AUTODESK. UNIVERSITY

Automated Resource Leveling and Scheduling at LAIKA

Michael Nowakowski

Pipeline Technical Director I LAIKA

He now wears different (arguably more fashionable) glasses than he did in this headshot.

About Me

Michael Nowakowski is a Pipeline Technical Director at LAIKA. He focuses on studio workflows related to scheduling, fabrication, and asset organization.

On his Instagram profile, @michael__nowakowski, he chooses to describe himself as “an international multimedia art collective specializing in pictures of trees”.


INTRO

About LAIKA

Missing Link (2019)

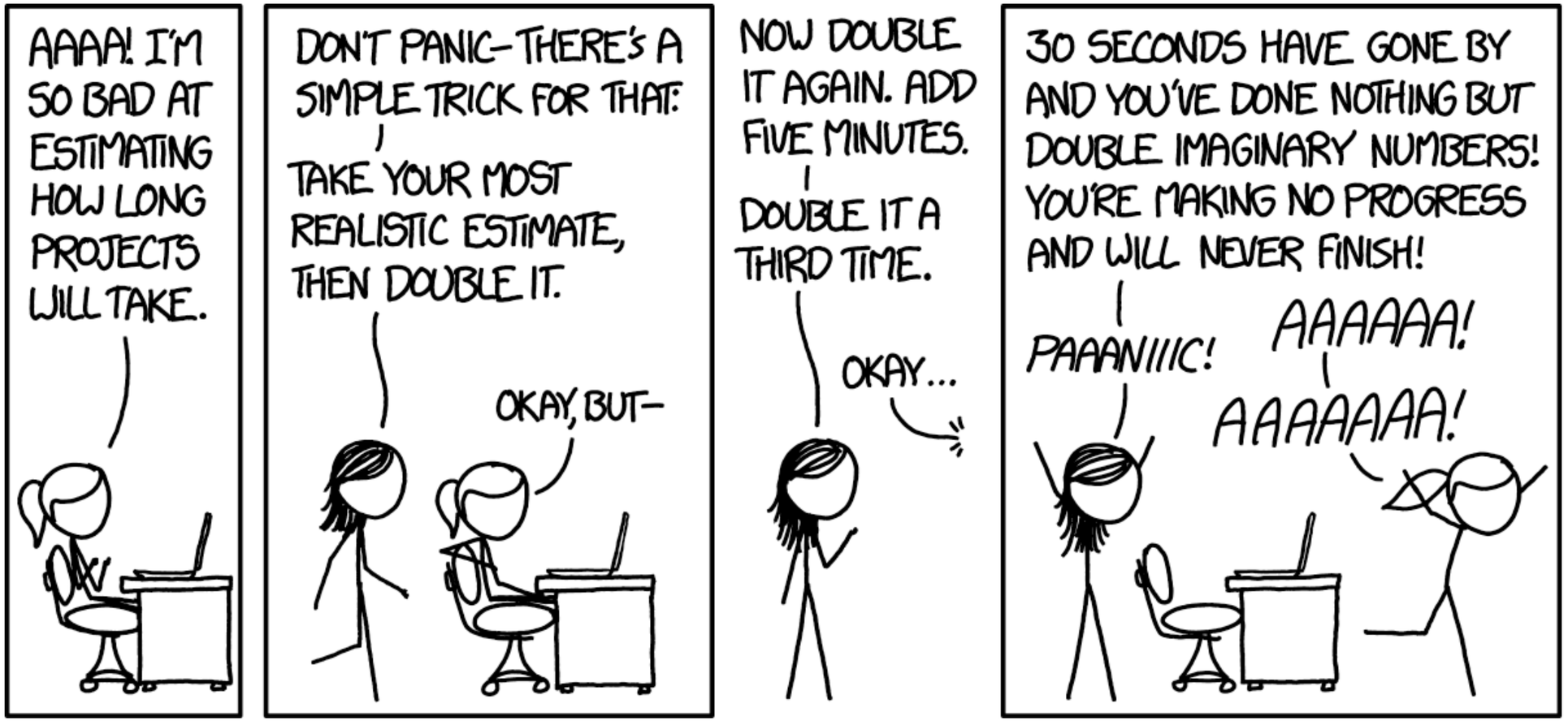
Kubo and the Two Strings (2016)

The BoxTrolls (2014)

ParaNorman (2012)

Coraline (2009)

LAIKA



[Corollary to Hofstadter's Law: Every minute you spend thinking about Hofstadter's Law is a minute you're NOT WORKING AND WILL NEVER FINISH! PAAAAAANIIIIIIC!] - xkcd.com/1658

LAIKA’s Scheduling Needs

1 - GET THE RIGHT RESOURCES FOR THE WORK

Get the right resources for the production, and ensure we’re hiring an appropriate number of people with the right skills

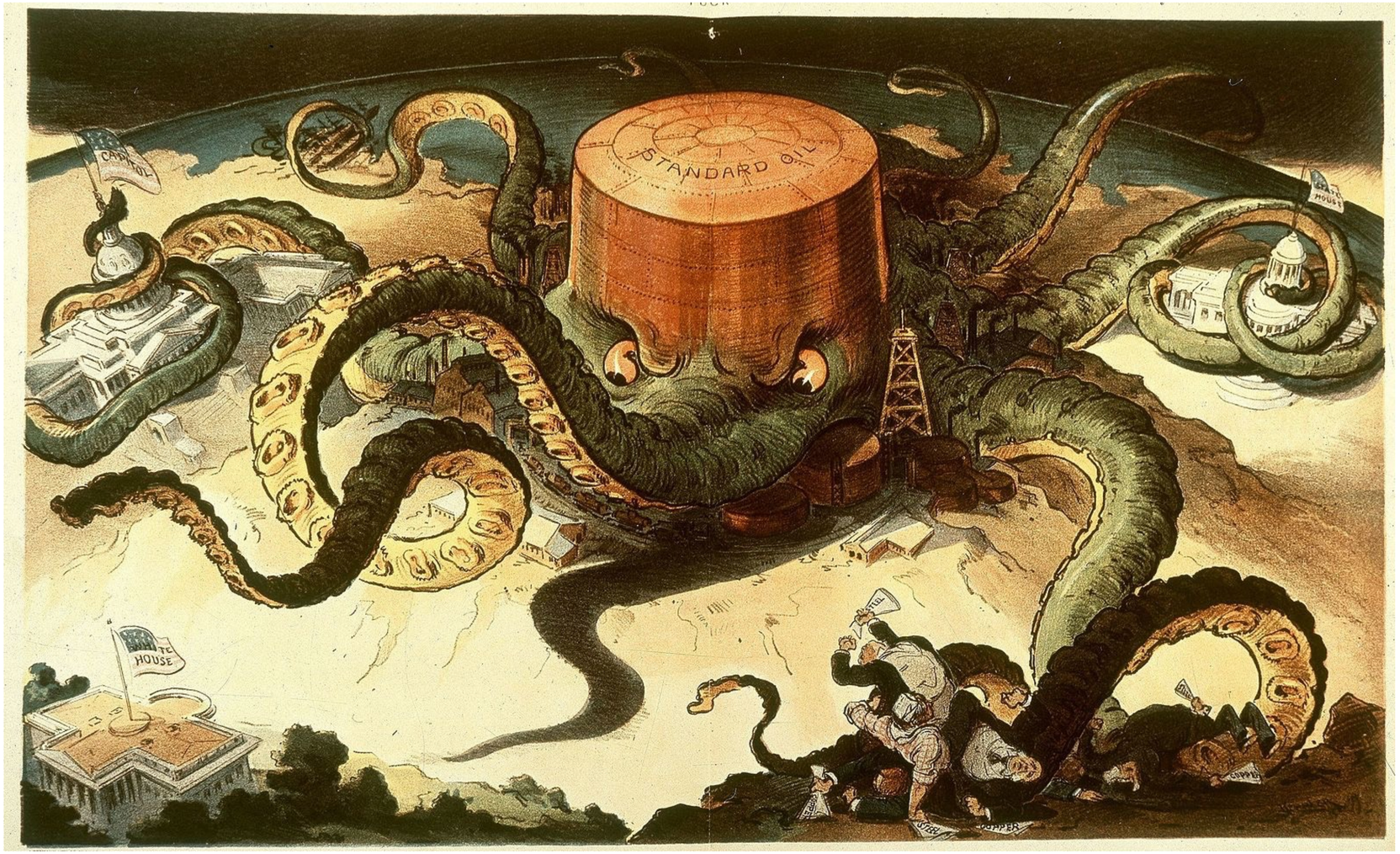
2 - PRIORITIZE WORK

Knowing what is due when, and who should be working on what, lets us make a movie as efficiently as possible.

3 - COMMUNICATE EFFECTIVELY

An effective schedule can help departments (and shops within the departments) know how their work integrates with LAIKA as a whole.

The Ideal Schedule



(but like… a friendly octopus?)

1 - (Reasonably) Accurate, with Room to Accommodate the Unexpected

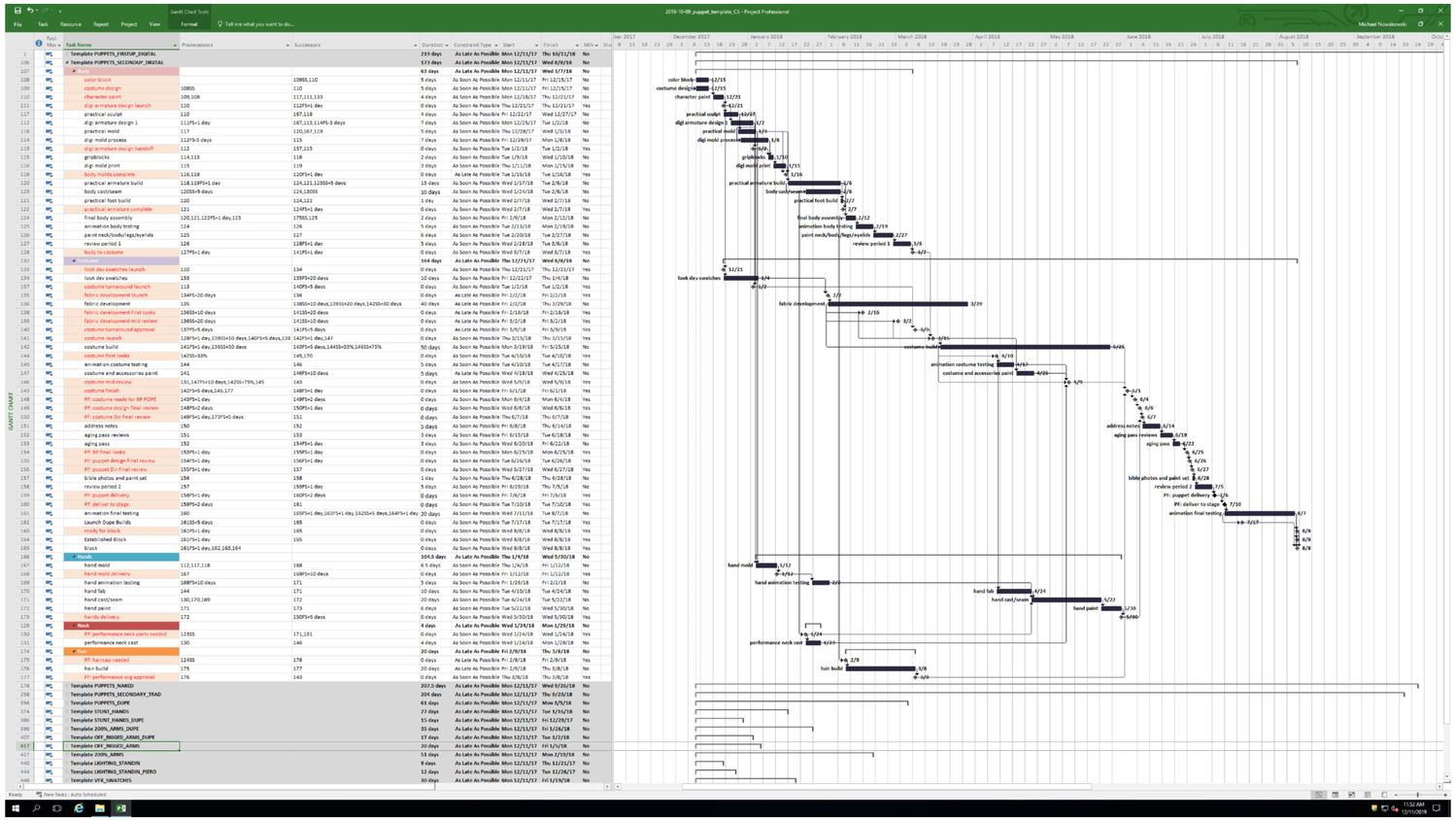
2 - Encompasses All Important Information

3 - Easy to Adjust

4 - Easy to communicate


PAST

Task Templates



“Task Templates” defining work plans for different types of Assets.

Ex.

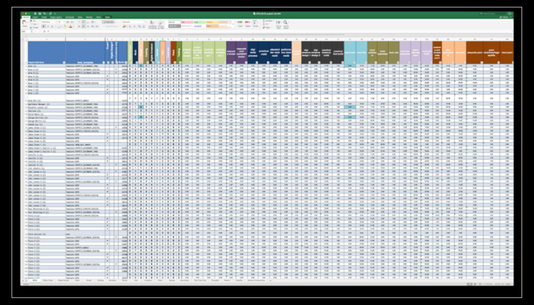
Sir Lionel (1) - First Up Build

Sir Lionel (2) - Dupe Build

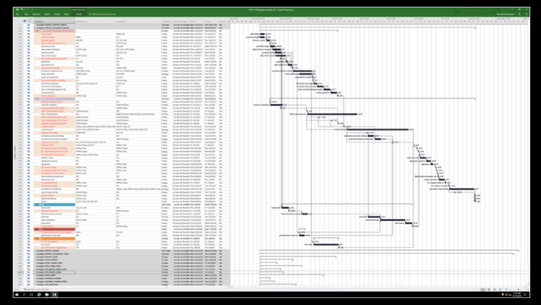
Sir Lionel (3) - Dupe Build

Complexity Doc

task_template	Dupe?	Digital Design?	New Costume only	Build	Digital Sculpt	Mold	Sculpt	Casting	Digital Armature	Hands	Hair	Costume	Paint	Testing	puppet body sculpt	sculpt: breakaparts, neck bib, reduction	modular breakdown 1	modular breakdown 2	maquette sculpt	maquette mold cast/distribution	digi mold process	practical mold	placeholder neck mold
Template PUPPETS_SECONDARY_TRAD				32245	3	1	0	2	1	1	4	4	4	3	4.00	2.00	0.00	0.00	5.00	0.00	0.00	13.00	2.00
Template PUPPETS_SECONDUP_DIGITAL			✔	32950	6	0	0	5	7	3	6	3	4	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Template PUPPETS_SECONDUP_DIGITAL			✔	32952	6	0	0	5	7	3	6	3	4	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Template DUPE	✔			33268	6	0	0	5	4	3	6	3	4	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Template DUPE	✔			38612	6	0	0	5	4	3	6	3	4	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Template PUPPETS_FIRSTUP_DIGITAL				32954	4	4	3	5	4	3	6	3	4	3	4.00	2.00	4.00	2.00	5.00	0.00	6.00	3.00	2.00
Template DUPE	✔			33269	4	0	0	5	4	3	6	3	4	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Template DUPE	✔			39797	4	0	0	5	4	3	6	3	4	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Template DUPE	✔			47602	4	0	0	5	4	3	6	3	4	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Template PUPPETS_NAKED				32293	7	2	1	4	1	1	6	2	3	3	4.00	2.00	9.00	0.00	0.00	0.00	0.00	9.00	2.00
Template PUPPETS_SECONDARY_TRAD				32278	3	1	1	1	2	1	3	2	2	2	4.00	2.00	0.00	0.00	5.00	0.00	0.00	13.00	2.00
Template PUPPETS_SECONDARY_TRAD				32268	3	1	0	7	1	1	4	4	4	3	4.00	2.00	0.00	0.00	5.00	0.00	0.00	13.00	2.00
Template PUPPETS_SECONDARY_TRAD				32271	3	1	3	7	1	1	3	4	4	3	4.00	2.00	0.00	0.00	5.00	0.00	0.00	13.00	2.00
Template PUPPETS_SECONDARY_TRAD				32247	3	1	1	1	1	1	4	2	2	2	4.00	2.00	0.00	0.00	5.00	0.00	0.00	13.00	2.00
Template PUPPETS_FIRSTUP_DIGITAL				32956	7	3	0	4	4	1	4	2	2	2	4.00	2.00	9.00	0.00	5.00	0.00	6.00	2.00	2.00
Template PUPPETS_SECONDARY_TRAD				32964	3	1	1	1	2	3	2	2	3	2	4.00	2.00	0.00	0.00	5.00	0.00	0.00	13.00	2.00
Template PUPPETS_SECONDARY_TRAD				32310	3	1	0	1	1	1	3	3	2	3	4.00	2.00	0.00	0.00	5.00	0.00	0.00	13.00	2.00
Template PUPPETS_SECONDUP_DIGITAL			✔	32968	6	0	0	4	7	3	3	5	6	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Template PUPPETS_FIRSTUP_DIGITAL				32970	4	3	1	4	5	1	4	5	6	3	4.00	2.00	4.00	2.00	0.00	5.00	6.00	2.00	2.00
Template DUPE	✔			32972	4	0	0	4	5	1	4	5	6	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Template DUPE	✔			33273	4	0	0	4	5	1	4	5	6	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Template DUPE	✔				4	0	0	4	5	1	4	5	6	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Template 1050_HALF_NAKED					0	0	1	2	7	1	4	0	6	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.00	0.00
Template PUPPETS_SECONDARY_TRAD				32342	3	1	0	2	1	3	2	3	5	3	4.00	2.00	0.00	0.00	5.00	0.00	0.00	13.00	2.00
Template PUPPETS_SECONDARY_TRAD				32299	3	1	0	7	1	1	2	3	5	3	4.00	2.00	0.00	0.00	5.00	0.00	0.00	13.00	2.00
Template PUPPETS_FIRSTUP_DIGITAL				32974	4	3	2	4	5	1	5	3	2	3	4.00	2.00	4.00	2.00	0.00	5.00	6.00	2.00	2.00
Template DUPE	✔			33275	4	0	0	4	5	1	5	3	2	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Template DUPE	✔			39813	4	0	0	4	5	1	5	3	2	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Template PUPPETS_SECONDUP_DIGITAL			✔	32976	6	4	6	4	4	1	5	2	4	3	0.00	0.00	0.00	0.00	0.00	0.00	6.00	3.00	2.00
Template PUPPETS_SECONDARY_TRAD				32248	3	1	1	1	2	1	3	4	2	3	4.00	2.00	0.00	0.00	5.00	0.00	0.00	13.00	2.00

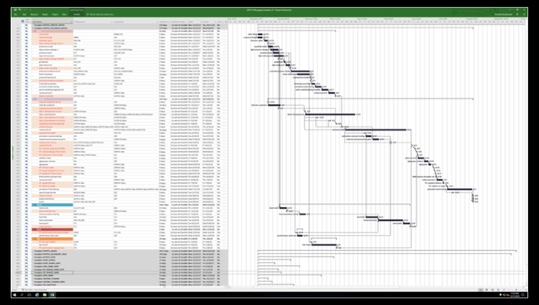


Complexity Doc
(MS Excel)



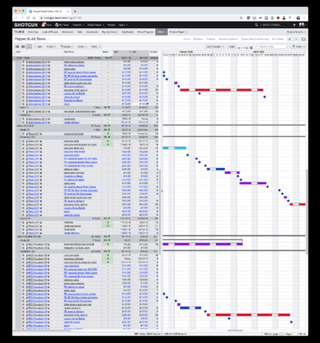
Task Templates
(MS Project)

Excel To Project



Asset Schedule File
(MS Project)

Project to Shotgun



Build Tasks
(Shotgun)

Limitations

!!!! Limited Modeling Capabilities
Relying on start/end dates and PM/coordinator knowledge to maintain dependencies

!!!! Cumbersome Roundtrip
The roundtrip is laborious, and the only other option is hand-adjusting.

