

# **THE KNOWLEDGE ACCELERATOR: BIG PICTURE THINKING IN SMALL PIECES**

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# GOAL: CROWDSOURCE INFORMATION SYNTHESIS

- Synthesize online information for complex/open-ended questions into a coherent article
- Ask Knowledge Accelerator something => receive a well-written answer complete with category tags
- Limited maximum task payment to \$1 US => target task time of approximately 5-10 minutes

## How Do I Get My Tomato Plants To Produce More Tomatoes?

### Contents

1. [Tomatos - Feeding](#)
2. [Pruning Is Love](#)
3. [Maintenance And Harvesting](#)
4. [Tomatos - Proper Potting Procedure](#)
5. [Weather And Sunlight Conditions](#)
6. [Growing Tomatoes](#)
7. [Tomatos - Stakes And Support](#)

### Tomatos - Feeding

Producing better tomato plants is as simple as picking the perfect soil. There are many market soils or one can add a few things to their own soil. Extra nutrients go a long way in producing more tomatoes per plant.

Tomatoes are heavy feeders since they are smaller plants that depend on the bushy growth to support fruit production. They can benefit from some added nutrition even if you use the best soil. Cutting back on nitrogen will ensure a big, gorgeous pile of fruit coming your way in no time!

Tomatoes take up nutrients the best when the soil pH ranges from 6.2 to 6.8. They need a constant supply of major and minor plant nutrients. Following the rates on the fertilizer label, mix a balanced timed-release or organic fertilizer to the soil as you prepare planting holes.

Feeding tomatoes regularly is critical for a good yield. At the very least, you need a good liquid food that is high in potassium.

Any tomato feed from a garden center should do the job. If you want take it a step further, check out Sea Nymph's natural seaweed-based feed or BioBizz's BioGrow, which include molasses to feed the microbes in the soil. About half way through the season, I add a 1 inch (2.5 cm) layer of worm compost or local farm manure to the top of my containers. This adds extra nutrients and soil life.

Amend your plant beds with your own or purchased compost; dry, timed-release fertilizer; and most importantly, worm castings. Add 5 cubic feet of Gardner & Bloome compost; 5 quarts of Gardner & Bloome 4-6-3 Tomato, Herb & Vegetable fertilizer; and a quart of 100% pure worm castings for every 50 square feet of garden space.

### References:

- [Vertical veg man: how to grow tomatoes successfully](#) ([www.theguardian.com](#))
- [Tomatoes..How To Get The Most From Your Plants In The Garden!](#) ([oldworldgardenfarms.com](#))
- [Love Apple Farms](#) ([www.growbetterveggies.com](#))
- [10 Tips for Growing Great Tomatoes](#) ([gardening.about.com](#))

