase the Blur value to have a smoother shadow.
4. Right-click the Body Highlight node you just defined and choose twice Duplicate from the menu that opens. Link the Mozart father and sister nodes to the duplicated effect nodes: the other two puppets will have the same body shadow.
5. Activate the preview in the work area, and calibrate any body highlight effect to change the shadows on the three characters, and optimize the result.

**Rendering the Scene**

When the scene is completed and approved, it is ready to be rendered out according to production settings.

A final check concerns the output settings, then the rendering can be performed directly while the scene is loaded, or in batch mode.

Before starting to define the animation, set the 04 Special FX project in the Paperless Tutorial folder as your current project. As a starting point, load the special FX scene from the 04 Special FX\scenes folder.

If you want to check the final result of the rendering process you can load the clip sc_N2_render.mov available in the 04 Special FX\scenes\sc_N2_specialFX\out folder.

To define the scene output settings:
Choose File → Output Settings, and set the location, name, file format and render frame range of the current scene rendering.

**Note:** if the location is +outputs, the render will be saved in 04 Special FX\scenes\sc_N2\out, that is the default output folder for the current project Special FX.

To render the scene:
Do one of the following:
- Choose File → Render to render directly the current scene according to the Output Settings.
- Submit the scene to the batch list in order to run a queue of tasks in background while you perform other works on your computer. For details see Toonz Harlequin or Toonz Bravo User Guide.
Click & Kat Case Study

Company Profile
MatitAnimatA animation studio, active in Roma since 1996, is one of the most established Italian animation studios and has been working on several Italian and European productions, both for television (Felix, Hocus & Lotus, Marco e Gina, GB e W, Lupo Alberto) and cinema (Felix, Opopomoz, Three Wise Men, Der Kleine Eisbar). MatitAnimatA runs also the BDB academy, a professional training center with courses for animators and computer graphic artists.

The studio stepped in the paperless animation production with an animation series for television titled Click & Cat, 26 x 5' episodes for Rai Fiction - Cineteam.

They opted for using Toonz 5.0, because thanks to this choice the production could be made completely in-house with no need to subcontract some production steps such as drawing or animation to external studios.

Traditional vs. Paperless
Initially the production had to follow the traditional approach, but before starting the studio decided to analyze the productivity of the paperless approach as well, as it seemed suitable a series of short episodes with a fixed cast of characters.

The paperless approach resulted more productive than the traditional one, required only 142 man-days against 295 to produce 5 minutes of animation (i.e. the animation required for one episode).

The table below contains the required man-days in the traditional and paperless approach, for each step of the production.

<table>
<thead>
<tr>
<th></th>
<th>Traditional</th>
<th>Paperless</th>
</tr>
</thead>
<tbody>
<tr>
<td>Models</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Library</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>Layout</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Backgrounds</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>-------------</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Animation</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>Drawing Cleanup</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>Scan &amp; Digital Cleanup</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>Ink &amp; Paint</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Special FX</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Render</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>295 man-days</td>
<td>142 man-days</td>
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</table>

**Paperless Production Figures**

**Production**

<table>
<thead>
<tr>
<th>Type</th>
<th>Animated series for television</th>
</tr>
</thead>
<tbody>
<tr>
<td>Episodes</td>
<td>26</td>
</tr>
<tr>
<td>Episode Running Time</td>
<td>5'</td>
</tr>
<tr>
<td>Main characters</td>
<td>4</td>
</tr>
<tr>
<td>Average number of minor characters per episode</td>
<td>2</td>
</tr>
<tr>
<td>Main locations</td>
<td>10</td>
</tr>
<tr>
<td>Average number of location backgrounds per episode</td>
<td>25</td>
</tr>
<tr>
<td>Average number of props per episode</td>
<td>64</td>
</tr>
<tr>
<td>Average number of character per scene</td>
<td>2</td>
</tr>
</tbody>
</table>
Staff
The average number of people working at the production was 18. At the beginning of the production, only the staff involved in episodes storyboard and the building of the library was engaged. In the same way at the end of the production, only the staff involved in episodes layout and animation was engaged.