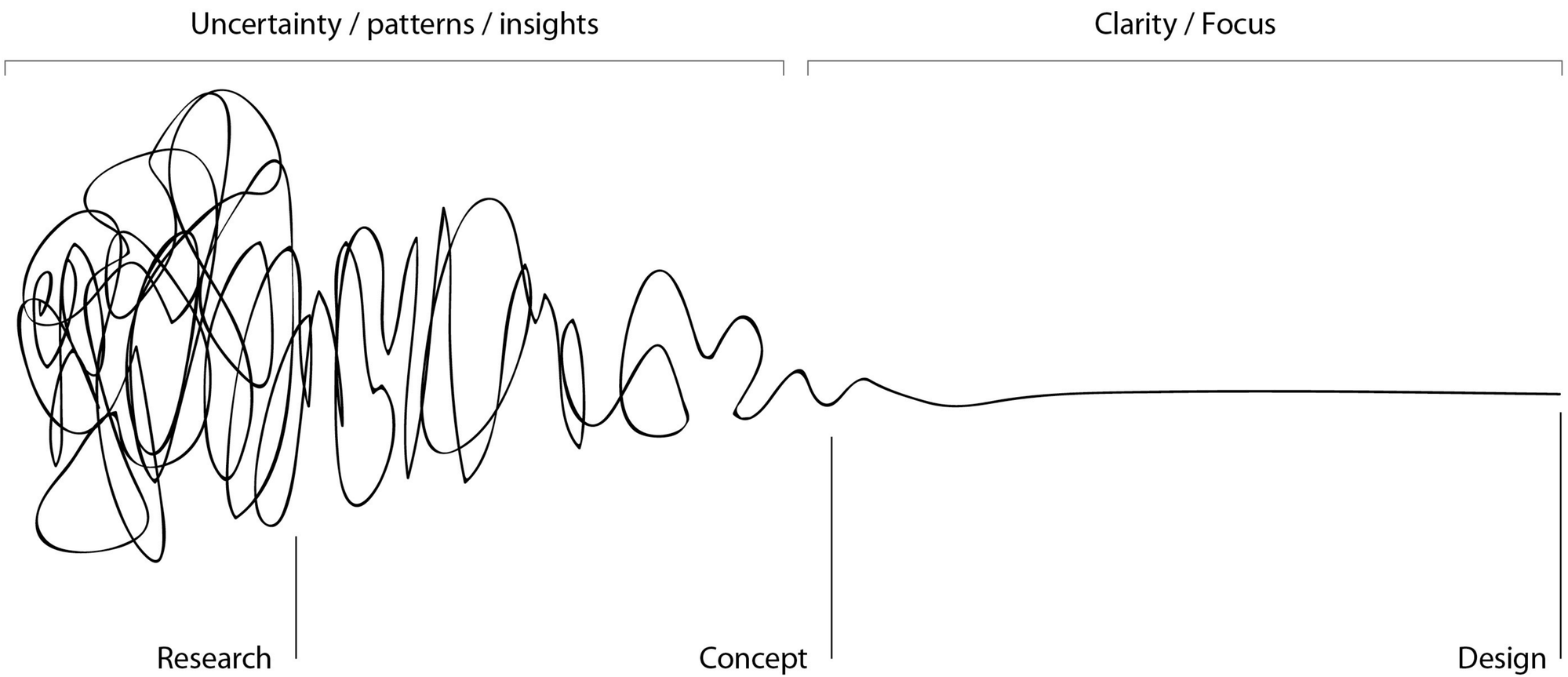
!!!! Visualization
Hard to get a sense of the overall build schedule
…or of situations where resources might be over/under-utilized.

!!!! Manual Resource Leveling
Leveling by hand means adjusting start/end dates, and hoping that adjustments for one shop don't stack work for another.

!!!! Actuals
No one trusts the schedule, so no one maintains it.


PRESENT

Design And Development



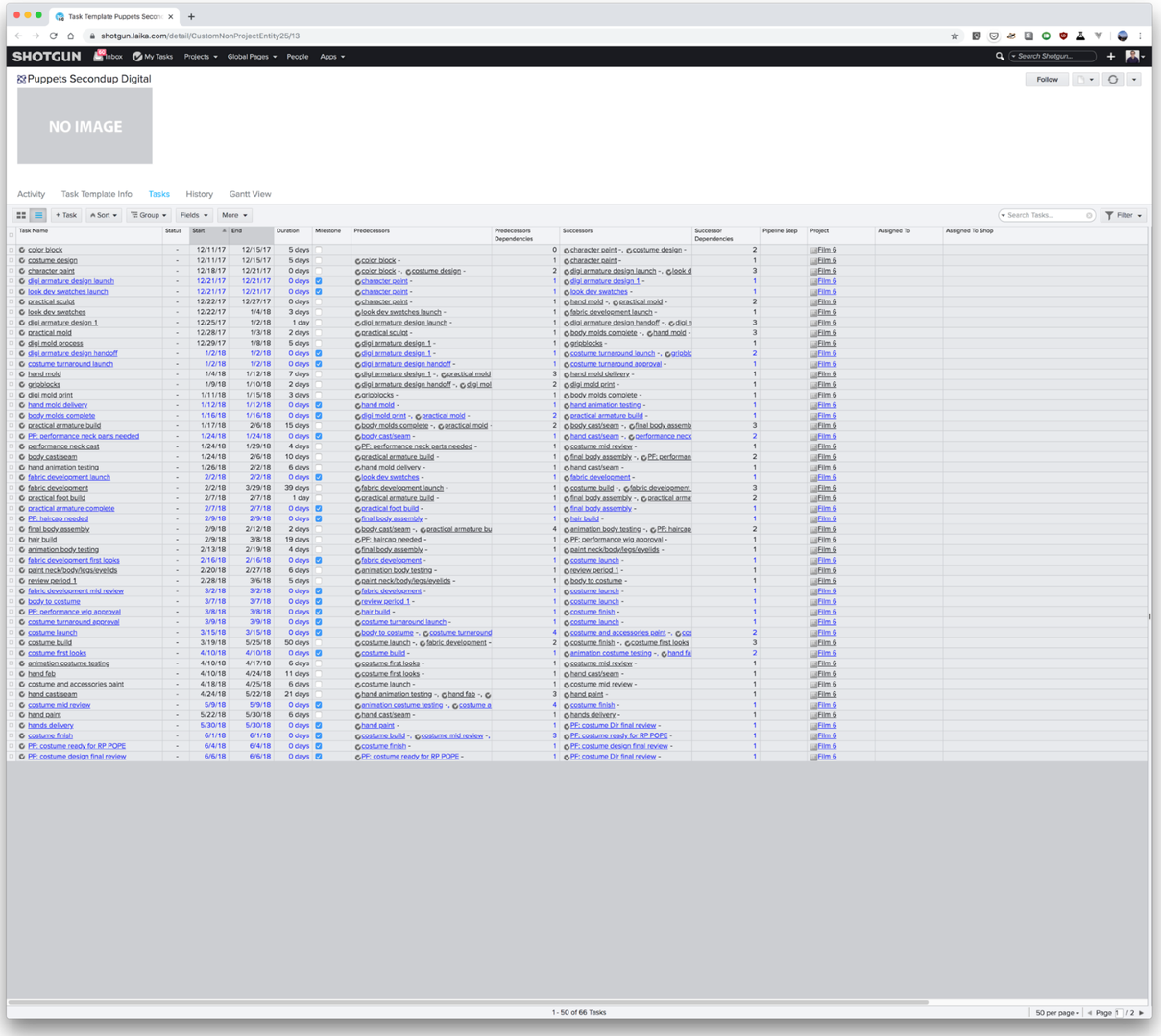
(The Process of Design Squiggle by Damien Newman, thedesignsquiggle.com)

Shotgun As Backend

1 - Existing Tracking / Reporting Tools Still Worked

2 - Familiar UI for Filtering / statuses / assignments / adjustments

3 - Minimized Scope Creep



Gantt - Puppets Firstup Digital

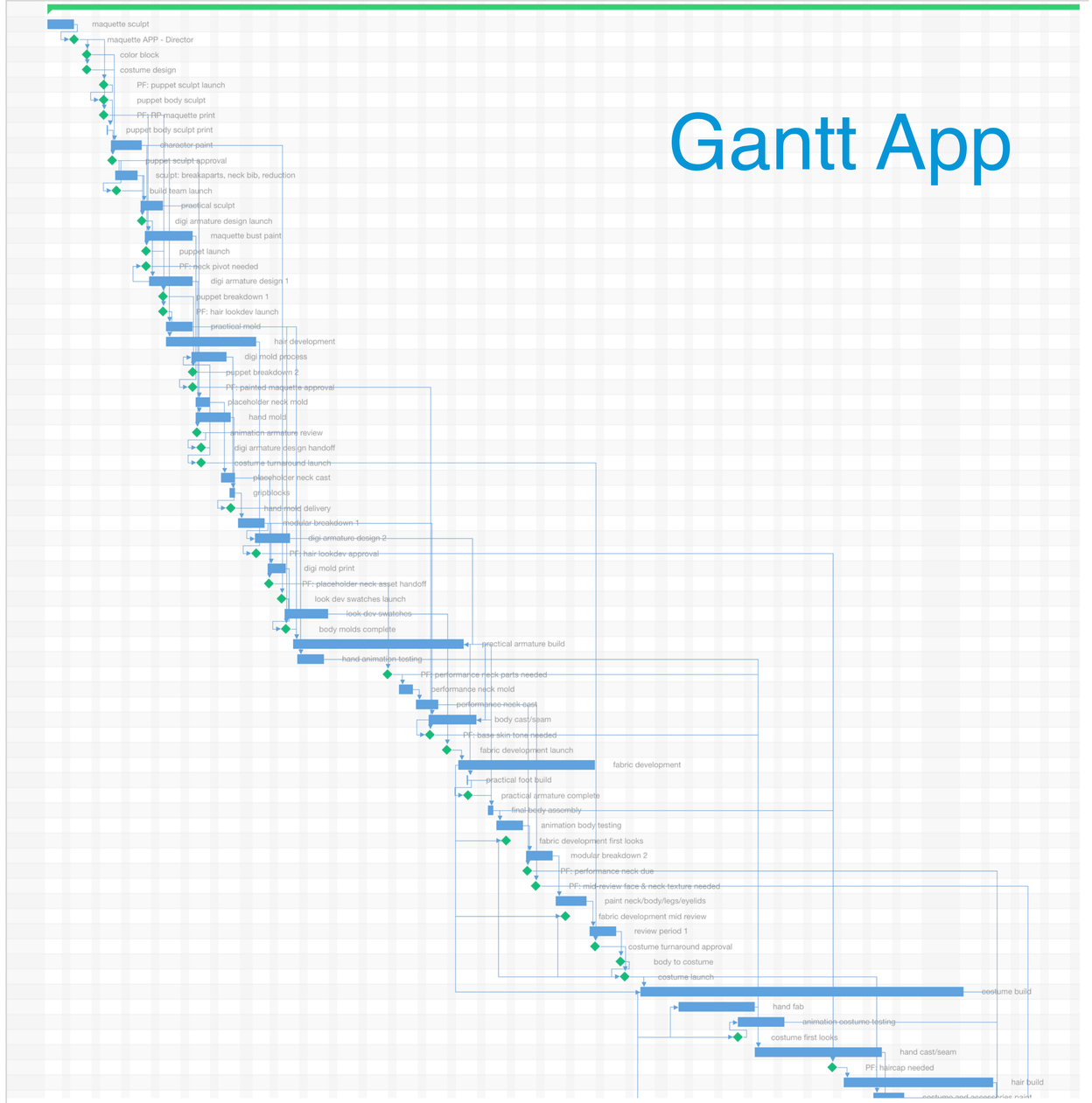
Today | Undo | Redo | Add | Remove | Refresh Data | Print | Save

Tasks

#	Task Name	Start	Finish	Duration	Predecess…	Successors	Constraint	Manual mo…	Assigne
1	**Puppets Firstup Digital**	01/02/2018	10/31/2018	209 d			Start no earlier than	No	
2	maquette sculpt	01/02/2018	01/08/2018	5 d		3	As soon as possible	No	
3	maquette APP - Director	01/08/2018	01/08/2018	0 d	2	4FS+3;5FS…	As soon as possible	No	
4	color block	01/11/2018	01/11/2018	0 d	3FS+3	10	As soon as possible	No	
5	costume design	01/11/2018	01/11/2018	0 d	3FS+3	10FS+3	As soon as possible	No	
6	PF: puppet sculpt launch	01/15/2018	01/15/2018	0 d	3FS+5	7	As soon as possible	No	
7	puppet body sculpt	01/15/2018	01/15/2018	0 d	6	9	As soon as possible	No	
8	PF: RP maquette print	01/15/2018	01/15/2018	0 d	3FS+5	16;21FS+10	As soon as possible	No	
9	puppet body sculpt print	01/16/2018	01/16/2018	1 d	7	11FS+1	As soon as possible	No	
10	character paint	01/17/2018	01/24/2018	6 d	5FS+3;4	17FS+1;16…	As soon as possible	No	
11	puppet sculpt approval	01/17/2018	01/17/2018	0 d	9FS+1	13FS+1;12…	As soon as possible	No	
12	sculpt: breakaparts, neck bib, redu…	01/18/2018	01/23/2018	4 d	11	15FS+1;14	As soon as possible	No	
13	build team launch	01/18/2018	01/18/2018	0 d	11FS+1	15	As soon as possible	No	
14	practical sculpt	01/24/2018	01/29/2018	4 d	12	22;28	As soon as possible	No	
15	digi armature design launch	01/24/2018	01/24/2018	0 d	12FS+1;13	19FS+1	As soon as possible	No	
16	maquette bust paint	01/25/2018	02/05/2018	8 d	8;10	26	As soon as possible	No	
17	puppet launch	01/25/2018	01/25/2018	0 d	10FS+1	20FS+2	As soon as possible	No	
18	PF: neck pivot needed	01/25/2018	01/25/2018	0 d	19SS-1	27	As soon as possible	No	
19	digi armature design 1	01/26/2018	02/05/2018	7 d	15FS+1	29FS+1;18…	As soon as possible	No	
20	puppet breakdown 1	01/29/2018	01/29/2018	0 d	17FS+2	25FS+5	As soon as possible	No	
21	PF: hair lookdev launch	01/29/2018	01/29/2018	0 d	8FS+10	23	As soon as possible	No	
22	practical mold	01/30/2018	02/05/2018	5 d	11;14	42;43;28	As soon as possible	No	
23	hair development	01/30/2018	02/20/2018	15 d	21	37	As soon as possible	No	
24	digi mold process	02/05/2018	02/13/2018	7 d	30FS-3	33	As soon as possible	No	
25	puppet breakdown 2	02/05/2018	02/05/2018	0 d	20FS+5	33	As soon as possible	No	
26	PF: painted maquette approval	02/05/2018	02/05/2018	0 d	16	49FS+20	As soon as possible	No	
27	placeholder neck mold	02/06/2018	02/09/2018	4 d	18;19	32	As soon as possible	No	
28	hand mold	02/06/2018	02/14/2018	7 d	14;22;11;19	34	As soon as possible	No	
29	animation armature review	02/06/2018	02/06/2018	0 d	19FS+1	30FS+1;43…	As soon as possible	No	
30	digi armature design handoff	02/07/2018	02/07/2018	0 d	29FS+1	24FS-3;31	As soon as possible	No	
31	costume turnaround launch	02/07/2018	02/07/2018	0 d	30	63FS+5	As soon as possible	No	
32	placeholder neck cast	02/12/2018	02/15/2018	4 d	27	39FS+5	As soon as possible	No	
33	gripblocks	02/14/2018	02/15/2018	2 d	24;25	35	As soon as possible	No	
34	hand mold delivery	02/14/2018	02/14/2018	0 d	28	44FS+10	As soon as possible	No	
35	modular breakdown 1	02/16/2018	02/22/2018	4 d	33	36FS-3;38;48	As soon as possible	No	
36	digi armature design 2	02/20/2018	02/28/2018	7 d	35FS-3	43FF+5	As soon as possible	No	
37	PF: hair lookdev approval	02/20/2018	02/20/2018	0 d	23	71	As soon as possible	No	
38	digi mold print	02/23/2018	02/27/2018	3 d	35	42	As soon as possible	No	
39	PF: placeholder neck asset handoff	02/23/2018	02/23/2018	0 d	32FS+5	45FS+20	As soon as possible	No	
40	look dev swatches launch	02/26/2018	02/26/2018	0 d	10	41	As late as possible	No	
41	look dev swatches	02/27/2018	03/09/2018	9 d	40	50FS+20	As late as possible	No	
42	body molds complete	02/27/2018	02/27/2018	0 d	22;38	43FS+1	As late as possible	No	
43	practical armature build	03/01/2018	04/10/2018	29 d	42FS+1;22…	52;48FF+3;…	As soon as possible	No	
44	hand animation testing	03/02/2018	03/08/2018	5 d	34FS+10	70	As soon as possible	No	
45	PF: performance neck parts needed	03/23/2018	03/23/2018	0 d	39FS+20	46;70	As soon as possible	No	
46	performance neck mold	03/26/2018	03/29/2018	4 d	45	47	As soon as possible	No	
47	performance neck cast	03/30/2018	04/04/2018	4 d	46	58FS+15;59	As soon as possible	No	
48	body cast/seam	04/02/2018	04/13/2018	10 d	43FF+3;35	54;49SS	As soon as possible	No	
49	PF: base skin tone needed	04/02/2018	04/02/2018	0 d	48SS;26FS…	70;59FS+20	As soon as possible	No	
50	fabric development launch	04/06/2018	04/06/2018	0 d	41FS+20	51	As late as possible	No	
51	fabric development	04/09/2018	05/11/2018	25 d	50	56SS+10;6…	As late as possible	No	
52	practical foot build	04/11/2018	04/11/2018	1 d	43	53;54	As soon as possible	No	
53	practical armature complete	04/11/2018	04/11/2018	0 d	52	54FS+1	As soon as possible	No	
54	final body assembly	04/16/2018	04/17/2018	2 d	43;48;52;5…	55;71	As soon as possible	No	
55	animation body testing	04/18/2018	04/24/2018	5 d	54	57	As soon as possible	No	
56	fabric development first looks	04/20/2018	04/20/2018	0 d	51SS+10	65SS+20	As late as possible	No	
57	modular breakdown 2	04/25/2018	05/01/2018	5 d	55	60	As soon as possible	No	
58	PF: performance neck due	04/25/2018	04/25/2018	0 d	47FS+15	78FS+5	As soon as possible	No	
59	PF: mid-review face & neck texture…	04/27/2018	04/27/2018	0 d	49FS+20;47	78;80	As soon as possible	No	
60	paint neck/body/legs/eyelids	05/02/2018	05/09/2018	6 d	57	62	As soon as possible	No	
61	fabric development mid review	05/04/2018	05/04/2018	0 d	51SS+20	65SS+10	As late as possible	No	
62	review period 1	05/10/2018	05/16/2018	5 d	60	64FS+1	As soon as possible	No	
63	costume turnaround approval	05/11/2018	05/11/2018	0 d	31FS+5	65FS+5	As late as possible	No	
64	body to costume	05/17/2018	05/17/2018	0 d	62FS+1	65FS+1	As soon as possible	No	
65	costume launch	05/18/2018	05/18/2018	0 d	64FS+1;61…	66FS+1;73	As soon as possible	No	
66	costume build	05/22/2018	08/06/2018	49 d	65FS+1;51…	77FS+5;69…	As soon as possible	No	
67	hand fab	05/31/2018	06/18/2018	12 d	69SS-10	70	As soon as possible	No	
68	animation costume testing	06/14/2018	06/25/2018	7 d	69	78	As soon as possible	No	
69	costume first looks	06/14/2018	06/14/2018	0 d	66SS+16.1…	68;67SS-10	As soon as possible	No	
70	hand cast/seam	06/18/2018	07/18/2018	22 d	67;49;45;44	74	As soon as possible	No	
71	PF: haircap needed	07/06/2018	07/06/2018	0 d	54;37	72	As late as possible	No	
72	hair build	07/09/2018	08/13/2018	21 d	71	76	As late as possible	No	

