

# Automated Resource Leveling and Scheduling at LAIKA

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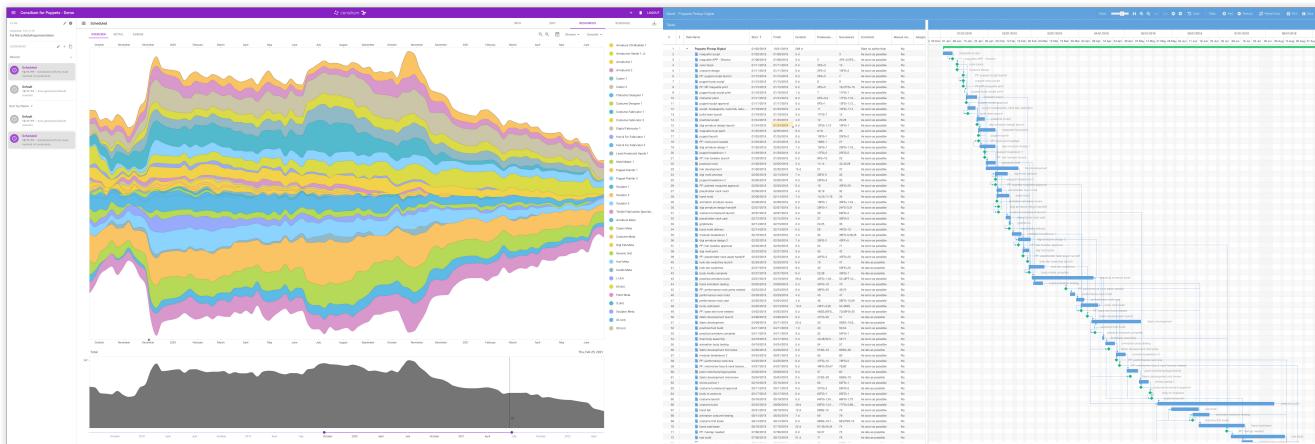


Figure 1: Left: Consilium's Streamgraph view. Right: A task template in LAIKA's Gantt

## ABSTRACT

To manage the ever-increasing complexity and collaboration in the creation of physical assets for LAIKA's hybrid stopmotion/CG features, we developed an integrated browser-based workflow that enables automated resource leveling and scheduling in a centralized system that is accessible to the entire studio.

## CCS CONCEPTS

- Human-centered computing → Visualization;
- Computing methodologies → Machine learning.

## KEYWORDS

Animated feature film production; scheduling

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## 1 SCHEDULING AT LAIKA

Creating LAIKA's hybrid stopmotion/CG animated feature films is a massive undertaking. Thousands of props, puppets, and costumes have to be created from scratch, and each has tight constraints – they must both express the creative language of the film and be able to be rigged and animated in painstaking frame-by-frame detail. Perhaps even more daunting is cross-department collaboration between our fabrication groups (Art, Puppets, and Rapid Prototyping) required to ensure all the assets fit into the same world and are delivered to the appropriate stages in time for their moment in the spotlight.

An accurate schedule is an essential part of enabling this intricate filmmaking machine. At LAIKA, scheduling starts with a bidding process where departments estimate the work necessary to create each asset by breaking it down into a list of tasks with durations, resource assignments, and dependencies on other tasks. These task lists are then brought into our production database and leveled to ensure three competing interests are met: (1) Each task is completed in time for other departments to complete their work, (2) Each asset is delivered in time for its scene shoot date, and (3) No group or person within each department is overloaded with tasks.

Balancing these goals is an incredibly difficult and time-consuming job that takes years of experience to master, especially given the complexity of a real production schedule. For example, the puppet schedule on LAIKA's upcoming film consists of 12,000 tasks spread across 300 assets, and resource leveling requires finding a way to

balance the workloads of 60 people in the department simultaneously. Hand-leveling such an enormous dataset is laborious; every push or pull in the order of tasks to benefit one group tends to come at the expense of every other group, with few easy solutions.