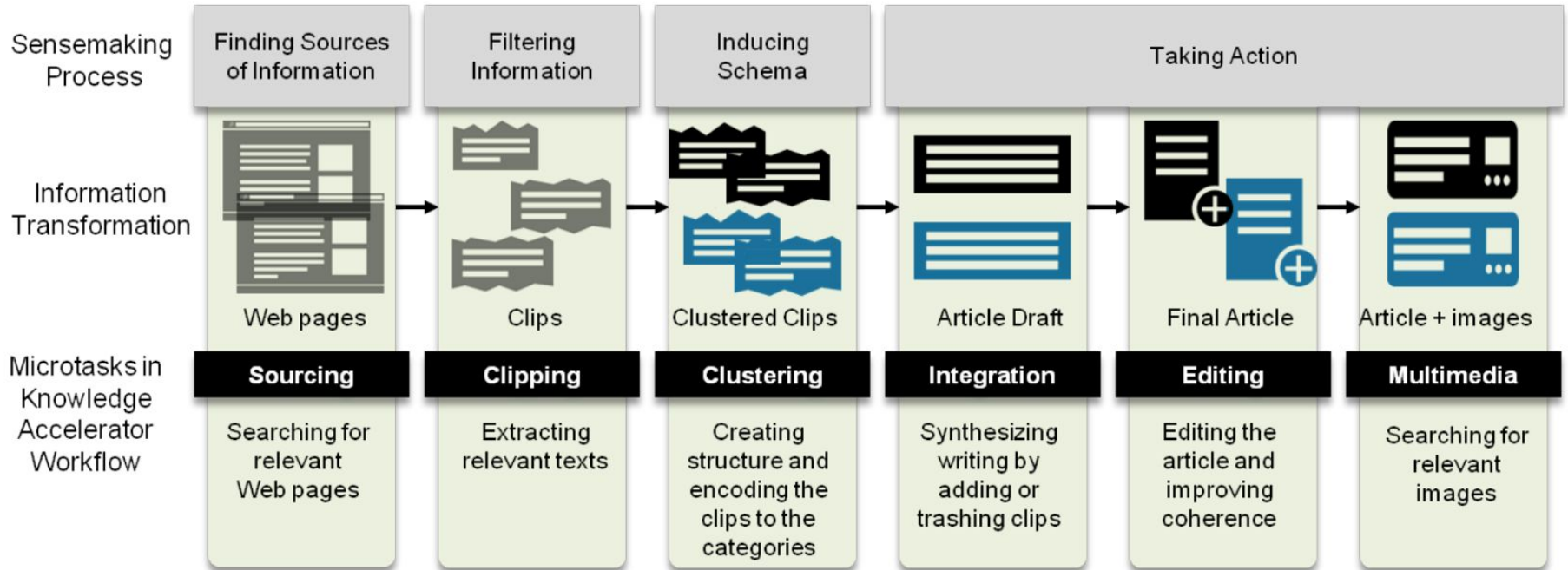
### Tomatos - Feeding



Producing better tomato plants is as simple as picking the perfect soil.



# THE PROCESS OF KA FROM START TO FINISH



# SOURCING AND CLIPPING



Categories

Plunger

Hot Water

Hanger

## wikiHow

### How to Unclog a Bathtub Drain

Use a plunger. Turn on the hot water and fill your tub with enough water to cover the clog. Pull with the plunger about 10 times to ensure that you fully clear the



look down the drain for hair. If you see some, use your finger to pull up as much as you can (you can wear rubber gloves if you'd prefer not to use your bare finger).

- Sources cited by at least two workers were sent to the filtering stage
- Presented with one web page and asked to highlight and save at least five pieces of information

### CHALLENGE:

Variable amount of useful information per page

### SOLUTION:

Showed workers sections that had already been highlighted and asked them to first look for unhighlighted areas

# CATEGORIES AND CLUSTERING

## CHALLENGE:

- Workers categorizing a clip lacked context
- Convey distribution without seeing data

## SOLUTION:

- Clustering phase to induce schema
- Workers choose 4 dissimilar seed clips
- Highlight discriminative keywords
- Query clips on "alike" or "different"
- SVM classifier and hierarchical clustering
- Match remaining clips to clusters

### **categories induced during clipping:**

Boil Water, use hot water, Plunger, try a snake, How to Remove drain stopper, bleach, Use Drano Max Gel, baking soda, drain, tips to unclog, problem, tools, research, internet research, ..., etc.

### **categories induced after clipping:**

Hot Water, Plunge, Plunger, Snake the Drain, Remove the Drain Cover, Drain Cleaner, Remove Hair Clusters.

### **annotator categories:**

Hot Water, Plunger, Plumbing Snake, Remove Cover, Chemicals, Bent Wire Hanger, Call a Plumber, Shop Vacuum.

# DEVELOPING A COHERENT ARTICLE: INTEGRATION

## INTEGRATION CHALLENGES:

- Creating coherence within a topic
- Workers reluctant to change others' work

## SOLUTION:

- 5 random clips of information for a given subtopic integrated into a shared text pad
- Cluster similar items & footnote redundancy
- Use “evaluate then act” strategy
- Read shared text then decide about clip
- Mark relevant lines or tag clip as new or trash