01/01/2018 | 02/01/2018 | 03/01/2018 | 04/01/2018 | 05/01/2018 | 06/01/2018 | 07/01/2018 | 08/01/2018

25 Dec | 01 Jan | 08 Jan | 15 Jan | 22 Jan | 29 Jan | 05 Feb | 12 Feb | 19 Feb | 26 Feb | 05 Mar | 12 Mar | 19 Mar | 26 Mar | 02 Apr | 09 Apr | 16 Apr | 23 Apr | 30 Apr | 07 May | 14 May | 21 May | 28 May | 04 Jun | 11 Jun | 18 Jun | 25 Jun | 02 Jul | 09 Jul | 16 Jul | 23 Jul | 30 Jul | 06 Aug | 13 Aug | 20 Aug | 27 Aug



Gantt App

Custom Data Model

TASKS

A unit of work.

Key Fields:

- Start Date
- End Date
- Duration - duration of task in calendar working days
- Headcount* - utilization of a resource assigned to this task (ex. 0.5 = 50% utilization)
- Working Days* - total resource utilization (Headcount * duration)

- Milestone
- Assignees
- Assigned to Shop*
- Status
- Link (which Asset, Shot, or Task Template they're associated with)

- Predecessors*
- Constraint Type*
- Constraint Date*
- Manually Scheduled*

- Positions*

- Consilium Positions*
- Consilium Locked*

DEPENDENCIES*

Defines a relationship between two Tasks.

Key Fields:

- Source Task
- Destination Task (predecessor)
- Dependency Type (FF, FS, SS, and SF… aka "the useless one")
- Offset

POSITION*

An employee's role at LAIKA (ingested from Production Accounting).

Fields:

- Consilium Weight
- Consilium Goal
- Consilium Limit
- Consilium Scale In
- Consilium Scale Out

- Max Workload - maximum utilization (may be less than / greater than 1)
- Assignment Positions - indicates other equivalent positions that can be used when distributing work after leveling (see "Generative Scheduling to Shotgun" for more info).

Custom Data Model

SHOT

A shot in the film.

UNIT*

A space on our stages that can be used for animation.

HUMANUSER

A person who can be assigned to Tasks.

TASK TEMPLATE*

Holds a set of Tasks and dependencies to “stamp” onto another entity.

ASSET

A physical or digital Asset.
For each department, we’ve developed a unique hierarchy of Assets to help organize the work to be done.

Art Hierarchy: Location / Set / Set Build / Set Parts
Puppets Hierarchy: Character / Puppet (Design) / Puppet Build / Puppet Subasset
Rapid: Character / Rapid Character / Variant

Fields (if used as resources like Positions):

- Name
- Delivery Date (“Earliest Oneline Block”, in LAIKA parlance)

- Consilium Weight*
- Consilium Goal*
- Consilium Limit*
- Consilium Scale In*
- Consilium Scale Out*

Bid Process

SHOT

A shot in the film.

UNIT*

A space on our stages that can be used for filming a scene.

HUMANUSER

A person who can be assigned to Tasks.

TASK TEMPLATE*

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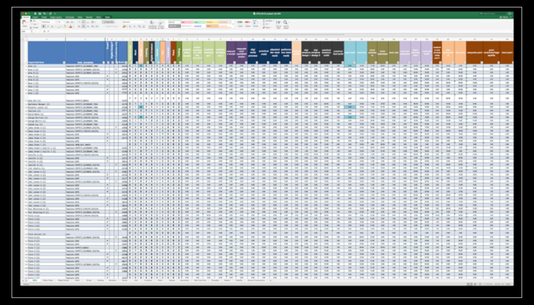
For each department, we’ve developed a unique hierarchy of Assets to help organize the work to be done.

Art Hierarchy: Location / Set / Set Build / Set Parts
Puppets Hierarchy: Character / Puppet (Design) / Puppet Build / Puppet Subasset
Rapid: Character / Rapid Character / Variant

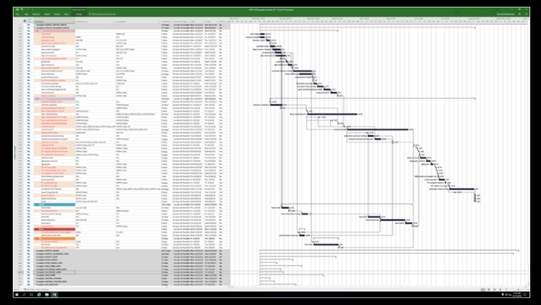
Fields (if used as resources like Positions):

- Name
- Delivery Date (“Earliest Oneline Block”, in LAIKA parlance)

- Consilium Weight*
- Consilium Goal*
- Consilium Limit*
- Consilium Scale In*
- Consilium Scale Out*

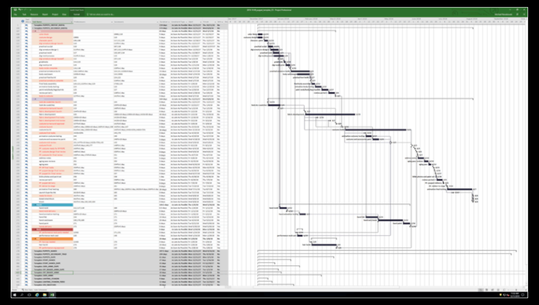


Complexity Doc
(MS Excel)



Task Templates
(MS Project)

Excel To Project

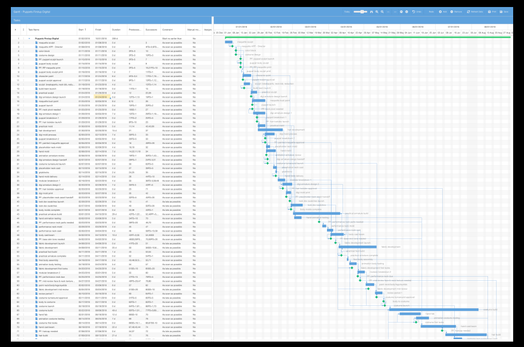


Asset Schedule File
(MS Project)

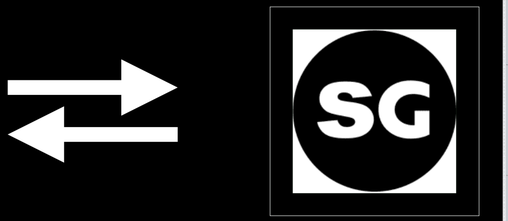
Project to Shotgun

Build Tasks
(Shotgun)

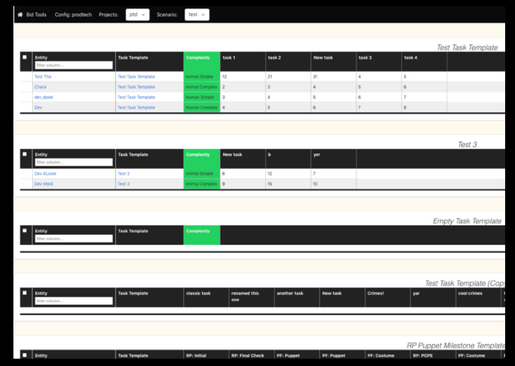
Old Bid Workflow



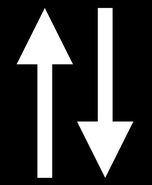
Bryntum Gantt

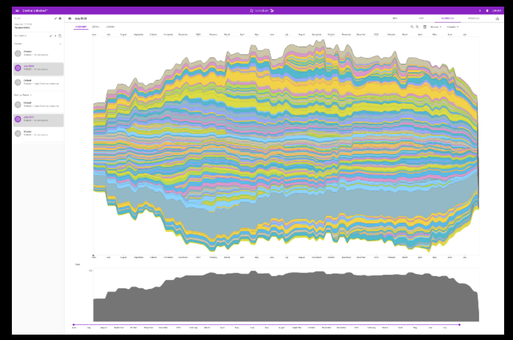


Shotgun



Bid App





Generative Scheduling

New Bid Workflow

Effective Data Modeling

1- MODEL WORKFLOWS

Gather information from shop leads, learn about show-specific needs.

2- BUILD TEMPLATES

As simple as possible, but no simpler.

Good:

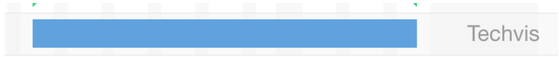
[“Techvis”]

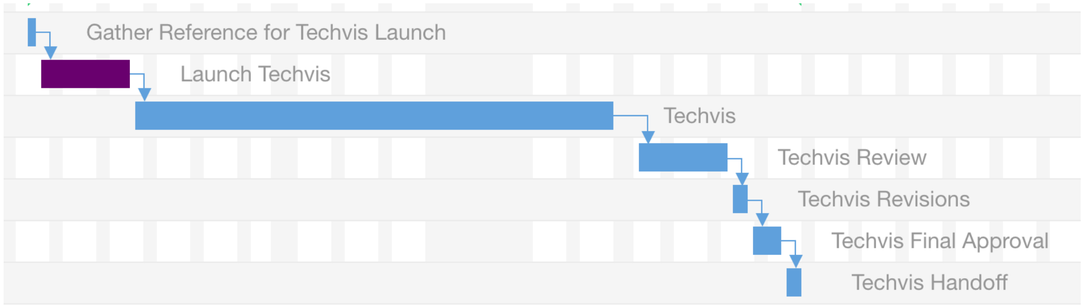
Bad:

[“Gather Reference for Techvis Launch”, “Launch Techvis”, “Techvis”, “Techvis Review”, “Techvis Revisions”, “Techvis Final Approval”]

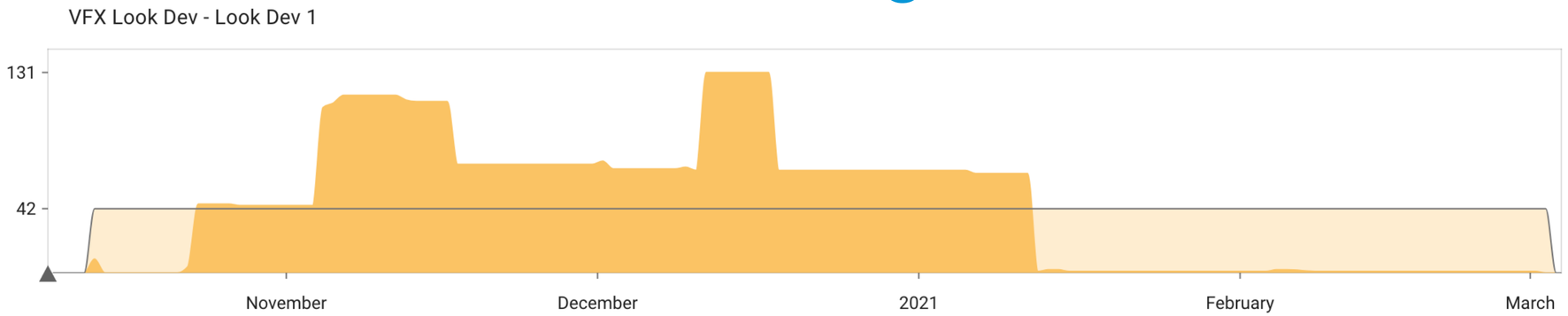
3- REVIEW AND ADJUST TEMPLATES

Capture accurate actuals, do build post-mortems.



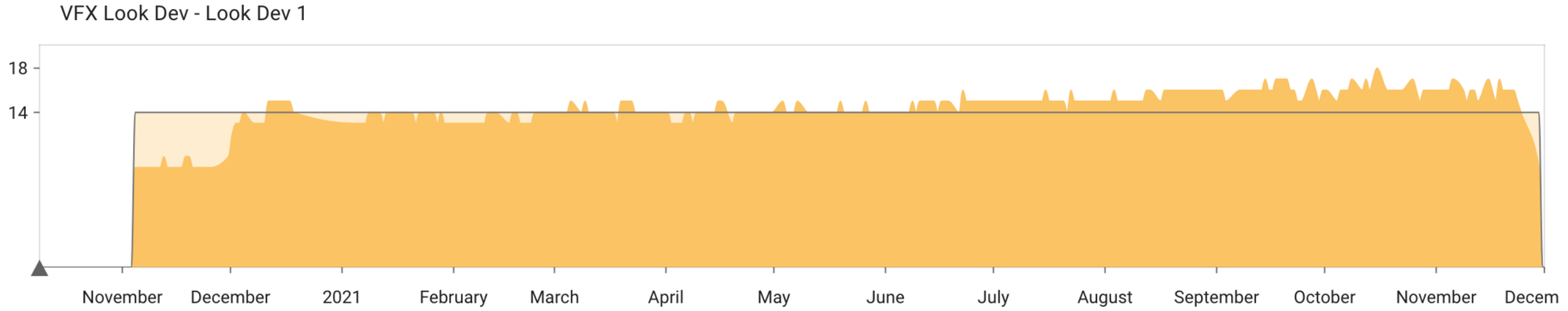


Leveling



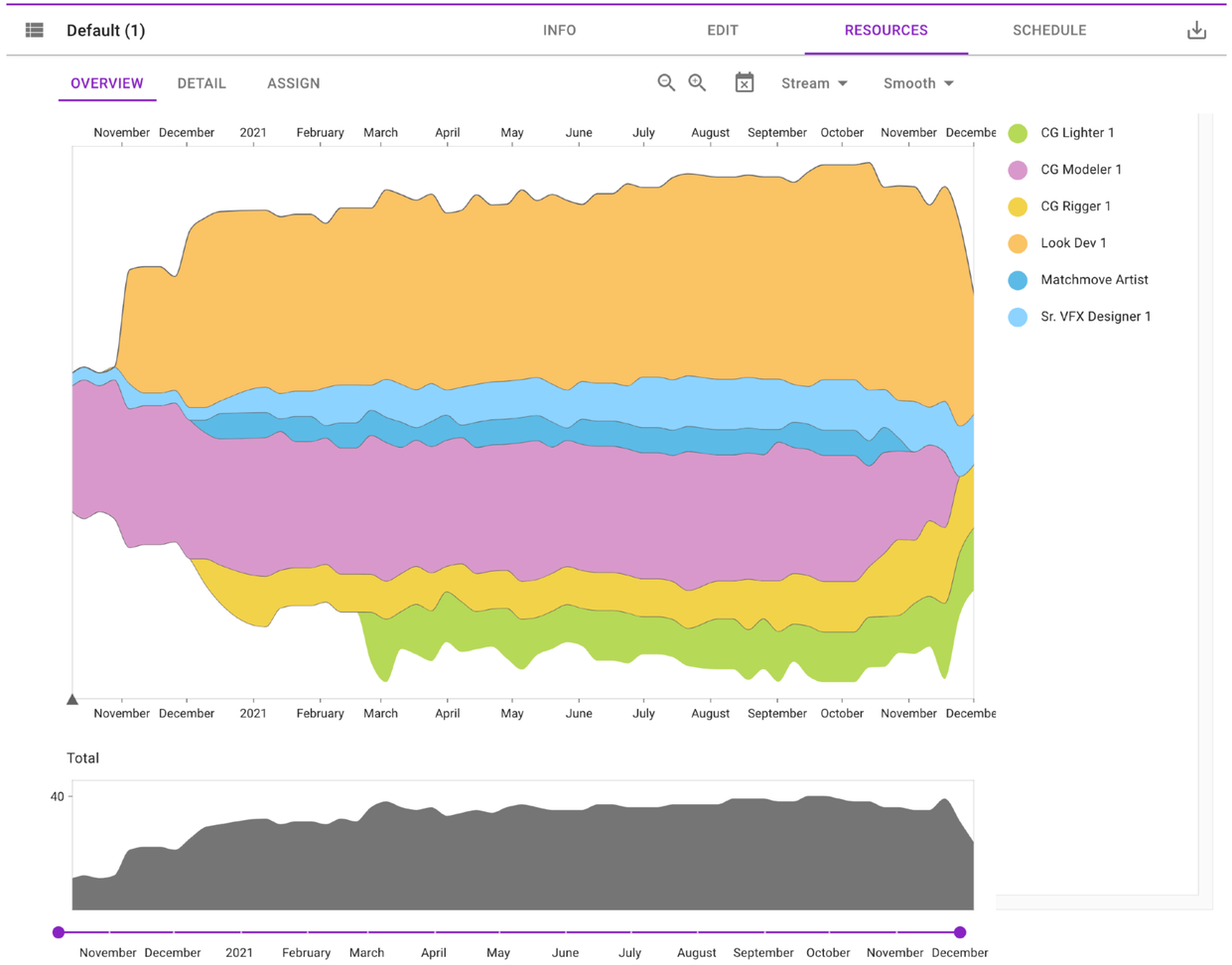
Weight	Goal	Limit	Scale In	Scale Out
1	42	0	0	0

VFX Look Dev - Resource Leveling — Before (Above) and After (below)



Weight	Goal	Limit	Scale In	Scale Out
1	14	0	0	0

Shotgun Generative Scheduling



New tool for generating optimized resource-leveled schedules.

