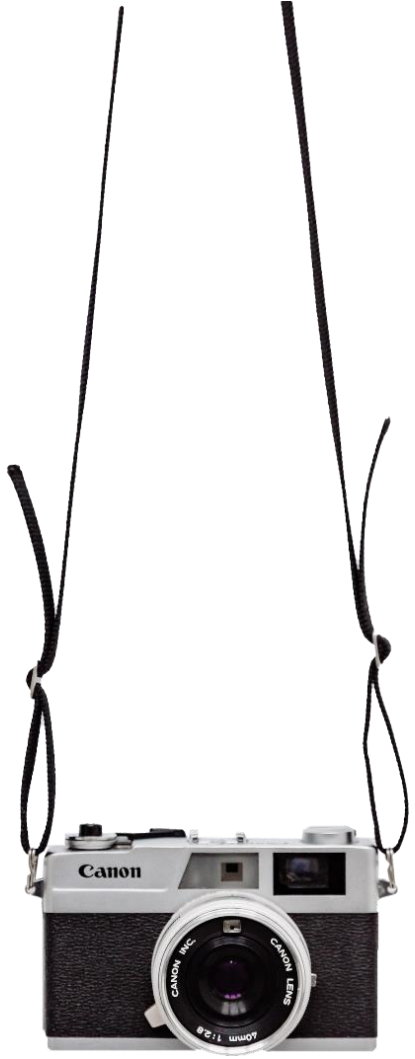


Systems Engineering and Photography? You Bet!

3 Dec 2022

Greg Bulla

Photography

A combination of **artistic vision** and **technical execution**. A form of art, but with a strong technical flair.