Some of the staff was involved in preproduction jobs, such as graphic design and storyboard, not requiring the knowledge of the Toonz features; the rest was involved in the actual animation production, such as library definition, scene layout and animation, and actually were Toonz operators.

In the following list you can find the professional roles required for the production and the number of people for each role. The number of people resulting from the list exceeds the total number of the staff,
because some of them had more than one role in the production. For example the layout supervisor was also one of the layout artist.

**Note:** Professionals always involved with a production project, such as production director or production secretary, are not included in the staff list.

<table>
<thead>
<tr>
<th>Step</th>
<th>Role</th>
<th>Description</th>
<th>Q.ty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storyboard</td>
<td>Storyboard Artist</td>
<td>Does storyboard drawings on paper or with Alias Sketchbook</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Storyboard Designer</td>
<td>Assembles storyboard drawings with text and notes in Flash</td>
<td>1</td>
</tr>
<tr>
<td>Videoboard</td>
<td>Videoboard Operator</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Library</td>
<td>Draftsman</td>
<td>Draws pencil sketches for characters dope sheets and backgrounds</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3d Artist</td>
<td>Creates models for location backgrounds and specific props with 3D software.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Background Artist</td>
<td>Edits rendered backgrounds with Photoshop.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Library Operator</td>
<td>Traces the character and prop from scanned sketches; create puppets and reference animations.</td>
<td>2</td>
</tr>
<tr>
<td>Layout</td>
<td>Layout Supervisor</td>
<td>Checks the scene layout created by the layout artists.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Layout Artist</td>
<td>Imports scene elements from the library, and define key animation.</td>
<td>4</td>
</tr>
<tr>
<td>Animation</td>
<td>Animation Supervisor</td>
<td>Checks the animation created by the animators.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Animator</td>
<td>Defines and calibrates elements animation from the layout scene.</td>
<td>6</td>
</tr>
</tbody>
</table>
Production Span
Production lasted 15 months, 3 for preproduction and 12 for episodes production. After the production started, it took 2 months to produce the first episode, followed by a production rate of 2 episodes per month in the first stage of the production (5 months), and 3 episodes per month at full capacity (5 months).

<table>
<thead>
<tr>
<th>Step</th>
<th>Role</th>
<th>Description</th>
<th>Q.ty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special FX</td>
<td>Special FX Operator</td>
<td>Adds special FX to the animation scenes.</td>
<td>1</td>
</tr>
<tr>
<td>Render</td>
<td>Render Operator</td>
<td>Checks output settings and render out scenes.</td>
<td>1</td>
</tr>
</tbody>
</table>

Preproduction 3 months
Production 12 months
Average rate of episodes per month 2.2
Rate of episodes per month at full capacity 3
The staff involved in the actual animation production, such as library definition, scene layout and animation, were Toonz first-time users, and for this reason the production had a ramp-up period.

The production rate increased both because the operators skills increased, and because the library already contained the needed characters and animations that were created for previous episodes.

In the first stage of the production, an episode took a lapse of 50 working days to be completed, where each production step took 10 days. Considering 18 people working on the production in the different steps, it took 8.2 man-months.

At full capacity, an episode took a lapse of 35 working days to be completed, where each production step took 7 days. Considering 18 people working on the production in the different steps, it took 5.7 man-months.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Full Production Span</strong></td>
<td>12 months</td>
</tr>
<tr>
<td><strong>Production Span for Each Step</strong></td>
<td>10 months</td>
</tr>
<tr>
<td><strong>Average rate of man-months per episode</strong></td>
<td>6.9</td>
</tr>
<tr>
<td><strong>Man-months for each episode at full capacity</strong></td>
<td>5.7</td>
</tr>
</tbody>
</table>