Generative Scheduling - Resource Parameters

Resource Parameters

Resource	Weight	Goal	Limit	Scale In	Scale Out
VFX Camera / Layout - Matchmove Artist	1	2	2	0	0
VFX Lighting - CG Lighter 1	1	6	7	0	0
VFX Look Dev - Look Dev 1	1	0	0	0	0
VFX Matte - Sr. VFX Designer 1	1	1	1	0	0
VFX Model - CG Modeler 1	1	6	7	0	0
VFX Rigging - CG Rigger 1	1000	5	5	0	0

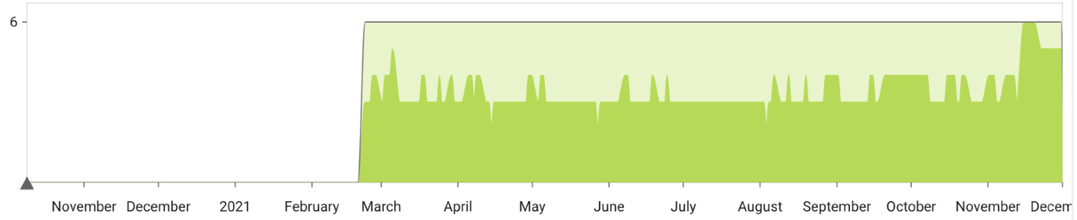
“Weight” - the relative importance of meeting a resource's target curve

"Goal" - the ideal number of tasks for a resource at any one time,

"Limit" - the upper bound on tasks

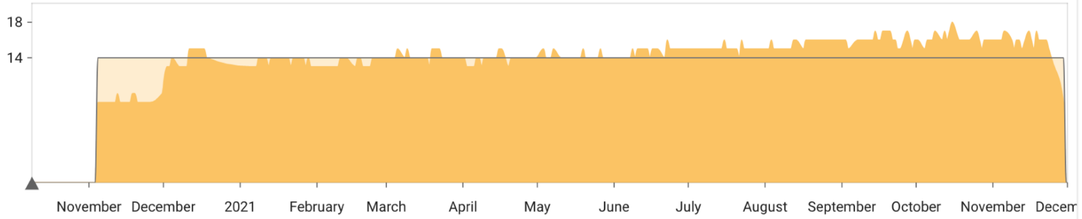
“Scale in/out” - the number of days over which to scale the resource curve in and out.

VFX Lighting - CG Lighter 1



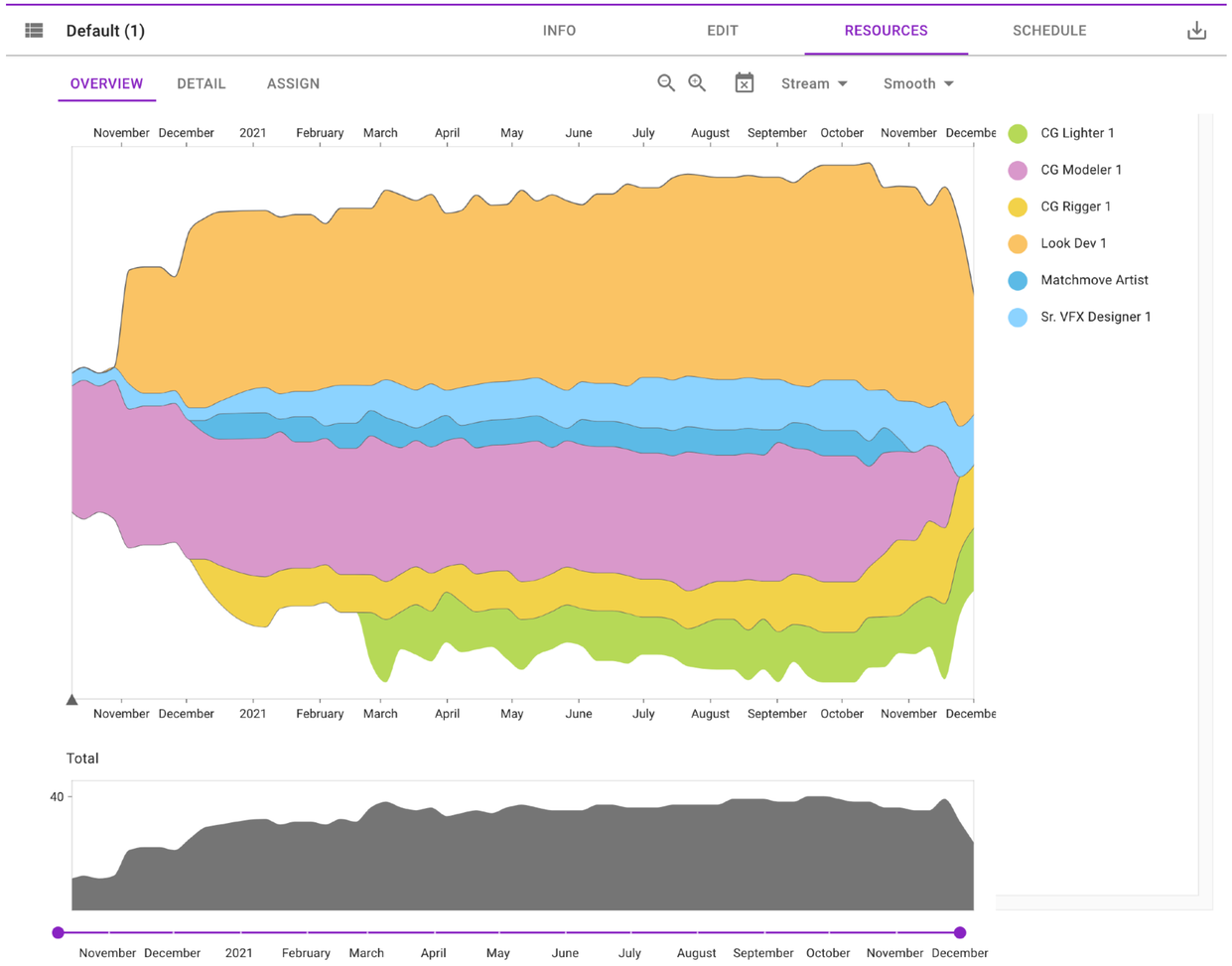
Weight	Goal	Limit	Scale In	Scale Out
1	6	7	0	0

VFX Look Dev - Look Dev 1



Weight	Goal	Limit	Scale In	Scale Out
1	14	0	0	0

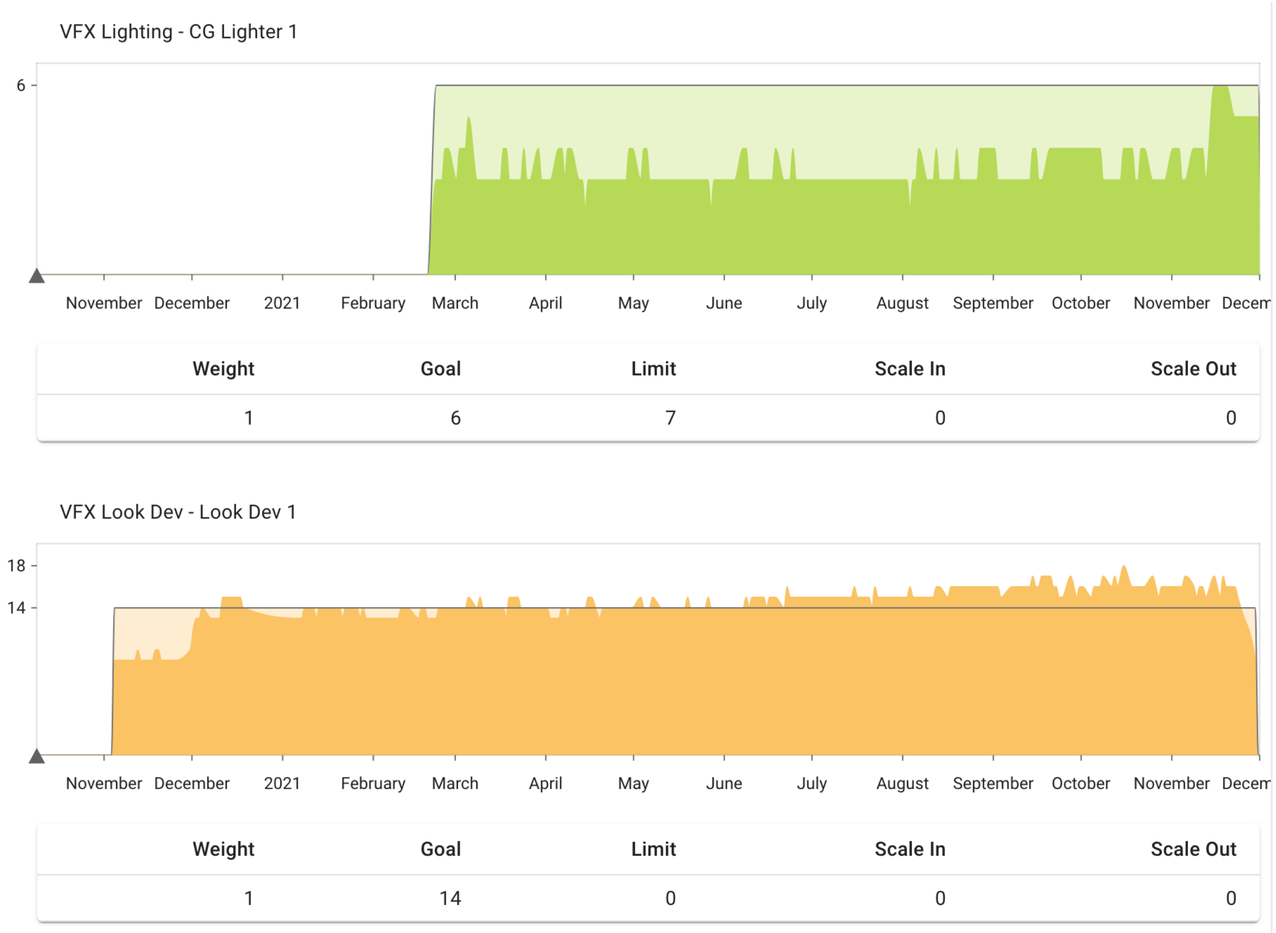
Generative Scheduling - Resources / Overview



A stream graph showing all the resources together.

From this tab, a user can identify points of concern, then switch to the Detail and Assign views to take a closer look.

Generative Scheduling - Resources / Detail



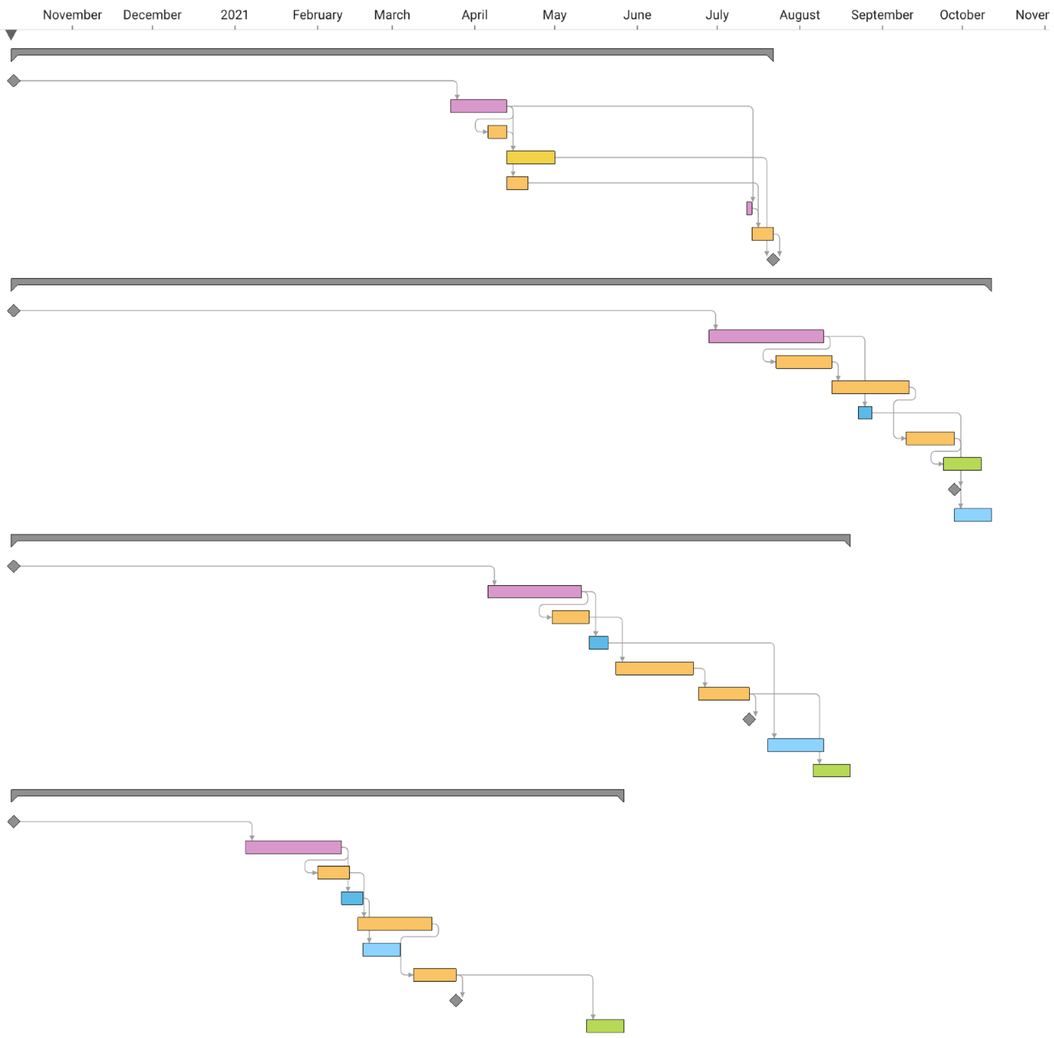
Shows target resource curves (depicted as a line), along with the actual utilization of the resource in the current scenario.

Load multiple resource curves at the same time to check the tradeoffs the app has made in its schedule

Generative Scheduling - Resources / Assign

Gantt view showing Tasks divided among the required resources.

Generative Scheduling - Resources / Gantt



Full Gantt chart representation of the plan, offering insight into the constraints and dependencies in a user's schedule.

Preparing Data for Generative Scheduling
1 - Asset Fabrication Leveling

1. TASKS FOR EACH ASSET

Tasks and their dependencies are loaded from Shotgun. Any Task that doesn’t have dependencies is locked in place.

2. DEPENDENCIES BETWEEN ASSETS

Relationships between builds.

Example: Asset Dependencies for Foodles / Foodles Old

Foodles A (1)

Foodles A (2) -- Launch Dupe Builds (Foodles A (1))

Foodles A (3) -- Launch Dupe Builds (Foodles A (1))

Foodles B (1) -- Launch Dupe Builds (Foodles A (1))

Foodles B (2) -- Launch Dupe Builds (Foodles B (1))

Foodles B (3) -- Launch Dupe Builds (Foodles B (1))

Foodles C (1) -- Launch Dupe Builds (Foodles A (1))

Foodles D (1) -- Costume director final review (Foodles A (1))

Foodles D (2) -- Costume director final review (Foodles D (1))

…

Foodles Old (1)

Foodles Old (1) -- Launch Dupe Builds (Foodles A (1))

Foodles Old (2) -- Launch Dupe Builds

3. POSITION ASSIGNMENTS FOR EACH TASK

Assign generic positions (instead of entering 15 different Costume Fabricators, a generic "Costume Fabricator" is used to indicate a class of position)

4. CUSTOM CONSTRAINTS

Additional restrictions on the scheduling engine beyond the inter-task dependencies.

For Puppets:

a. Each Asset must hit its block date

b. Locking any in-progress/complete/approved Task in-place (the engine shouldn't adjust its dates)

c. Locking certain builds in-place in their entirety.

Certain builds are already in progress, or need to deliver by certain dates, so all of their Tasks were locked in place and the engine scheduled the remainder of the Tasks around them.

Preparing Data for Generative Scheduling
2 - Scene Leveling

1. LOAD SCENE TASKS FROM SHOTGUN

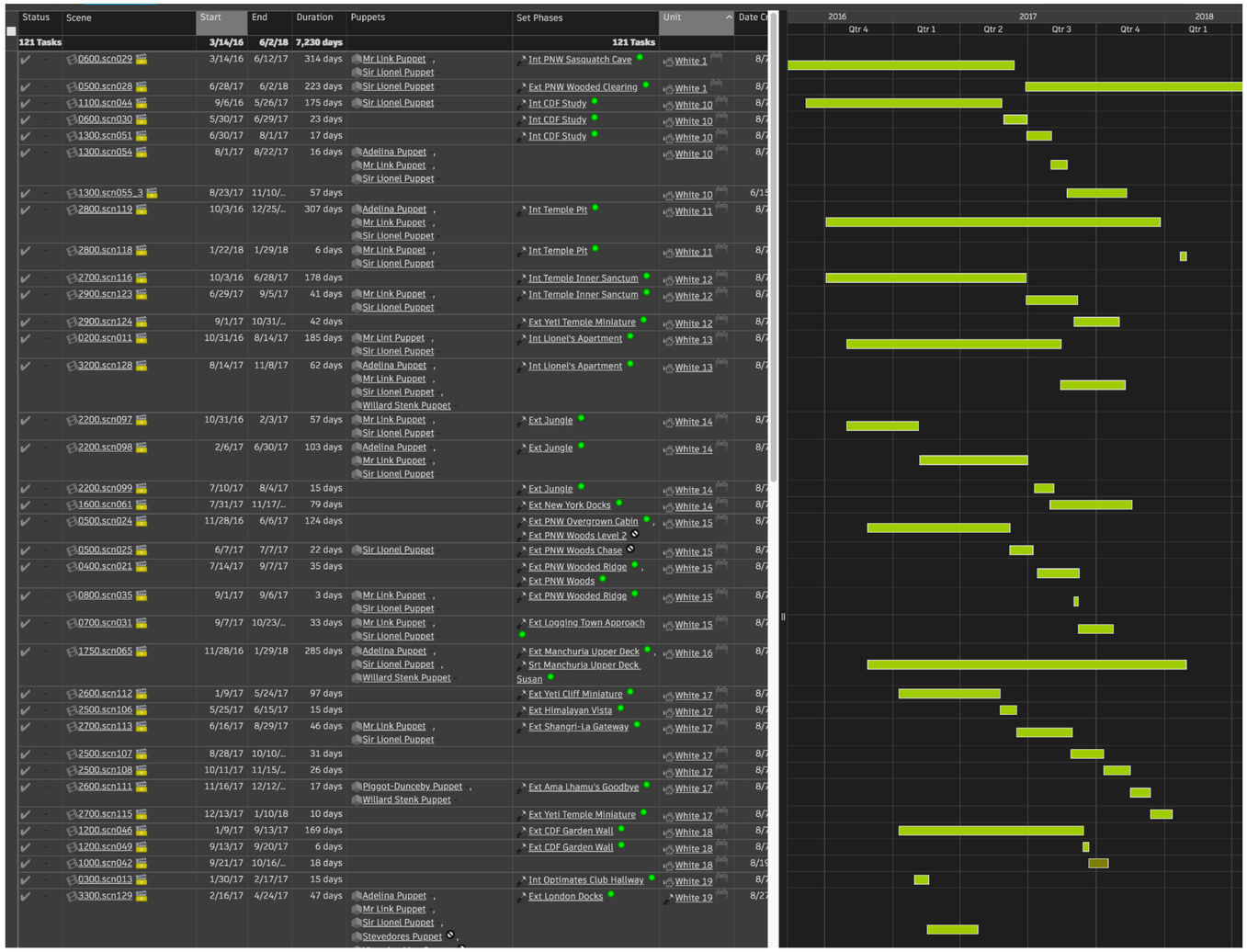
The scenes in the film and the Assets assigned to each scene.