Perhaps even worse, the moment that a hand-adjusted schedule is completed, new information (anything from daily changes in the shooting schedule to R&D taking longer than expected to story changes) makes it obsolete. Without effective tools to evaluate and adjust the schedule to accommodate changes, craftspeople end up overworked and assets deliver late, which slows the pace of shooting and makes it harder for downstream departments (rigging, camera, animation, and post) to meet their deadlines.

## 2 PREVIOUS SOLUTIONS

LAIKA previously developed a scheduling solution that utilized Microsoft Project to create task templates that expressed the work plan for various assets. These templates were then combined with custom per-asset durations from a spreadsheet, put back into Project to be auto-scheduled, then finally exported via a custom Python app to Shotgun, a web-based project management database that offers spreadsheet and Gantt views of tasks.

The nice part about being in Shotgun was that scheduling data was easily accessible for tracking and reporting. However, there were some major limitations. Shotgun's auto-scheduling features are primitive (with no support for complex dependencies or constraints), the task creation process was cumbersome, and there were no tools for visualizing resource levels.

## 3 DESIGN AND DEVELOPMENT

The goal of this project was to replace LAIKA's previous scheduling solution with an integrated, browser-based scheduling system that would work studio-wide and ensure we had a schedule that was accurate, adjustable, and easy to communicate.

### 3.1 Custom JavaScript Gantt

The first step was building an app that would enable users to capture all the complexities of a production schedule. To this end, a browser-based JavaScript Gantt application was created that could edit, auto-schedule, and save task information back to the database directly. Now, users can edit their templates and production schedules in the same application, with full access to auto-scheduling features like dependencies and constraints. Even better, this data is synced directly with Shotgun, so all of LAIKA's existing infrastructure for task assignments and reporting is still usable.

### 3.2 Resource Leveling in Consilium

Our Gantt application improved upon several shortcomings of the previous scheduling solution, but we still wanted to make strides in both visualization and automation of resource leveling. After evaluating a few constraint solvers, we ended up collaborating with an early-stage browser-based app called Consilium, which uses a machine learning approach to level tasks across resources based on a few weighted parameters for each resource.

We designed a workflow around Consilium that enabled users to jump directly from Shotgun into Consilium, run Consilium's auto-leveling, and then export their schedule back into Shotgun for

tracking and reporting. Consilium offers some enormous benefits to our scheduling workflow:

*3.2.1 Leveling for all resources simultaneously.* Consilium is able to consider all the resource groups at once while still placing higher priority on certain groups, and provides a resource detail view that makes it easy to compare available headcount to workload.

*3.2.2 Fast Schedule Iteration.* Schedule data is constantly in flux, so being able to adjust and level a schedule in a matter of minutes means that the schedule can respond quickly to changes in shoot schedules or staffing changes. It also enables the user to evaluate how different scenarios might affect their resources without spending days rearranging their schedules.

*3.2.3 Assignment.* Consilium is able to assign tasks to specific resources, which enables users to assign tasks to a "class" of resource (like a generic costumer) and have the app assign and evenly distribute work between Costumers 1 through 5.

Consilium has proven to be incredibly effective, and is being used in production at LAIKA for managing tasks in several departments, most notably as the primary means of scheduling the Puppets department.

## 4 LIMITATIONS

Using the Gantt and Consilium successfully requires developing a rich dataset that encompasses all the heuristics a user manipulating a schedule by hand would use. Thinking in terms of constraints and dependencies can be a challenge to new users, and certain scenarios are still difficult to represent in the scheduling engine.

## 5 CONCLUSION

The introduction of our new scheduling workflow has made a big impact at LAIKA. Schedule changes are significantly easier to accommodate, and there has been a considerable increase in confidence in the scheduling process.

## 6 FUTURE WORK

We have not yet attempted to combine all of LAIKA's scheduling information into a single schedule optimized in Consilium. Such a schedule would be enormously complex, but would aid in visualizing and supporting the frequent interdepartmental collaboration that helps LAIKA push the boundaries of stopmotion filmmaking.