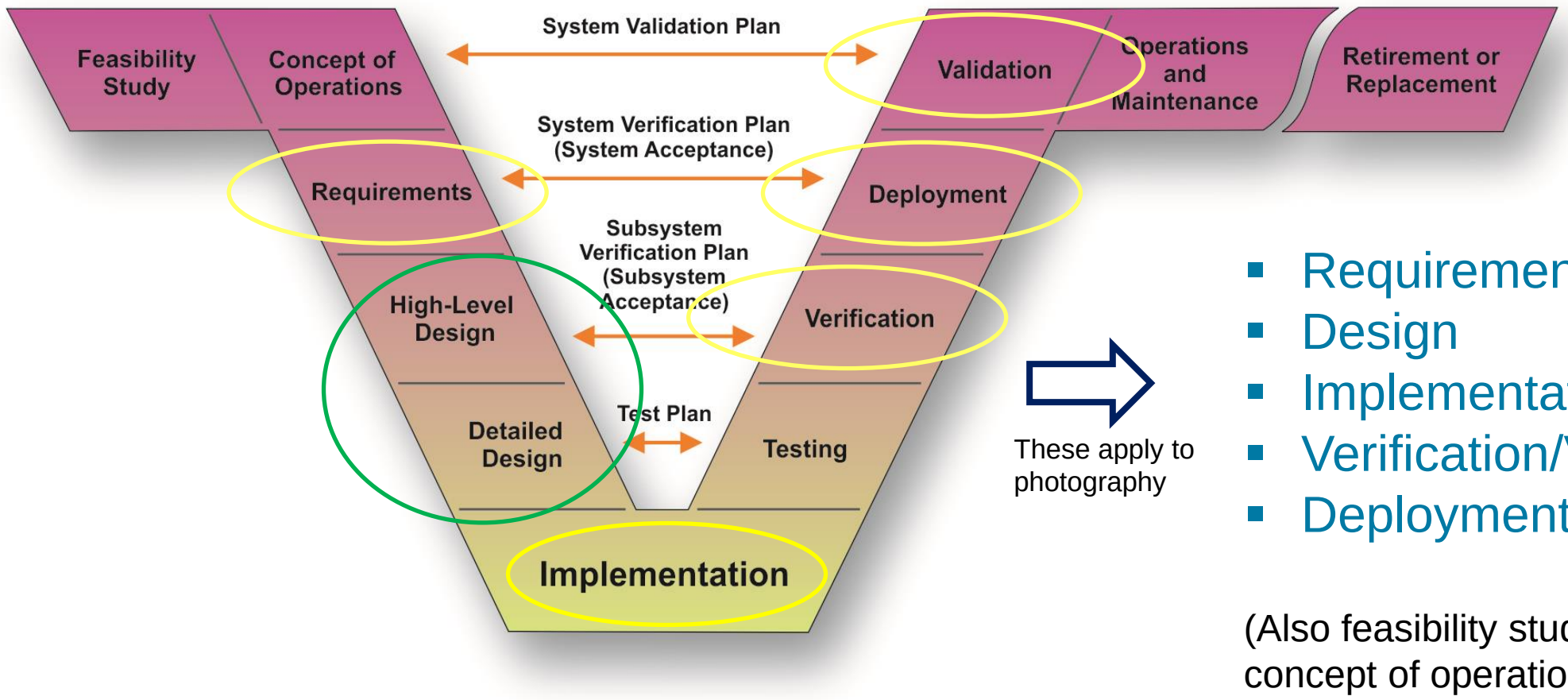
Question

Do *serious* photographers use Systems Engineering in their workflows, their creative processes, their planning & execution phases, etc.?

… Let’s take a look!

SE & Photography

Traditional Systems Engineering V



These apply to photography

- Requirements
- Design
- Implementation
- Verification/Validation
- Deployment

(Also feasibility studies and concept of operations, but ignore those for now)

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There are many TYPES of photography. E.g.,

- landscape
- studio
- event
- wildlife
- sports
- astro
- underwater
- night
- aerial
- portraiture
- family
- pet
- model
- macro
- advertisement
- & many more!

Each type has its **own degree and sort of planning**. Some, such as sports and landscape, are more about *read-and-react* and *discovery*, whereas others, like studio, are about *creating*.

Example: Landscape Photography

Requirements – What does one typically want in a landscape image, and how will this translate to **design, required photo gear, and planning**?

- **Whole scene** → wide angle lens
- **Good depth of field** (everything in focus) → smaller apertures/slower shutter speeds require camera stabilization, e.g., tripod
- **Agreeable lighting** → time of year and daytime considerations, e.g., golden hour (sunrise/sunset) for warm light in desert, mid-day for foliage, etc.
- Also, **Accessibility** → ability to reach the shooting area; will this require a permit, an SUV, hiking gear, an airline flight, etc.?

In-Depth Example: (Specialized) Night Shot

Star Swirls

As the Earth rotates, the nighttime stars appear to circle around the North Star.

What **equipment, technique, and planning** is required to capture such an image?

Fun Note – since it takes 24 hours for a star to fully rotate around the North Star, you can estimate in the photo how long the photographer left open the shutter. Here, I estimate approximately 1 hour.

Photo by Reign Abarintos on Unsplash

Star Swirl

REQUIREMENTS

What attributes should such a photo have?

What are the equipment and environmental requirements?

Star Swirl– (Typical) Requirements

- A great photo (given)
  - Long swirl
  - Nice, properly lit foreground object
- Camera with ability to **lock open its shutter** - the Bulb (b) setting and trigger
- Camera with enough **battery power** to remain open for at least several hours (note - noise reduction can double that requirement)
- Strong camera **stabilization** (tripod)
- **DARK** area and sky! Away from cities, moonless night
- **Clear** sky (haze obscures light, clouds catch light from nearby cities)
- Non-flight path
- Ideally a **non-travelled area** (no car headlights, worry about your camera disappearing, etc.)

Star Swirl

HIGH LEVEL DESIGN

Where, When, How?

Star Swirl – (Typical) High Level Design

- **Foreground**: the best star swirl images have interesting foreground subjects, like an aesthetically-pleasing building, etc. (…pure star swirl images can be pretty boring)
- **Balancing the foreground and background light**: this is important, and can also be a significant challenge!
- **Lens focal length**: how wide should the scene be? Note that the wider it is, the more chance there is that the scene can be contaminated by unwanted light.
- **Exposure time**: how long should the exposure be? Winter has longer nights, but the longer the exposure the greater the chance of problems. Battery can go dead (note – best to use a FILM camera with mechanical B setting)
- **Access:** reaching the shoot location. Is it freely accessible, do you have the right vehicle, hiking/camping gear, etc.?