2. GENERATE RESOURCES FOR EACH TASK

Assign Assets, Animators, and Units (based on Set Size).

0700.scn023 Resource List:

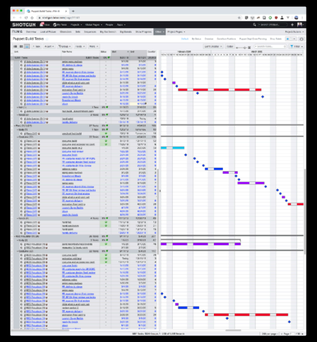
- **Ext Front Lawn: 1**
- **Generic Units: 2**
- **M Unit: 1**
- **XL Unit: 1**
- **Foodles A Puppet: 1**
- **Babbagepatch McGorkenSpork A Puppet: 1**
- **Animator: 1**



Status	Scene	Start	End	Duration	Puppets	Set Phases	Unit	Date C
121 Tasks		3/14/16	6/2/18	7,230 days		121 Tasks		
✔	0600.scn029	3/14/16	6/12/17	314 days	Mr Link Puppet, Sir Lionel Puppet	Int PNW Sasquatch Cave	White 1	8/7
✔	0500.scn028	6/28/17	6/2/18	223 days	Sir Lionel Puppet	Ext PNW Wooded Clearing	White 1	8/7
✔	1100.scn044	9/6/16	5/26/17	175 days	Sir Lionel Puppet	Int CDF Study	White 10	8/7
✔	0600.scn030	5/30/17	6/29/17	23 days		Int CDF Study	White 10	8/7
✔	1300.scn051	6/30/17	8/1/17	17 days		Int CDF Study	White 10	8/7
✔	1300.scn054	8/1/17	8/22/17	16 days	Adelina Puppet, Mr Link Puppet, Sir Lionel Puppet		White 10	8/7
✔	1300.scn055_3	8/23/17	11/10/...	57 days			White 10	6/19
✔	2800.scn119	10/3/16	12/25/...	307 days	Adelina Puppet, Mr Link Puppet, Sir Lionel Puppet	Int Temple Pit	White 11	8/7
✔	2800.scn118	1/22/18	1/29/18	6 days	Mr Link Puppet, Sir Lionel Puppet	Int Temple Pit	White 11	8/7
✔	2700.scn116	10/3/16	6/28/17	178 days		Int Temple Inner Sanctum	White 12	8/7
✔	2900.scn123	6/29/17	9/5/17	41 days	Mr Link Puppet, Sir Lionel Puppet	Int Temple Inner Sanctum	White 12	8/7
✔	2900.scn124	9/1/17	10/31/...	42 days		Ext Yeti Temple Miniature	White 12	8/7
✔	0200.scn011	10/31/16	8/14/17	185 days	Mr Link Puppet, Sir Lionel Puppet	Int Lionel's Apartment	White 13	8/7
✔	3200.scn128	8/14/17	11/8/17	62 days	Adelina Puppet, Mr Link Puppet, Sir Lionel Puppet, Willard Stenk Puppet	Int Lionel's Apartment	White 13	8/7
✔	2200.scn097	10/31/16	2/3/17	57 days	Mr Link Puppet, Sir Lionel Puppet	Ext Jungle	White 14	8/7
✔	2200.scn098	2/6/17	6/30/17	103 days	Adelina Puppet, Mr Link Puppet, Sir Lionel Puppet	Ext Jungle	White 14	8/7
✔	2200.scn099	7/10/17	8/4/17	15 days		Ext Jungle	White 14	8/7
✔	1600.scn061	7/31/17	11/17/...	79 days		Ext New York Docks	White 14	8/7
✔	0500.scn024	11/28/16	6/6/17	124 days		Ext PNW Overgrown Cabin, Ext PNW Woods Level 2	White 15	8/7
✔	0500.scn025	6/7/17	7/7/17	22 days	Sir Lionel Puppet	Ext PNW Woods Chase	White 15	8/7
✔	0400.scn021	7/14/17	9/7/17	35 days		Ext PNW Wooded Ridge, Ext PNW Woods	White 15	8/7
✔	0800.scn035	9/1/17	9/6/17	3 days	Mr Link Puppet, Sir Lionel Puppet	Ext PNW Wooded Ridge	White 15	8/7
✔	0700.scn031	9/7/17	10/23/...	33 days	Mr Link Puppet, Sir Lionel Puppet	Ext Logging Town Approach	White 15	8/7
✔	1750.scn065	11/28/16	1/29/18	285 days	Adelina Puppet, Sir Lionel Puppet, Willard Stenk Puppet	Ext Manchuria Upper Deck, Srt Manchuria Upper Deck Susan	White 16	8/7
✔	2600.scn112	1/9/17	5/24/17	97 days		Ext Yeti Cliff Miniature	White 17	8/7
✔	2500.scn106	5/25/17	6/15/17	15 days		Ext Himalayan Vista	White 17	8/7
✔	2700.scn113	6/16/17	8/29/17	46 days	Mr Link Puppet, Sir Lionel Puppet	Ext Shangri-La Gateway	White 17	8/7
✔	2500.scn107	8/28/17	10/10/...	31 days			White 17	8/7
✔	2500.scn108	10/11/17	11/15/...	26 days			White 17	8/7
✔	2600.scn111	11/16/17	12/12/...	17 days	Piggot-Dunceby Puppet, Willard Stenk Puppet	Ext Ama Lhamu's Goodbye	White 17	8/7
✔	2700.scn115	12/13/17	1/10/18	10 days		Ext Yeti Temple Miniature	White 17	8/7
✔	1200.scn046	1/9/17	9/13/17	169 days		Ext CDF Garden Wall	White 18	8/7
✔	1200.scn049	9/13/17	9/20/17	6 days		Ext CDF Garden Wall	White 18	8/7
✔	1000.scn042	9/21/17	10/16/...	18 days			White 18	8/19
✔	0300.scn013	1/30/17	2/17/17	15 days		Int Optimates Club Hallway	White 19	8/7
✔	3300.scn129	2/16/17	4/24/17	47 days	Adelina Puppet, Mr Link Puppet, Sir Lionel Puppet, Stevedores Puppet	Ext London Docks	White 19	8/27

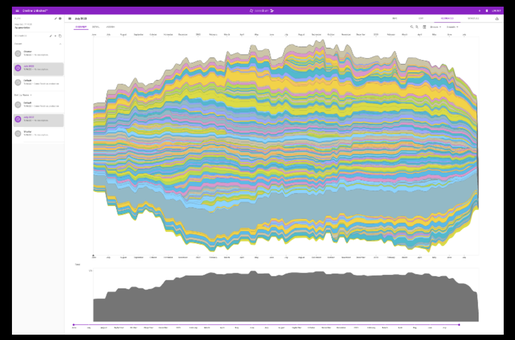
Oneline Tasks for *Missing Link*

Shotgun => Generative Scheduling / Generative Scheduling => Shotgun.
Tools for serializing data to/from Generative Scheduling.



Shotgun

“Generative Scheduling To Shotgun” **JSON** **“Shotgun To Generative Scheduling”**



Generative Scheduling

Shotgun => Generative Scheduling

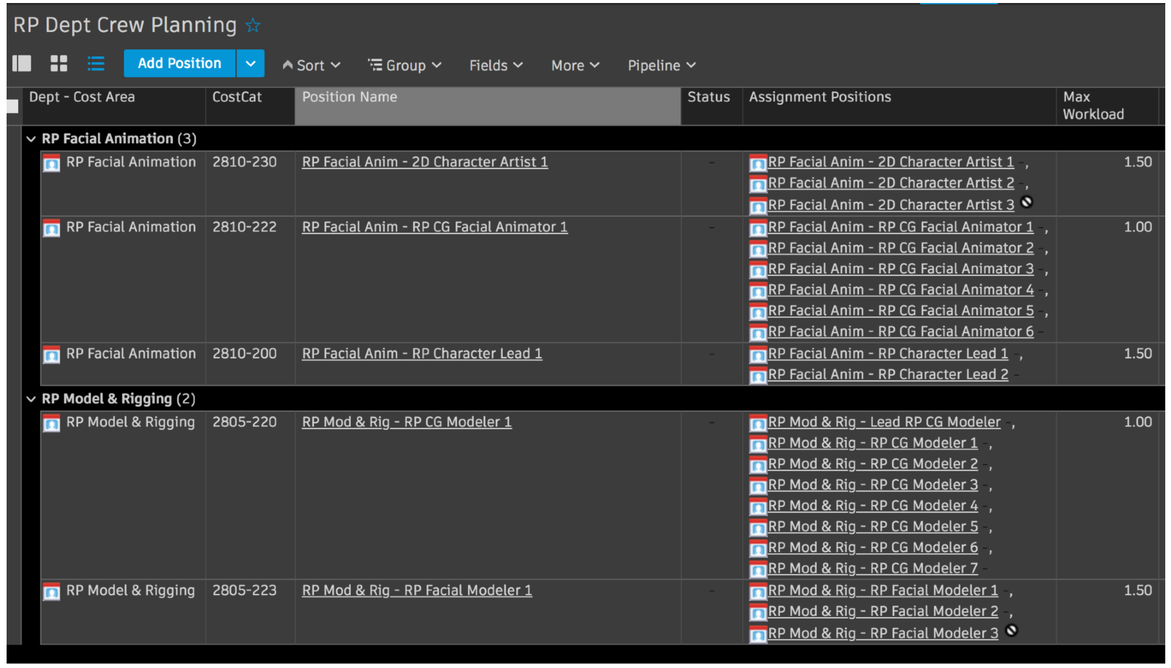
code	current_block	earliest_feasible_block	discrepancy
Babbagepatch McGorkenspork (2)	2020-05-21	2020-05-22	1
Enzo Gorlomi (1)	2021-01-26	2021-02-04	7
Antonio Margheretti (1)	2020-08-07	2020-08-18	7
Dominick Decocco (1)	2020-03-09	2020-03-26	13

Shotgun “Action Menu Item” for exporting data to Generative Scheduling

Generative Scheduling => Shotgun

Name	Required	Available	Difference	Available Resource Names	Feasible?	Entity Type
RP Mod & Rig - RP Rigger 6	3	2	1	RP Mod & Rig - Lead RP Rigger,RP Mod & Rig - RP Rigger 6	false	Position
RP Mod & Rig - RP Texture Artist 1	3	3	0	RP Mod & Rig - RP 3D Printing Texture Artist,RP Mod & Rig - RP 3D Printi…	true	Position
RP Mod & Rig - RP CG Modeler 1	15	8	7	RP Mod & Rig - Lead RP CG Modeler,RP Mod & Rig - RP CG Modeler 1,R…	false	Position
RP Facial Anim - RP CG Facial Animator 1	5	6	-1	RP Facial Anim - RP CG Facial Animator 1,RP Facial Anim - RP CG Facial …	true	Position
RP Facial Anim - RP Character Lead 1	2	2	0	RP Facial Anim - RP Character Lead 1,RP Facial Anim - RP Character Lea…	true	Position
RP Mod & Rig - RP Facial Modeler 1	3	3	0	RP Mod & Rig - RP Facial Modeler 1,RP Mod & Rig - RP Facial Modeler 2,…	true	Position
RP Facial Anim - 2D Character Artist 1	3	3	0	RP Facial Anim - 2D Character Artist 1,RP Facial Anim - 2D Character Arti…	true	Position

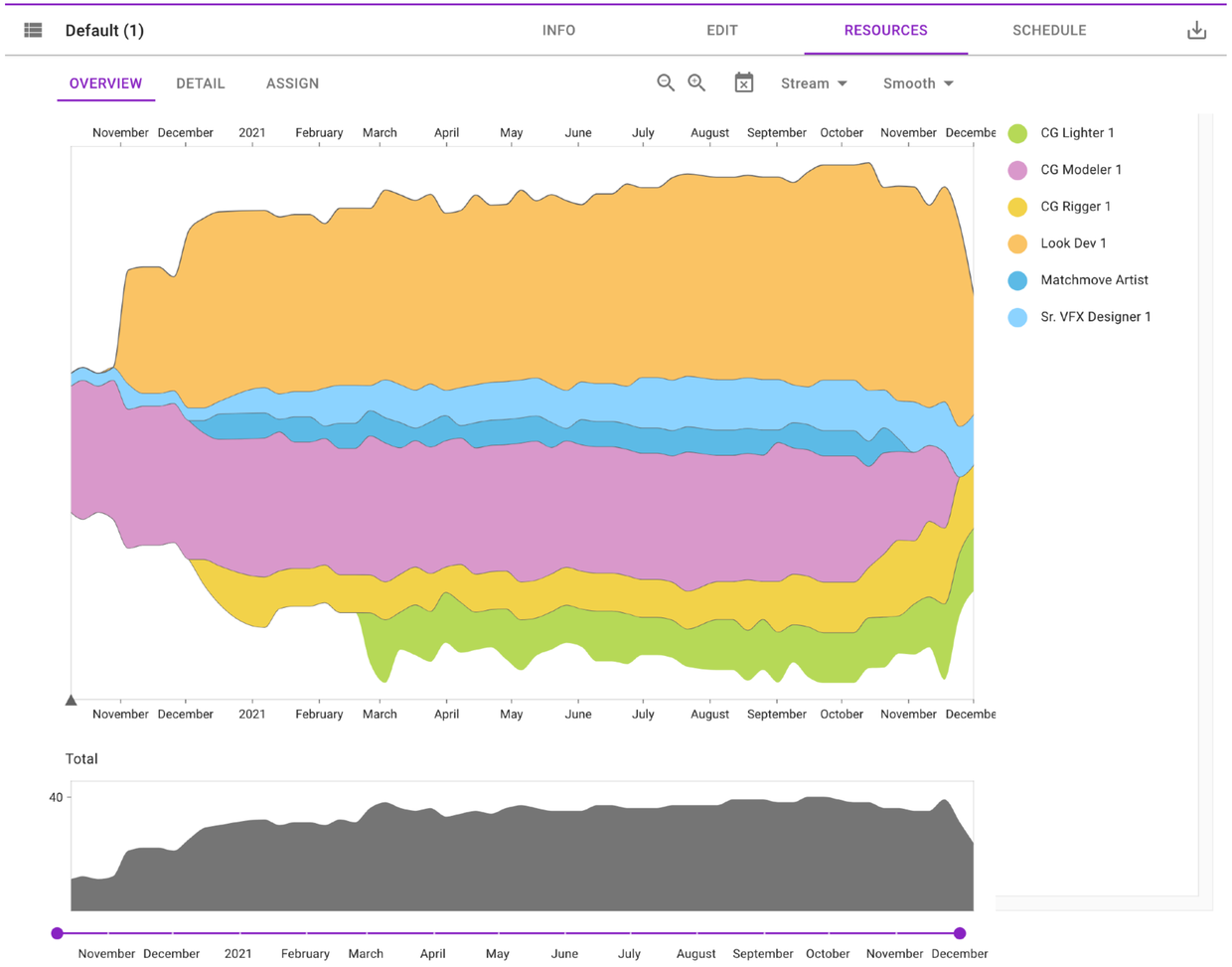
Shotgun “Action Menu Item” for loading a schedule from Generative Scheduling => Shotgun



Can bring back start / end dates and create position assignments for the tasks, distributing work so that each resource has tasks assigned, but isn’t overbooked.

LEFT: An example of Assigning “Max Workload” and “Assignment Positions” for a position to indicate max utilization of each position, and what positions can be used to distributed work assigned in Generative Scheduling.

