variety of designs are a big seller, at least in the weeks before Christmas. Not surprisingly, demand drops precipitously after that.

A particular design includes some imagery for the background and a description of how many openings there are for base images, and the geometry of those openings. The associate can be very creative in filling those openings with photographs and with other compositions.

We found some interesting challenges dealing with these designs and the base images that go in them. For instance, what happens when a customer places an order, but then a new version of the design gets rolled out to the studio? At a smaller scale, what do you do if the associate nested one design within another—such as a sepia-tinted photograph inside a border—and then changes or deletes the original design?

At first, this looked like a nightmare of reference counting and hidden linkages. Every scheme we considered created a web of object references that could lead to gaps, missing images, or surprising changes. As a team, we all believed in "The Rule of Least Surprise," so hidden linkages causing changes to ripple from one product to another just wasn't going to work.

When our lead visionary came up with a simple, clear answer, it didn't take more than 30 seconds to sell the rest of us on it. The solution incorporated two rules:

1. Don't change anything after creating it. Designs and compositions would be immutable.
2. Copy, don't reference, the original.

Taken together, this means that selecting a design actually copies that design into the working space. If the associate adds the resulting composition to the album, it's actually a complete and self-contained copy of the design that gets added. Likewise, nesting one enhanced image into another makes a copy of the original and grafts it into the new composition. From the moment that graft happens, the original composition and the new one are completely independent of each other.

These copies are not just a trick of object references in memory. The actual XML description of the composition contains a complete copy of the design or the embedded compositions. This description lives in the studio's database, and it's the same description that gets sent on the DVD. When the studio manager burns the day's orders to DVD, the StudioServer packs in everything needed to create the final render: source images, backgrounds, alpha masks, and the instructions about how to combine them into the final image.

Having the complete description of the whole composition—including the design itself—on DVD became a huge advantage for production.

Previous systems kept the designs in a library, and orders just referenced them by ID. That meant the designers had to coordinate design IDs between the studios and the centralized printing facility. Therefore, designs had to be "registered" in production before they could be rolled out to the field. Should the IDs get out of sync, as sometimes happened, the wrong design would be produced and customers would not get the products they expected. Likewise,