Star Swirl

DETAILED LEVEL DESIGN

Camera and lighting details

Logistics

Star Swirl – (Typical) Detailed Design

- **More Foreground** – must ensure the scene isn't overly bright (it too bright will burn out detail on the image)
- **More Balancing foreground/background light** – decide on, obtain and prepare the supplemental lighting (strobes, flashlight, etc.) If shooting film, bring digital camera to do/see tests.
- **All technical considerations** – decide on ISO, aperture, protection from wind, trigger device (test!), supplemental battery pack(?), etc.
- **During-the-shoot considerations** – keeping warm, protection from critters, camping equipment, chair, food, & keeping an eye on the camera, etc.
- **Conditions** – best time of year to get the shot (temperature, lighting, crowds, etc.)

Star Swirl

IMPLEMENATION

Monitoring Weather

Transportation

Performing tests

Doing it

Star Swirl – (Typical) Implementation

- **Weather prediction –** look at long and short-term forecasts. Delay trip if necessary
- **Making, using checklist –** almost a must! Helps avoid forgetting important steps or equipment
- **Testing equipment beforehand –** test before departing
- **Flexibility –** must be prepared to adjust the plan in the field
- **Travel –** reaching the shoot location
- **Small field tests –** will only have one chance to get the real image. Therefore, best to do a few **short exposure experiments** in the field to verify everything
- **Time to do it – right! –** time to execute. Avoid operator errors; check and double check all settings. Have fun!

Star Swirl

VERIFICATION & VALIDATION

Examining the results

Performing post processing

Get feedback

Star Swirl – (Typical) Verification & Validation

After the shoot,

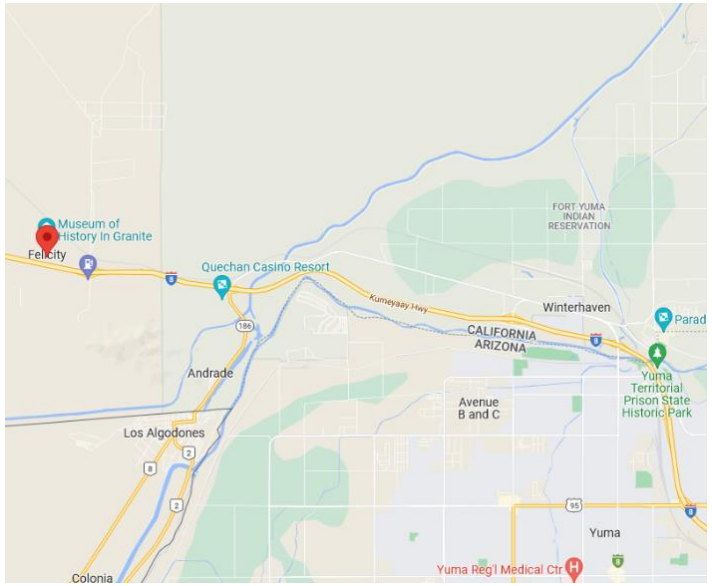
- **Inspect results, choose best** photo(s)
- Perform **post processing (‘post’)** as necessary
- Get **feedback**, make adjustments

Actual Star Swirl PHOTOSHOOT

Night Swirl - Felicity, California, 2014

Star Swirl – Real World Example

High Level Design



- **Foreground subject:** interesting church on hill at Felicity, CA, the Museum of History In Granite.
- **Location:** CA/AZ border. Near Yuma, but far enough away for sufficient darkness.
- **Isolated but accessible:** mostly isolated, only slightly breaking official visitation hours…

✓ **Bonus:** church façade faces south, so North Star aligns directly behind it.

Star Swirl – Real World Example

Detailed Design

- **Choice of equipment**:
  - Mamiya 645 Medium Format film camera with **mechanical Bulb** (b) setting
  - Wired remote **trigger with locking capability**
  - 45mm MF Lens (28mm equivalent)
  - Fuji Velvia 100 ISO **film** (120mm medium format)
  - Slik 212 **tripod**
  - Nikon D700 digital camera, for lighting experiments beforehand
  - Nikon SB-700 detachable **flash**, 92 Guide number, for lighting foreground
- **Other details:**
  - Flashlight to work at night, avoid rattlesnakes in dark, etc.
  - Tape to block the Mamiya's back viewport (to avoid fogging film)
  - Alarm clock