Generative Scheduling Summary



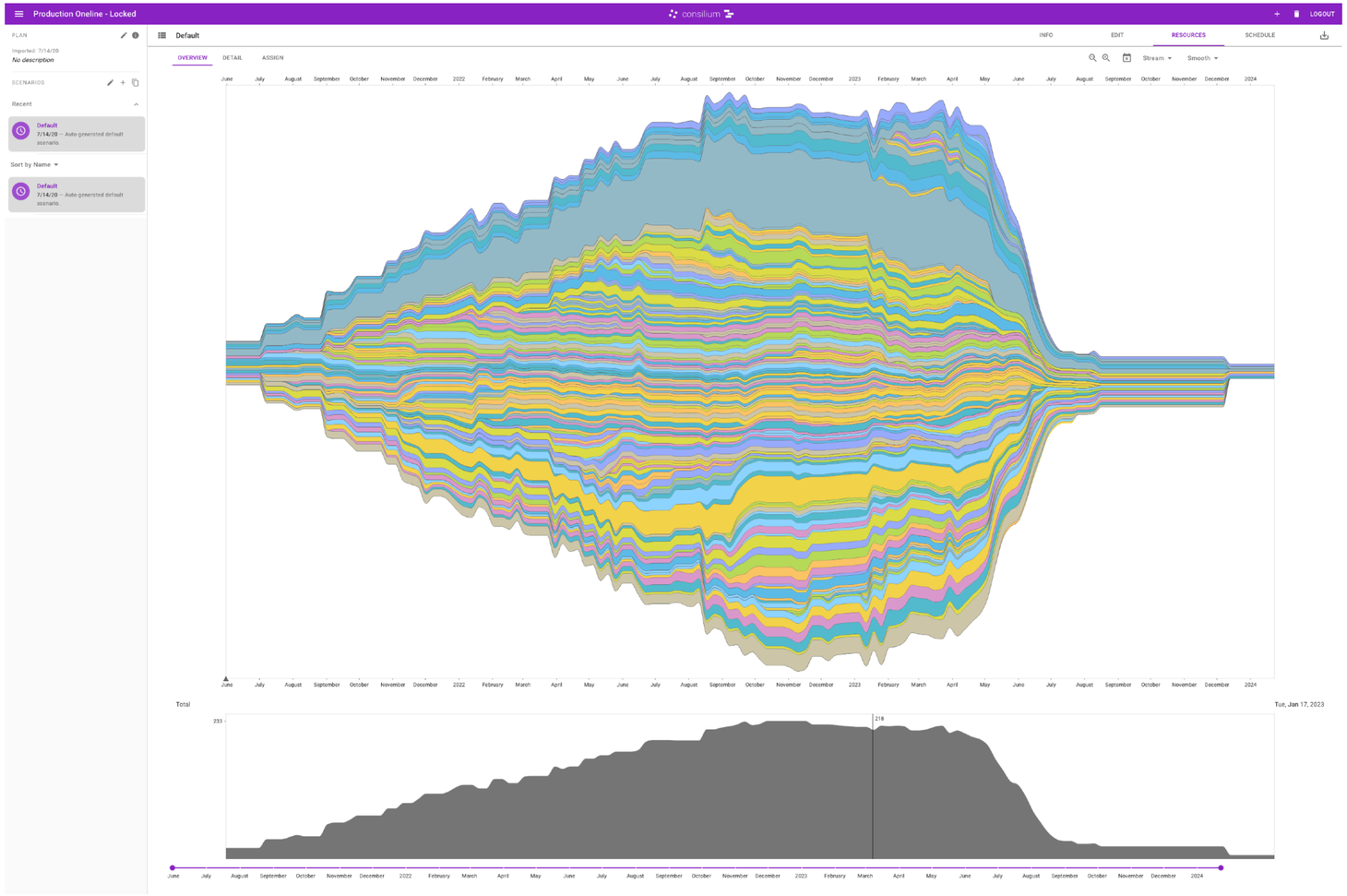
1- Leveling for All Resources Simultaneously

2- Effective Visualization

3- Fast Schedule Iteration

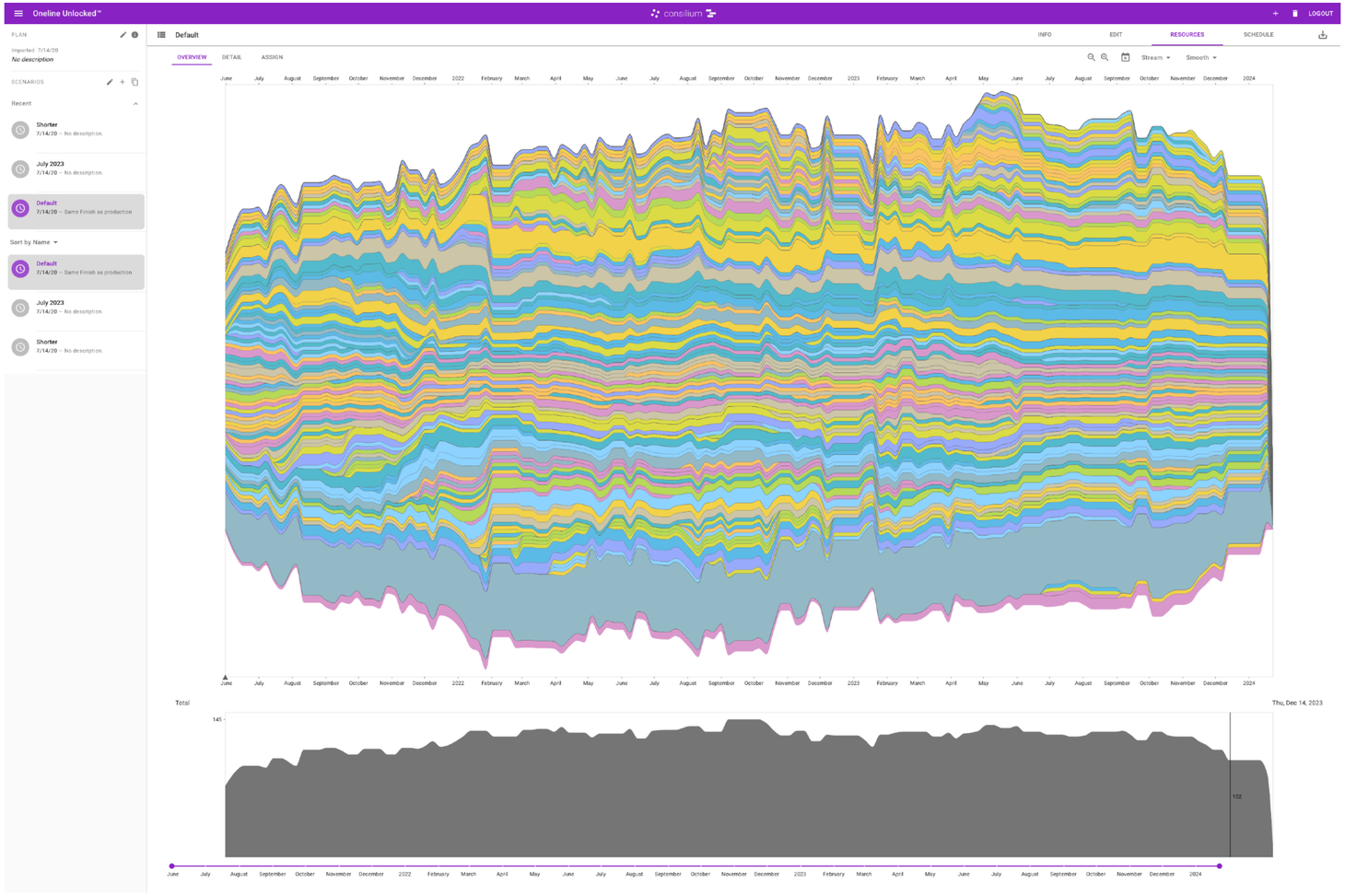
4- Assignment Distribution

Generative Scheduling vs. Human Leveling



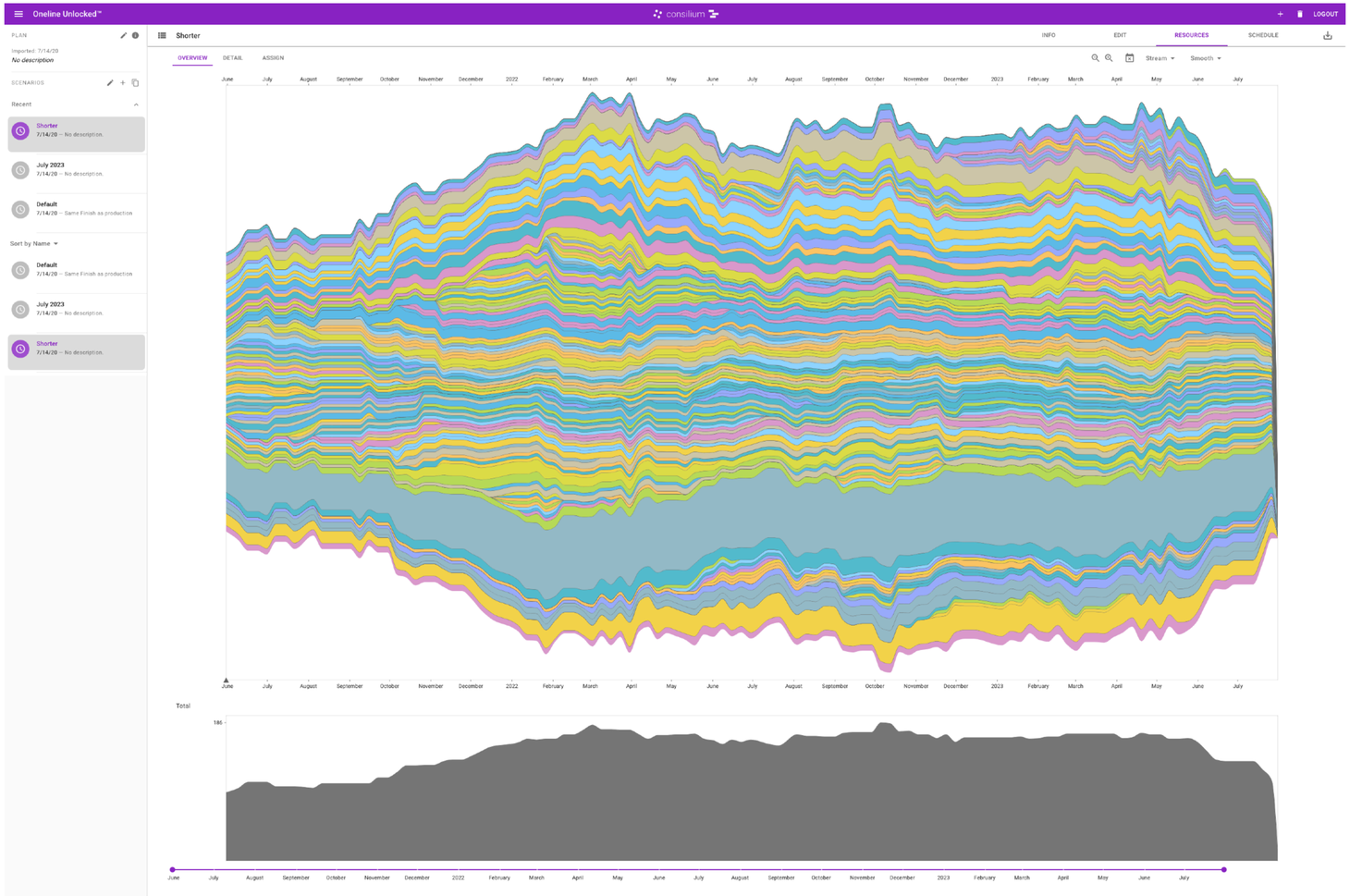
Human-Leveled – 334 Assets to shoot the film over 3.5 years.

Generative Scheduling vs. Human Leveling



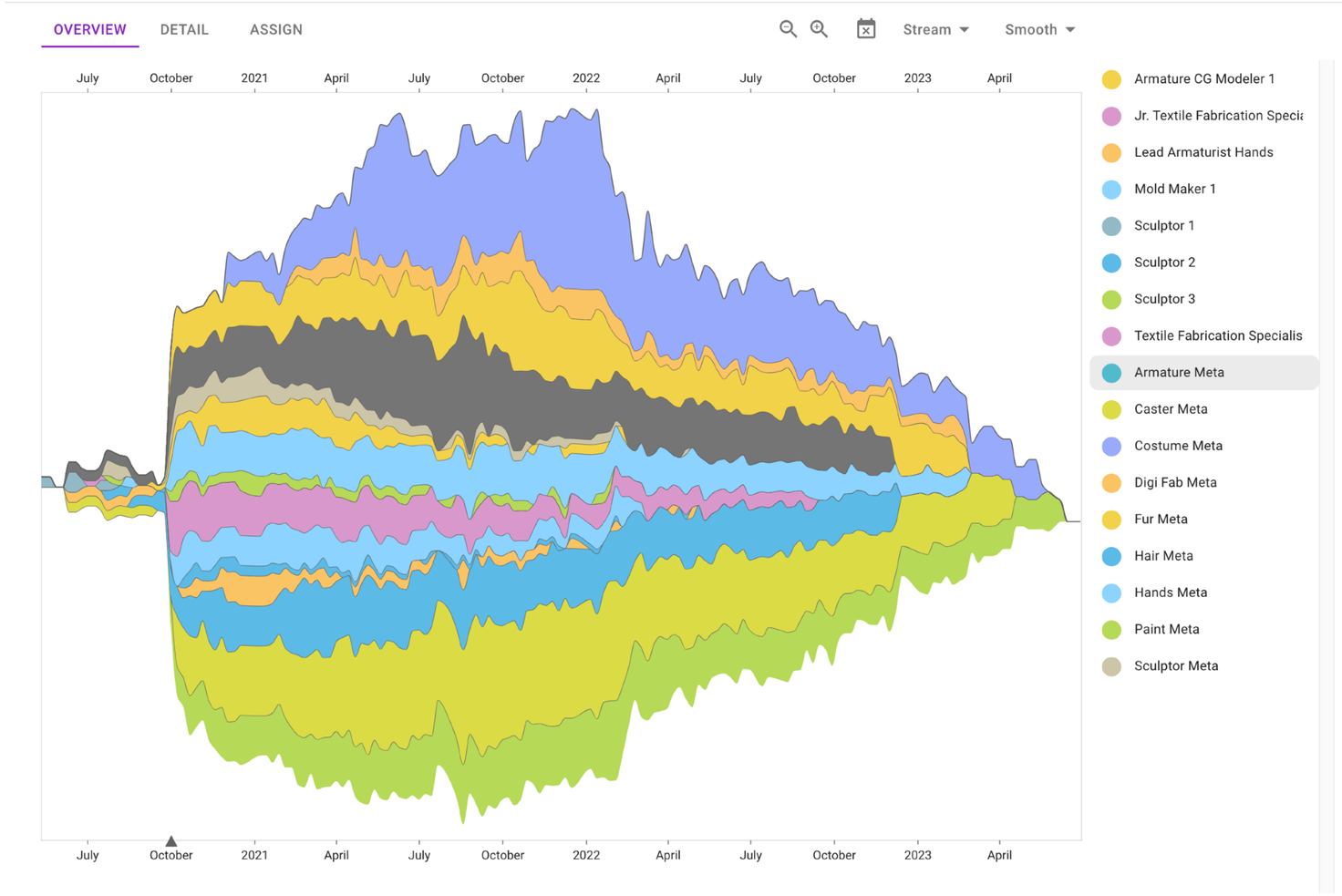
Generative Scheduling – 251 Assets to shoot the film over 3.5 years.
Savings of 83 assets.

Generative Scheduling vs. Human Leveling



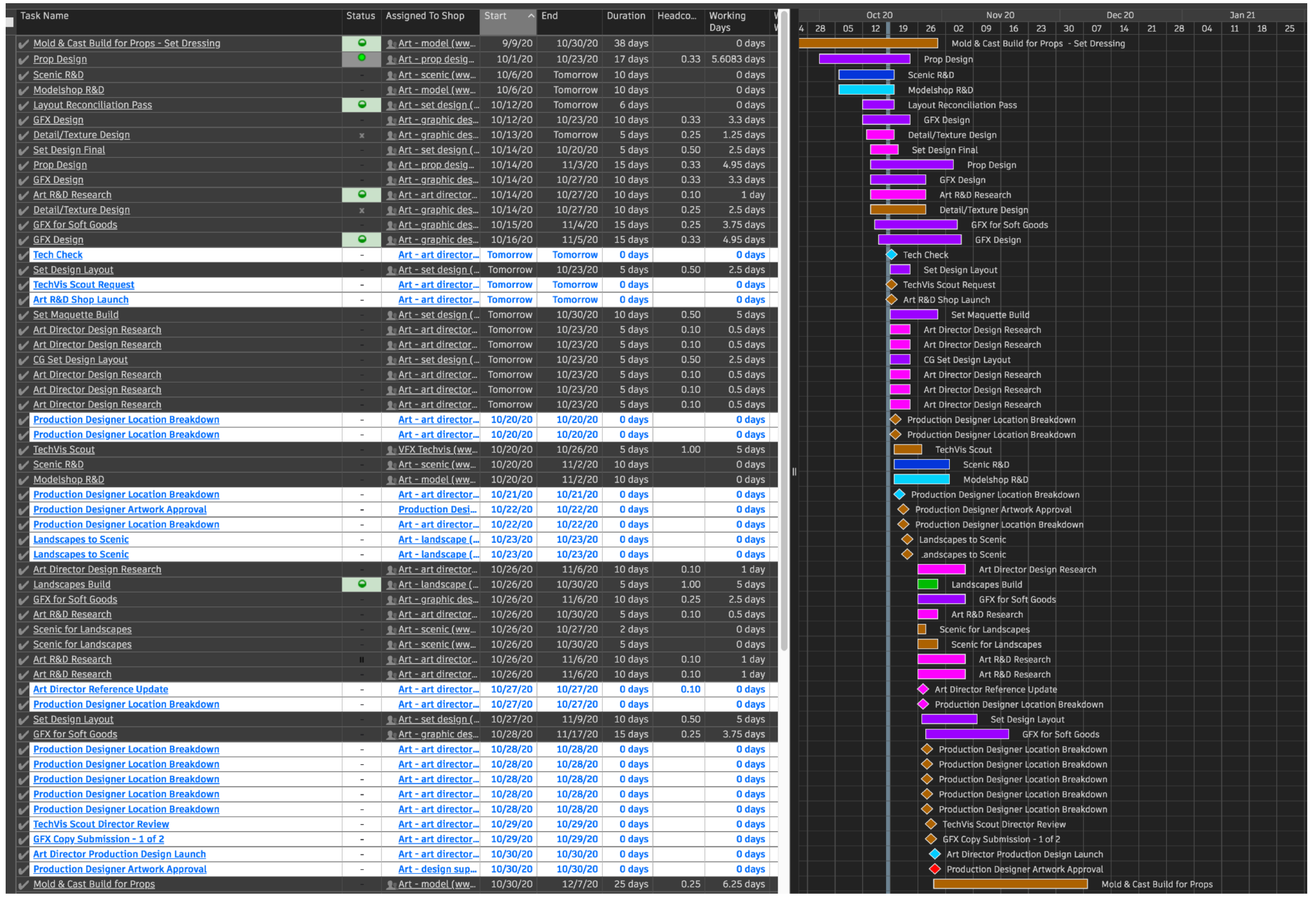
Generative Scheduling – 308 Assets to shoot the film over 2.5 years.
(savings of one calendar year and 26 Asset builds)