## EDITING CHALLENGE:

- Creating coherence between topics

## SOLUTION:

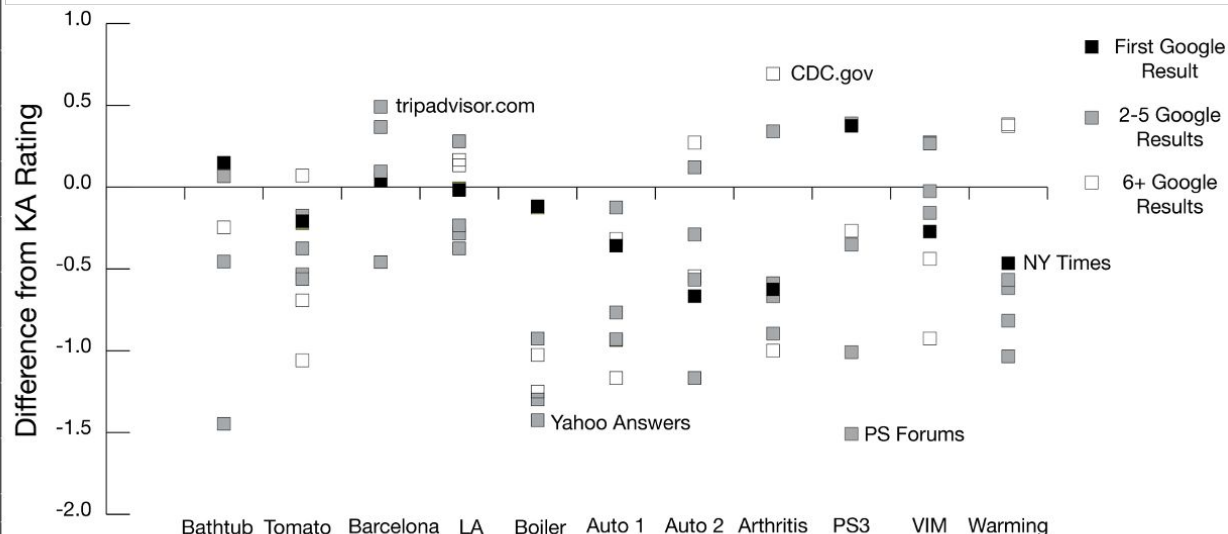
- “Vote then edit”: horizontal & vertical workflow
- Hypothesis: choice creates sense of ownership
- 3 workers vote on 3 versions of an edited subtopic section & edit a different subtopic subsection
- 3 workers vote on those versions & improve them with all other subtopic paragraphs presented

# EVALUATION AND RESULTS

- Separate set of crowd workers (paid \$1.50/task) perform comparison to top Google & worker results
- Rate comprehensiveness, confidence, helpfulness, trustworthiness, understandability, & writing of each web page on a seven point Likert scale (from 1 to 7) & explain rating on each dimension
- Selected 11 target questions by browsing Q&A forums, Reddit, & referencing online browsing habits
- Aggregating across questions, output was rated significantly higher than the (even expert) web pages
- Only failed on 2 travel & a VIM question: highly curated industry & style mismatch (broken order)
- For 2 automotive questions, discovered all categories validated by 2 commercial products & experts
- On average, running a question through the KA system cost a total of \$108.50
- Made with Mechanical Turk and Ruby on Rails

Question	N	Score
<b>Q1:</b> <i>How do I unclog my bathtub drain?</i>	116	0.292 *
<b>Q2:</b> <i>How do I get my tomato plants to produce more tomatoes?</i>	177	0.420 *
<b>Q3:</b> <i>What are the best attractions in LA if I have two little kids?</i>	158	-0.044
<b>Q4:</b> <i>What are the best day trips possible from Barcelona, Spain?</i>	98	-0.109
<b>Q5:</b> <i>My Worcester CDi Boiler pressure is low. How can I fix it?</i>	139	0.878 *
<b>Q6:</b> <i>2003 Dodge Durango has an OBD-II error code of P440. How do I fix it?</i>	138	0.662 *
<b>Q7:</b> <i>2005 Chevy Silverado has an OBD-II error code of C0327. How do I fix it?</i>	135	0.412 *
<b>Q8:</b> <i>How do I deal with the arthritis in my knee as a 28 year old?</i>	139	0.391 *
<b>Q9:</b> <i>My Playstation 3 has a solid yellow light, how do I fix it?</i>	119	0.380 *
<b>Q10:</b> <i>What are the key arguments for and against Global Warming?</i>	138	0.386 *
<b>Q11:</b> <i>How do I use the VIM text editor?</i>	138	0.180

\* = significant at  $p < 0.01$  after Bonferroni correction



Phase	Task Pay	Avg. # of Tasks	Avg. Cost
Sourcing	\$0.25	15	\$3.75
Clipping	\$0.50	21.6	\$10.80
Clustering 1	\$1.00	10	\$10.00
Clustering 2	\$1.00	10	\$10.00
Integrate	\$0.50	37.2	\$18.60
Edit 1	\$0.75	28.8	\$21.60
Edit 2	\$1.00	28.8	\$28.80
Images	\$0.50	9	\$4.50
<b>Total</b>		160.4	\$108.05



## DISCUSSION QUESTIONS

- In the article, they specify knowledge synthesis as the generation of a coherent article from small contributions, integrating different sources, viewpoints, and topics found online. What does knowledge synthesis mean to you?
- In the article, they discuss a workflow for crowdsourcing the article given an input question. Can you think of additional uses, improvements, or evolutions for the process they created?
- What are the limitations of using a crowd to assemble "small pieces" into a "big picture"?