Star Swirl – Real World Example

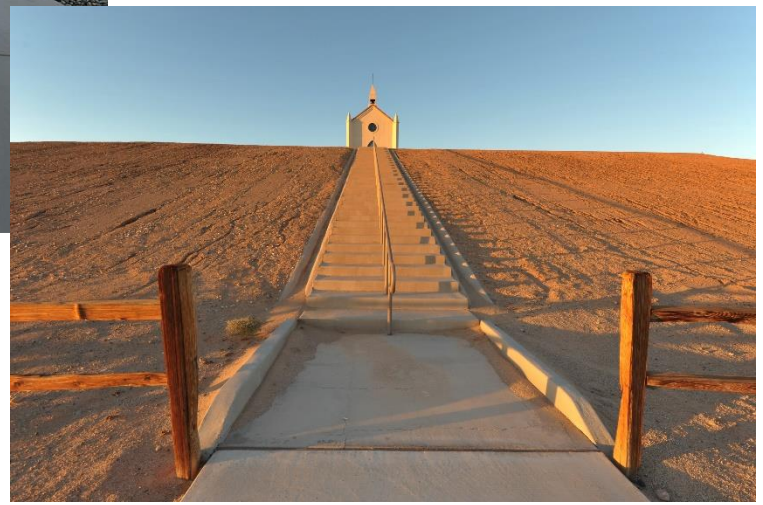
Implementation

Overall details

- **Drive:** 2.5 hours (~ 165 miles)
- **Weather**: warm evening (Oct), moonless & mostly clear. Completely dark by 9pm
- **Isolation**: very few visitors
- **Human factors**: parked near entrance, slept in back of SUV
- **Exposure**: ~ 7 hours. Ended exposure at ~ 4:15 am (well before dawn)

Star Swirl – Real World Example

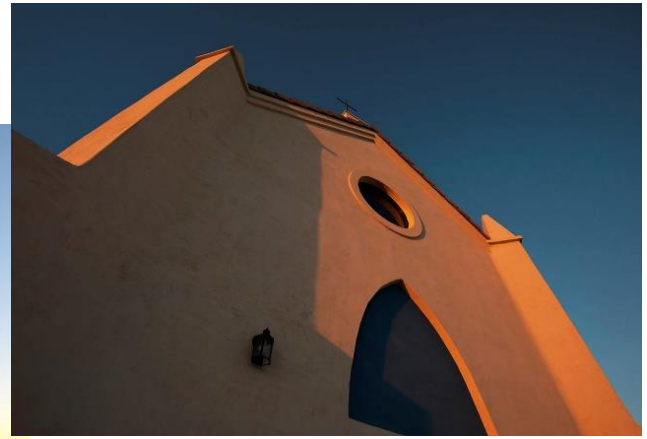
Location ……..



Star Swirl – Real World Example

Subject ……..

(All images should have a subject)



Risk! Church had flood lights that, if powered, would completely burn out the church in the image.

Workaround: None, as there was no way to safely (and legally) disconnect them. Luckily, they did not illuminate.

Star Swirl – Real World Example

Implementation

Like a space launch, only one chance to get it right.

Implementation Steps

- Determine the **best camera angle**
- Emplace **tripod**
- Determine **correct amount of foreground lighting**: experiment flashing the façade with strobe and digital camera. Check image to estimate correct exposure
- Replace digital camera on the tripod with **film camera**. Block rear viewport
- Set correct aperture, manually focus (not super easy in the dark), attach remote trigger
- **Lock open shutter** on film camera using B setting and locking remote trigger
- **Flash the foreground**. Slightly underexpose, as ambient starlight will add slightly more exposure overnight

Then hope for the best!

Star Swirl – Real World Example

- **Foreground Lighting Experiments (using digital camera)**

Star Swirl – Real World Example

Verification & Validation

Examining the Captured Image on Film

- Film scanned into a digital image
- Is this an acceptable base image?

Notice the flash head illuminations in the photo. These must be eliminated in post processing.

Star Swirl – Real World Example

Verification & Validation

Post processing:

- Eliminate distractions
- Straighten image
- Adjust colors, density
- **Success or Failure?** This is where you determine whether you need to do a reshoot

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Conclusion

- For **serious** results, **serious** photographers think about image requirements, design, and implementation.
- This *can* be considered to correlate to **systems engineering**.
- Post processing is now a given. However, similar to engineering, **photographers try to get things as right as possible from the start** (in design and implementation) to minimize post-work.

SE & Photography

THANK YOU