Generative Scheduling - Puppets Schedule



12,000 tasks representing work for 60 people. Leveling Runtime: 70s

Day to Day Task Management in Shotgun

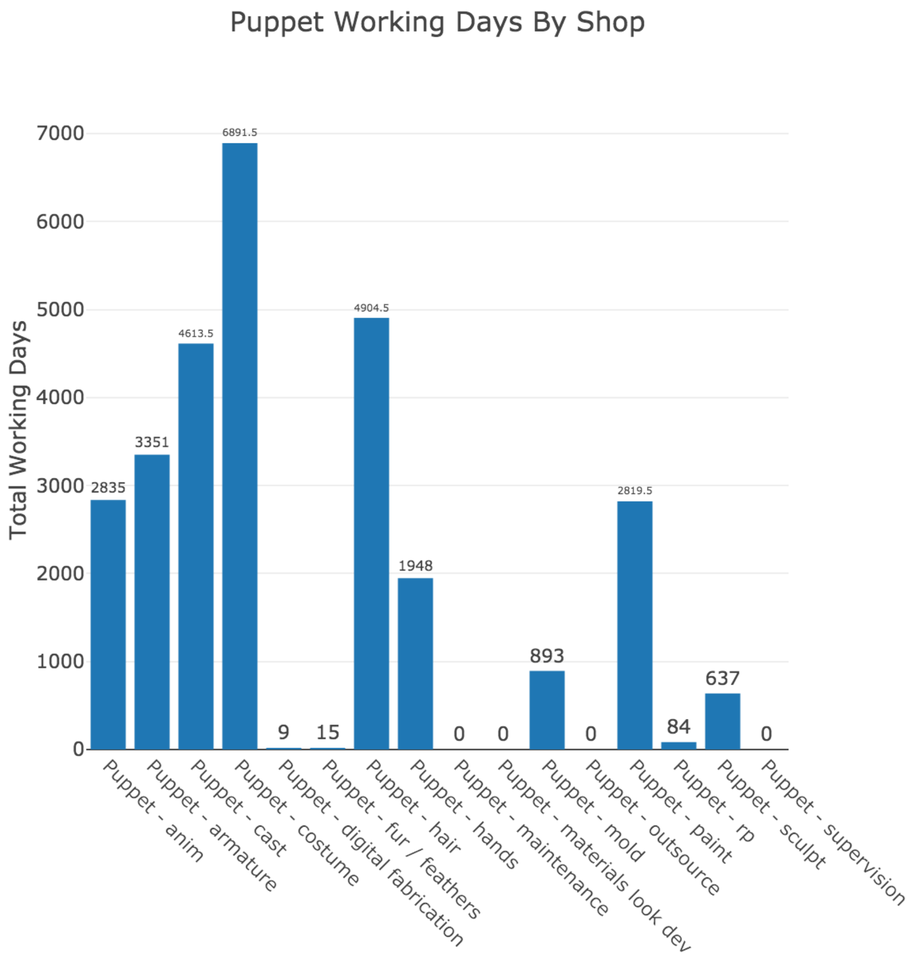


Task Name	Status	Assigned To Shop	Start	End	Duration	Headco...	Working Days
Mold & Cast Build for Props - Set Dressing		Art - model (ww...	9/9/20	10/30/20	38 days		0 days
Prop Design		Art - prop desig...	10/1/20	10/23/20	17 days	0.33	5.6083 days
Scenic R&D	-	Art - scenic (ww...	10/6/20	Tomorrow	10 days		0 days
Modelshop R&D	-	Art - model (ww...	10/6/20	Tomorrow	10 days		0 days
Layout Reconciliation Pass		Art - set design (...	10/12/20	Tomorrow	6 days		0 days
GFX Design	-	Art - graphic des...	10/12/20	10/23/20	10 days	0.33	3.3 days
Detail/Texture Design	x	Art - graphic des...	10/13/20	Tomorrow	5 days	0.25	1.25 days
Set Design Final	-	Art - set design (...	10/14/20	10/20/20	5 days	0.50	2.5 days
Prop Design	-	Art - prop desig...	10/14/20	11/3/20	15 days	0.33	4.95 days
GFX Design	-	Art - graphic des...	10/14/20	10/27/20	10 days	0.33	3.3 days
Art R&D Research		Art - art director...	10/14/20	10/27/20	10 days	0.10	1 day
Detail/Texture Design	x	Art - graphic des...	10/14/20	10/27/20	10 days	0.25	2.5 days
GFX for Soft Goods	-	Art - graphic des...	10/15/20	11/4/20	15 days	0.25	3.75 days
GFX Design		Art - graphic des...	10/16/20	11/5/20	15 days	0.33	4.95 days
Tech Check	-	Art - art director...	Tomorrow	Tomorrow	0 days		0 days
Set Design Layout	-	Art - set design (...	Tomorrow	10/23/20	5 days	0.50	2.5 days
TechVis Scout Request	-	Art - art director...	Tomorrow	Tomorrow	0 days		0 days
Art R&D Shop Launch	-	Art - art director...	Tomorrow	Tomorrow	0 days		0 days
Set Maquette Build	-	Art - set design (...	Tomorrow	10/30/20	10 days	0.50	5 days
Art Director Design Research	-	Art - art director...	Tomorrow	10/23/20	5 days	0.10	0.5 days
Art Director Design Research	-	Art - art director...	Tomorrow	10/23/20	5 days	0.10	0.5 days
CG Set Design Layout	-	Art - set design (...	Tomorrow	10/23/20	5 days	0.50	2.5 days
Art Director Design Research	-	Art - art director...	Tomorrow	10/23/20	5 days	0.10	0.5 days
Art Director Design Research	-	Art - art director...	Tomorrow	10/23/20	5 days	0.10	0.5 days
Art Director Design Research	-	Art - art director...	Tomorrow	10/23/20	5 days	0.10	0.5 days
Production Designer Location Breakdown	-	Art - art director...	10/20/20	10/20/20	0 days		0 days
Production Designer Location Breakdown	-	Art - art director...	10/20/20	10/20/20	0 days		0 days
TechVis Scout	-	VFX Techvis (ww...	10/20/20	10/26/20	5 days	1.00	5 days
Scenic R&D	-	Art - scenic (ww...	10/20/20	11/2/20	10 days		0 days
Modelshop R&D	-	Art - model (ww...	10/20/20	11/2/20	10 days		0 days
Production Designer Location Breakdown	-	Art - art director...	10/21/20	10/21/20	0 days		0 days
Production Designer Artwork Approval	-	Production Desi...	10/22/20	10/22/20	0 days		0 days
Production Designer Location Breakdown	-	Art - art director...	10/22/20	10/22/20	0 days		0 days
Landscapes to Scenic	-	Art - landscape (...	10/23/20	10/23/20	0 days		0 days
Landscapes to Scenic	-	Art - landscape (...	10/23/20	10/23/20	0 days		0 days
Art Director Design Research	-	Art - art director...	10/26/20	11/6/20	10 days	0.10	1 day
Landscapes Build		Art - landscape (...	10/26/20	10/30/20	5 days	1.00	5 days
GFX for Soft Goods	-	Art - graphic des...	10/26/20	11/6/20	10 days	0.25	2.5 days
Art R&D Research	-	Art - art director...	10/26/20	10/30/20	5 days	0.10	0.5 days
Scenic for Landscapes	-	Art - scenic (ww...	10/26/20	10/27/20	2 days		0 days
Scenic for Landscapes	-	Art - scenic (ww...	10/26/20	10/30/20	5 days		0 days
Art R&D Research	-	Art - art director...	10/26/20	11/6/20	10 days	0.10	1 day
Art R&D Research	-	Art - art director...	10/26/20	11/6/20	10 days	0.10	1 day
Art Director Reference Update	-	Art - art director...	10/27/20	10/27/20	0 days	0.10	0 days
Production Designer Location Breakdown	-	Art - art director...	10/27/20	10/27/20	0 days		0 days
Set Design Layout	-	Art - set design (...	10/27/20	11/9/20	10 days	0.50	5 days
GFX for Soft Goods	-	Art - graphic des...	10/28/20	11/17/20	15 days	0.25	3.75 days
Production Designer Location Breakdown	-	Art - art director...	10/28/20	10/28/20	0 days		0 days
Production Designer Location Breakdown	-	Art - art director...	10/28/20	10/28/20	0 days		0 days
Production Designer Location Breakdown	-	Art - art director...	10/28/20	10/28/20	0 days		0 days
Production Designer Location Breakdown	-	Art - art director...	10/28/20	10/28/20	0 days		0 days
Production Designer Location Breakdown	-	Art - art director...	10/28/20	10/28/20	0 days		0 days
TechVis Scout Director Review	-	Art - art director...	10/29/20	10/29/20	0 days		0 days
GFX Copy Submission - 1 of 2	-	Art - art director...	10/29/20	10/29/20	0 days		0 days
Art Director Production Design Launch	-	Art - art director...	10/30/20	10/30/20	0 days		0 days
Production Designer Artwork Approval	-	Art - design sup...	10/30/20	10/30/20	0 days		0 days
Mold & Cast Build for Props	-	Art - model (ww...	10/30/20	12/7/20	25 days	0.25	6.25 days

- **Use Shotgun for short-term record keeping**

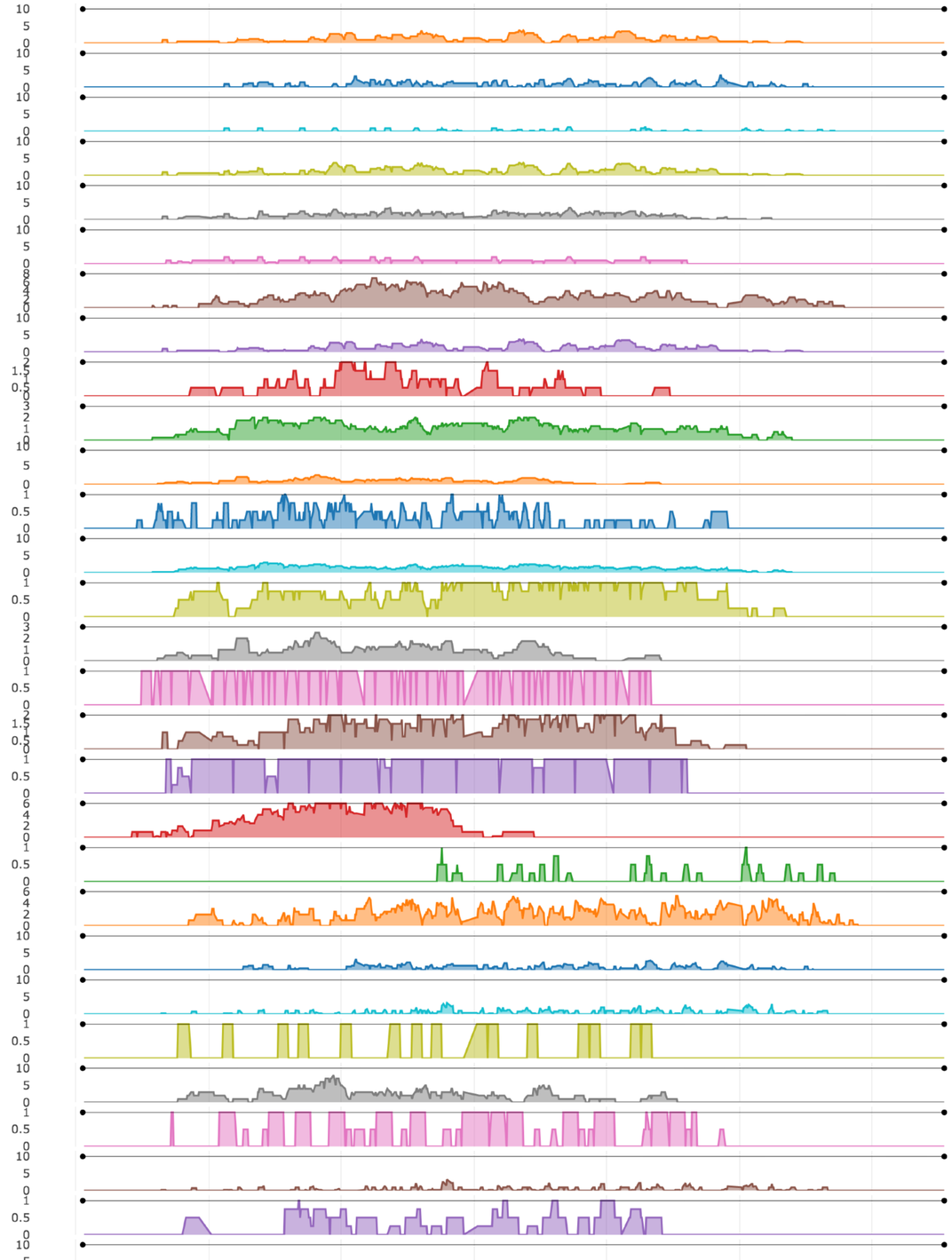
- **Export to Generative Scheduling to handle larger changes (delivery date changes, build additions / removals, task template adjustments)**

Custom Shotgun Workflows



New visualization tools built using Plotly.js to summarize schedule information.

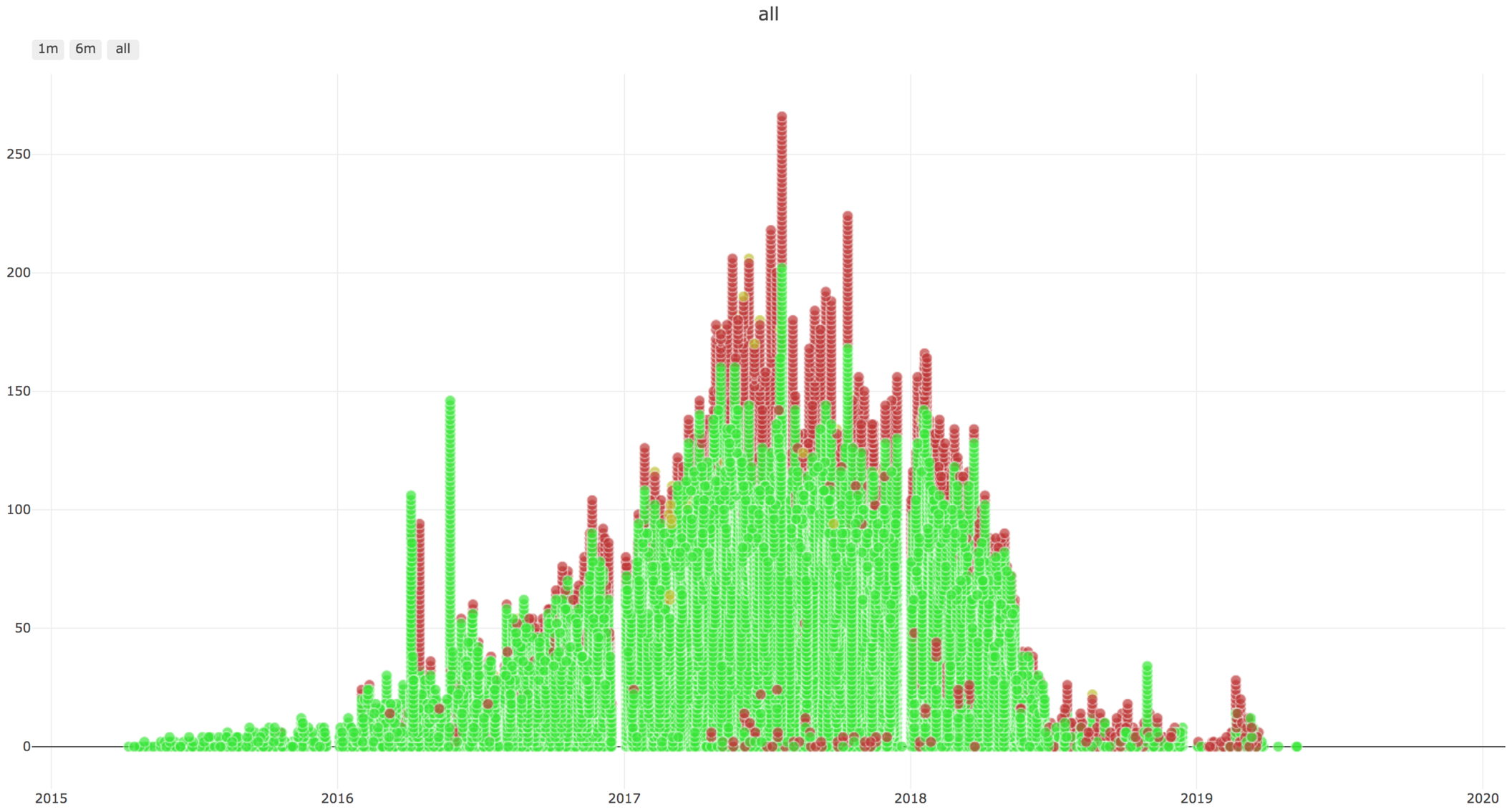
LEFT: Working days by shop - Puppet Dept.



- SPF Support - Prod Asst - Scenic Consilium Goal
- SPF Supervision - Head of Set Shop 1 Consilium Goal
- SPF Supervision - Head of Set Dressing 1 Consilium Goal
- SPF Supervision - Head of Scenic 1 Consilium Goal
- SPF Supervision - Head of Model Shop 1 Consilium Goal
- SPF Supervision - Head of Landscapes 1 Consilium Goal
- SPF Scenic - Scenic Artist 1 Consilium Goal
- SPF Scenic - Lead Scenic Artist Consilium Goal
- SPF Modelshop - Soft Goods 1 Consilium Goal
- SPF Modelshop - Mold Maker 1 Consilium Goal
- SPF Modelshop - Model Builder 1 Consilium Goal
- SPF Modelshop - Miniature Lighting Engineer Consilium Goal
- SPF Modelshop - Lead Mold Maker Consilium Goal
- SPF Modelshop - Jr. Mold Maker 1 Consilium Goal
- SPF Modelshop - Jr. Model Builder 1 Consilium Goal
- SPF Modelshop - CG Modeler Consilium Goal
- SPF Model Shop - Lead Model Builder Consilium Goal
- SPF Landscaping - Lead Landscape Artist Consilium Goal
- SPF Landscaping - Landscape Artist 1 Consilium Goal
- SPF Dressing - Lead Set Dresser Consilium Goal
- SPF Construction - Set Carpenter 1 Consilium Goal
- SPF Construction - Lead Carpenter Consilium Goal
- Prod Mgmt - 1st AD 1 Consilium Goal
- Metal Fab - Water Jet Operator Consilium Goal
- Metal Fab - Metal Fabricator Consilium Goal
- Metal Fab - Laser Cutter Operator Consilium Goal
- L&C - Director of Photography 1 Consilium Goal
- Art/Fabrication - Soft Goods Maker 1 Consilium Goal
- Art/Fabrication - Production Coordinator 3 Consilium Goal
- Art/Fabrication - Production Coordinator 2 Consilium Goal
- Art/Design - Visual Dev Artist 1 Consilium Goal
- Art/Design - Set Designer 1 Consilium Goal
- Art/Design - Prop Designer 1 Consilium Goal
- Art/Design - Prod Coordinator Consilium Goal
- Art/Design - Printer Operator Consilium Goal
- Art/Design - Print Operator PA 1 Consilium Goal
- Art/Design - Jr Prop Designer Consilium Goal
- Art/Design - Jr Graphics Designer 1 Consilium Goal
- Art/Design - Graphic Designer 1 Consilium Goal
- Art/Design - Asst Art Director 1 Consilium Goal
- Art/Design - Art Director 1 Consilium Goal
- Art/Design - APM Consilium Goal
- SPF Support - Prod Asst - Scenic
- SPF Supervision - Head of Set Shop 1
- SPF Supervision - Head of Set Dressing 1
- SPF Supervision - Head of Scenic 1
- SPF Supervision - Head of Model Shop 1
- SPF Supervision - Head of Landscapes 1
- SPF Scenic - Scenic Artist 1
- SPF Scenic - Lead Scenic Artist
- SPF Modelshop - Soft Goods 1
- SPF Modelshop - Mold Maker 1
- SPF Modelshop - Model Builder 1
- SPF Modelshop - Miniature Lighting Engineer
- SPF Modelshop - Lead Mold Maker
- SPF Modelshop - Jr. Mold Maker 1
- SPF Modelshop - Jr. Model Builder 1
- SPF Modelshop - CG Modeler
- SPF Model Shop - Lead Model Builder
- SPF Landscaping - Lead Landscape Artist
- SPF Landscaping - Landscape Artist 1
- SPF Dressing - Lead Set Dresser
- SPF Construction - Set Carpenter 1
- SPF Construction - Lead Carpenter
- Prod Mgmt - 1st AD 1
- Metal Fab - Water Jet Operator
- Metal Fab - Metal Fabricator
- Metal Fab - Laser Cutter Operator
- L&C - Director of Photography 1

Utilization by day vs. goal. Art Positions.

(Similar to Generative Scheduling Detail View)

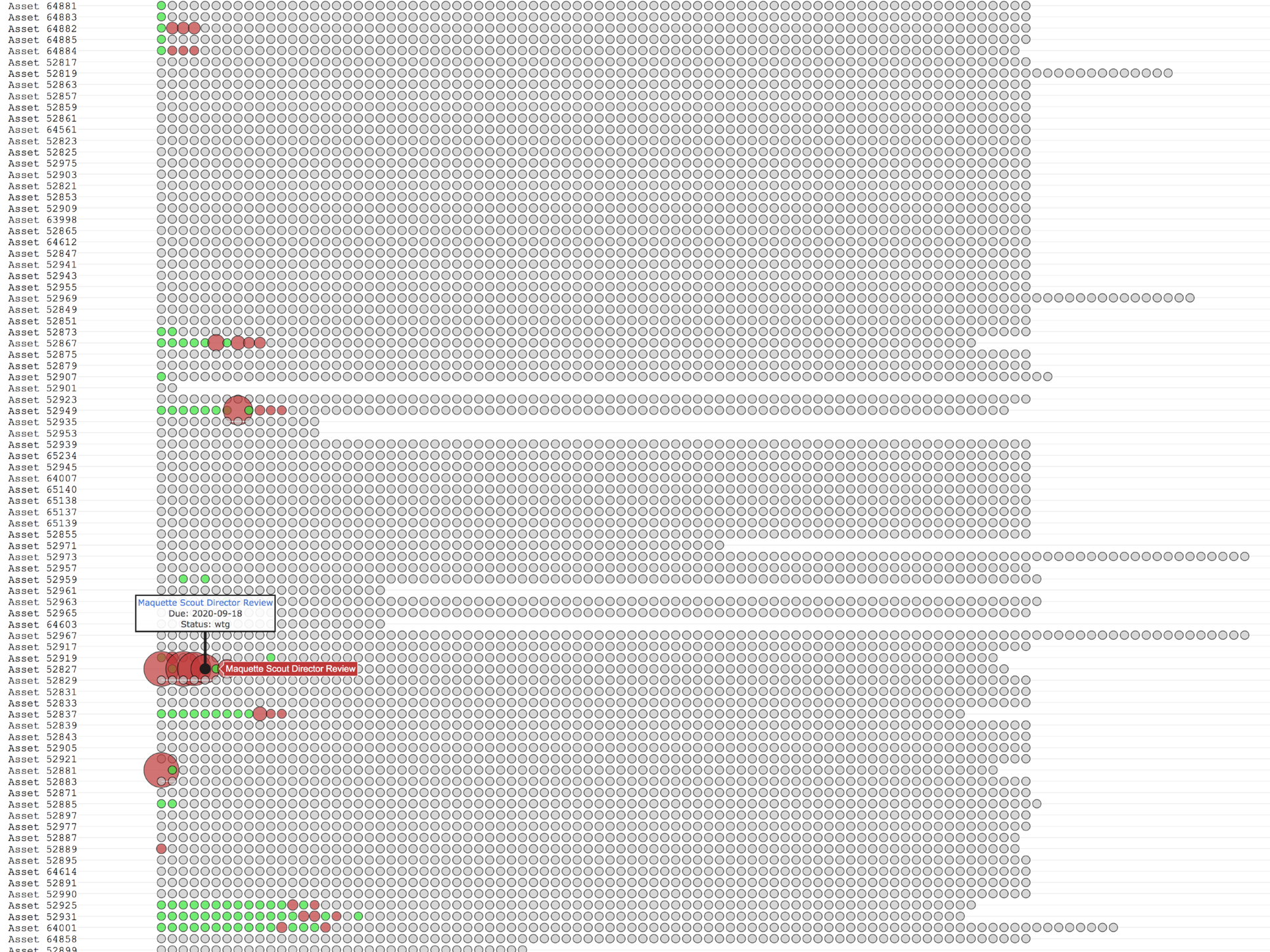


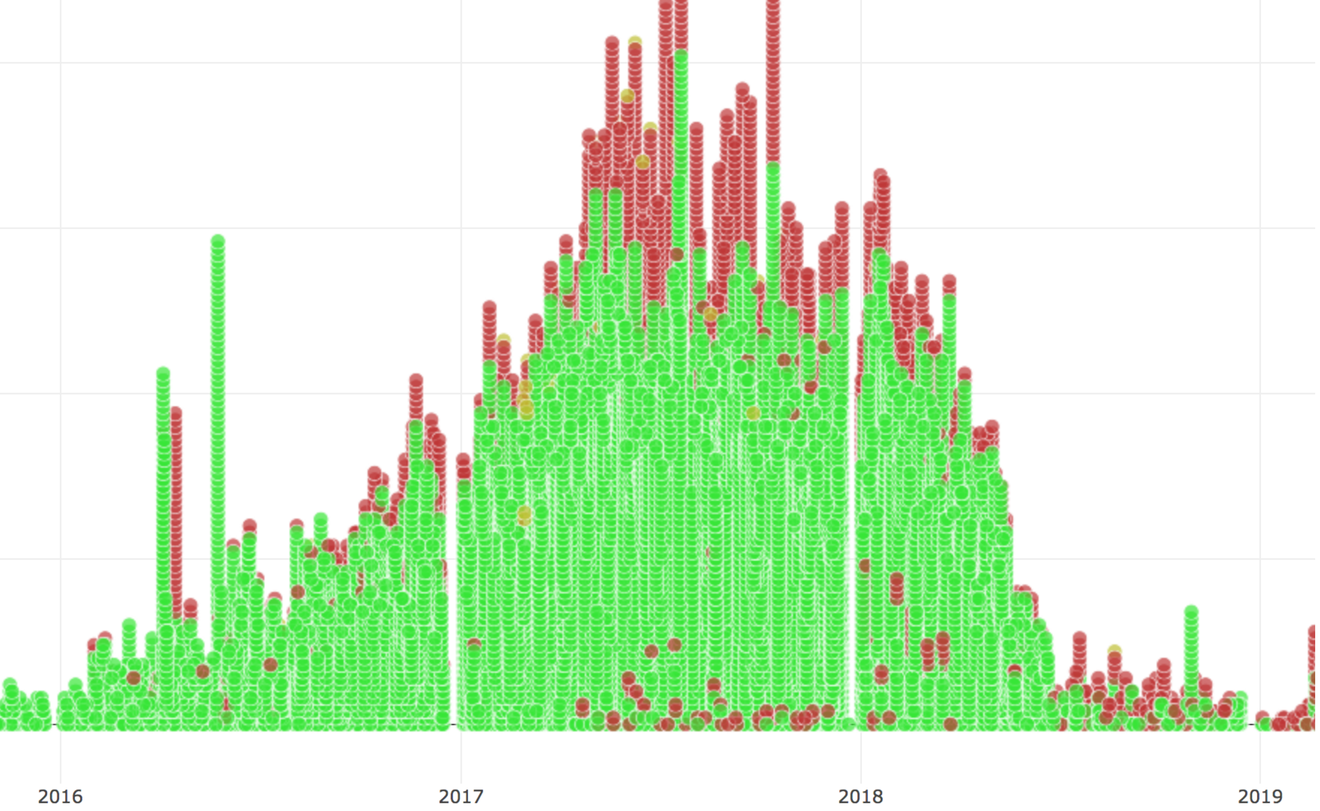
Project Task Status Summary - Missing Link

(green = complete, red = overdue, yellow = on hold, grey = waiting to start)

Asset Timeline - task statuses by Asset, laid out sequentially.

Tasks get bigger as they become more overdue.





Designing Effective Visualizations

1- Understand User's Questions

2- Learn about the Dataset

3- Look at a LOT of Visualizations

4- Experiment. Iterate. Experiment Again.

Scheduling Process - In Summary

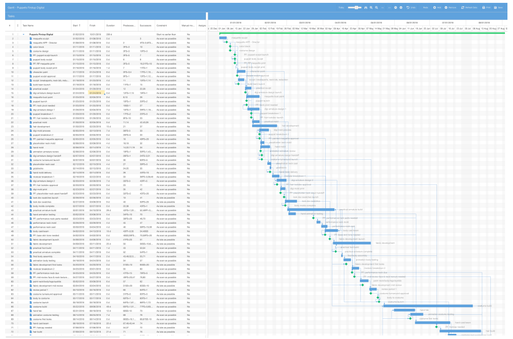
1- Bidding (Bryntum Gantt, Bid App)

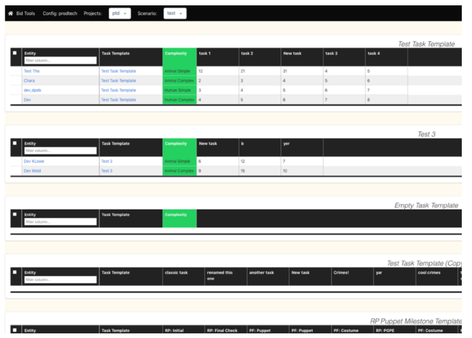
2- Shotgun => Generative Scheduling

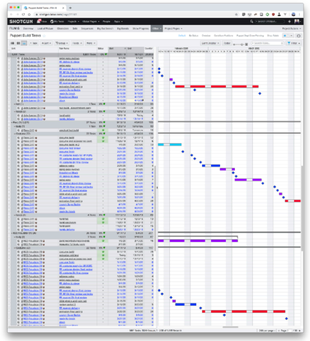
3- Generative Scheduling

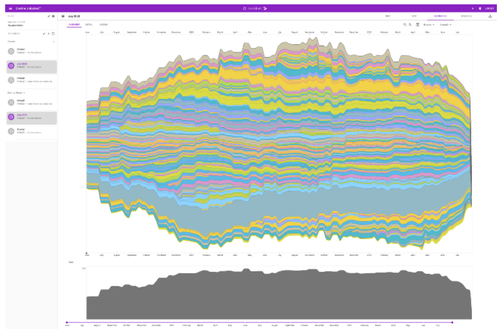
4- Generative Scheduling => Shotgun

5- Task Management in Shotgun









Limitations

DATA MODELING

- Finding the right representation can be challenging, incomplete data may not level accurately.
- Some common occurrences (like varying durations based on assignee) can’t be handled in Generative Scheduling.

LEARNING CURVE

- Thinking in terms of constraints and dependencies can be a challenge to those accustomed to manual resource leveling

MAINTENANCE

- Keeping a schedule and its dependencies up to date is a major time investment - it requires frequent adjustments to task statuses, start/end dates, and assignments.

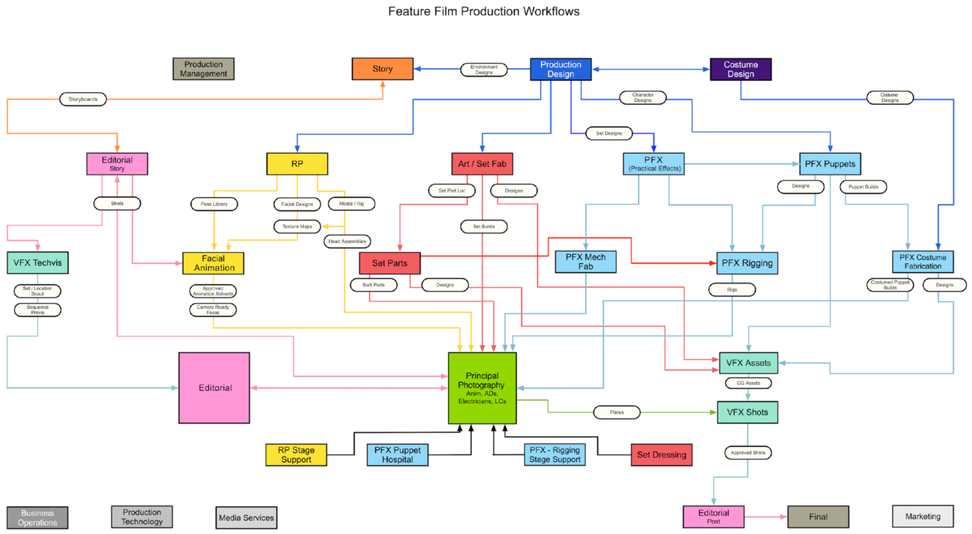
TIME-BASED SCHEDULING

- No Support for hour / minute level scheduling (needed for stage and machining pipelines)

Future Work

STUDIO-WIDE SCHEDULING

Combine all of LAIKA's data into a single giant schedule optimized by Generative Scheduling app.



(See? Kinda looks like the octopus from earlier)

SCHEDULING ENGINE IMPROVEMENTS

- **Affinity function for keeping Tasks on the same build close together in time (reduce context switches)**
- **Fine-grained resource curve controls**
- **Time-based scheduling**

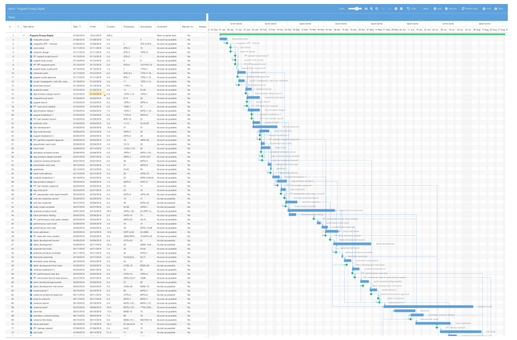
NEW VISUALIZATION APPROACHES

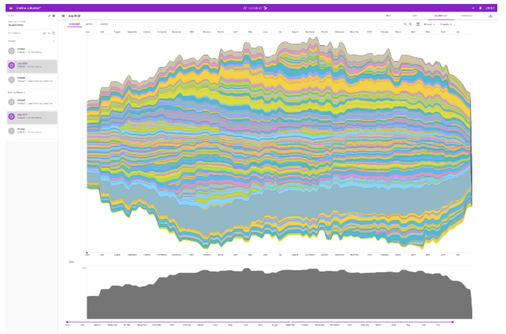
- Kanban boards, network diagrams, alternative gantt representations.

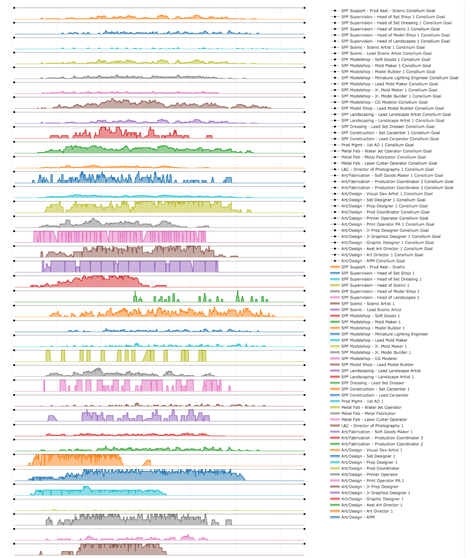
Conclusion

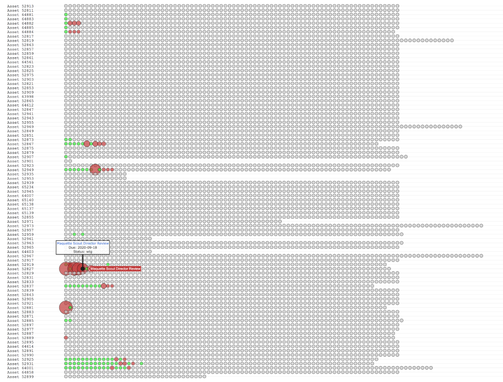
The introduction of our new scheduling workflow has made a big impact at LAIKA – changes are now significantly easier to accommodate, and there is increased confidence in the scheduling process.

Filmmaking at LAIKA happens over a very long timeframe, with each film taking several years to complete, so unfortunately we don't have a full sense of time or cost savings yet, but results so far have been quite promising, with users able to turn around new bids and resource lists faster than ever before.









Acknowledgements

Lastly, none of this would have been possible without the efforts of a whole team of people. I'd like to thank the early adopters of this workflow for embracing the new workflow and providing valuable feedback on every step of the process.

Early Adopters:

- **Carlyn Siegler**
- **Marina Capizzi**
- **Finley Mulligan**
- **Derrick Huang**

I’d also like to thank everyone involved in developing these new workflows:

- **Jeff Stringer – who provided the resources and guidance for the new workflow.**
- **Phil Peterson – for his ongoing development of the Generative Scheduling app.**
- **Tony Aiello and Owen Nelson – for their foundational work on scheduling at LAIKA.**
- **The LAIKA Shotgun Team (Ben Brandt, Emilee Chen, Paul Kubala, Daniel Pebly, and Ellen Duong)**

Reference

Reference:

Material directly mentioned in the talk.

Shotgun for Production Management in LAIKA's Animated Features (Autodesk University 2018) - Tony Aiello - https://www.autodesk.com/autodesk-university/class/Shotgun-Production-Management-LAIKAs-Animated-Features-2018

Scheduling - xkcd.com/1658

The Process of Design Squiggle by Damien Newman, thedesignsquiggle.com

Wikimedia - Standard Oil Octopus - https://upload.wikimedia.org/wikipedia/commons/a/a0/Standard_oil_octopus_loc_color.jpg

Stacked Area Graphs Are Not Your Friend - Myles Harrison
https://everydayanalytics.ca/2014/08/stacked-area-graphs-are-not-your-friend.html

Related Material:

Material I found insightful while developing this workflow.

The Design of Everyday Things - Don Norman
https://en.wikipedia.org/wiki/The_Design_of_Everyday_Things

Beautiful Evidence - Edward Tufte
https://www.edwardtufte.com/tufte/books_be

Project Management Graphics (or Gantt Charts) - Edward Tufte Message Board
https://www.edwardtufte.com/bboard/q-and-a-fetch-msg?msg_id=000076

The Mythical Man-Month - Fred Brooks
https://en.wikipedia.org/wiki/The_Mythical_Man-Month

Choose Boring Technology - Dan McKinley
https://mcfunley.com/choose-boring-technology

Technology:

Links to some of the tech used in this project.

Flask
https://flask.palletsprojects.com/en/1.1.x/

Plotly.js
https://plotly.com/javascript/

Shotgun API
https://developer.shotgunsoftware.com/python-api/

Bryntum Gantt
https://www.bryntum.com/products/gantt/