# **EXPERT CROWDSOURCING WITH FLASH TEAMS**

Daniela Retelny, Sebastien Robaszkiewicz,  
Alexandra To, Walter Lasecki, Jay Patel, Negar  
Rahmati, Tulsee Doshi, Melissa Valentine,  
Michael S. Bernstein

Stanford University, University of Rochester

# FOUNDRY: EXPERT TEAMS ON DEMAND

- Framework for dynamically assembling and managing paid experts from the crowd
- Complex interdependent goals
- Sequences of linked modular tasks & handoffs that can be computationally managed
- Interactive systems reason about & manipulate teams' structures
- Each task has an input & produces an output
- Teams can be combined, scaled, and pipelined
- Just provide desired input and output for project

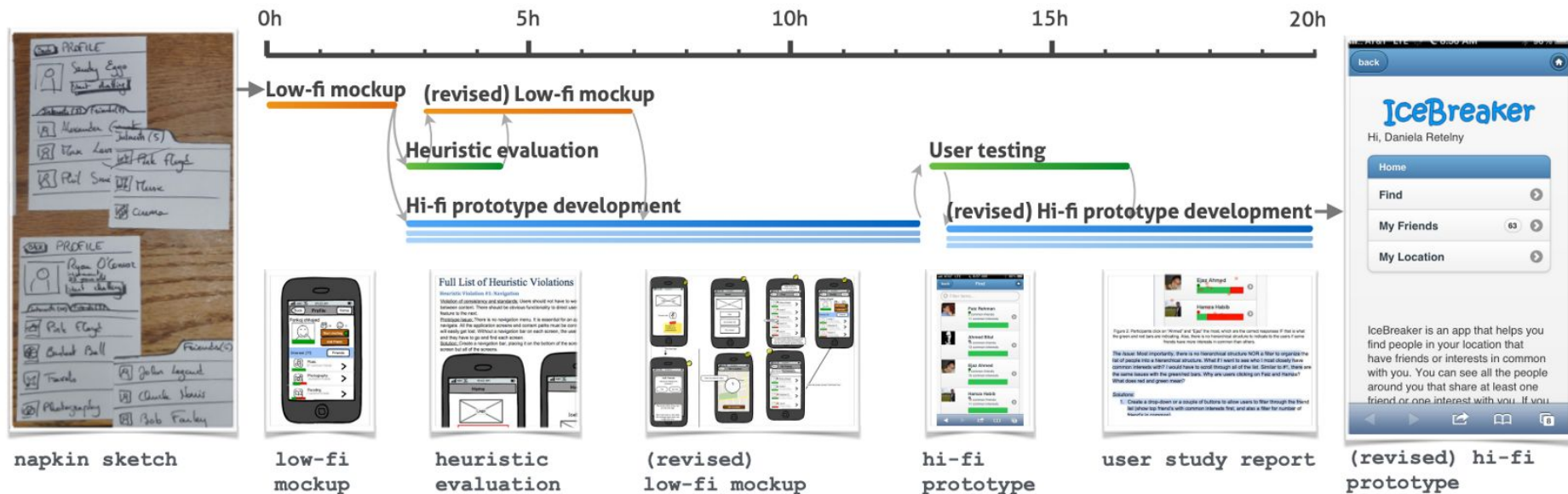
## CHALLENGE:

- Microtask crowdsourcing cannot coordinate experts because they do not effectively leverage participants' diverse skills

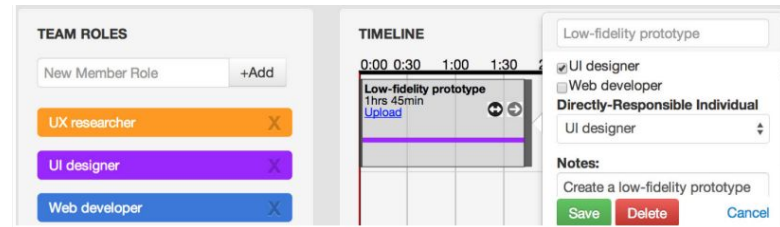
## SOLUTION: Follow a user-centered design process

- Transform a napkin sketch into a tested prototype
- Create an animated movie from a prompt
- Develop an online class (with video & quizzes)

# EXAMPLE FLOW



# ORGANIZATIONAL BEHAVIOR

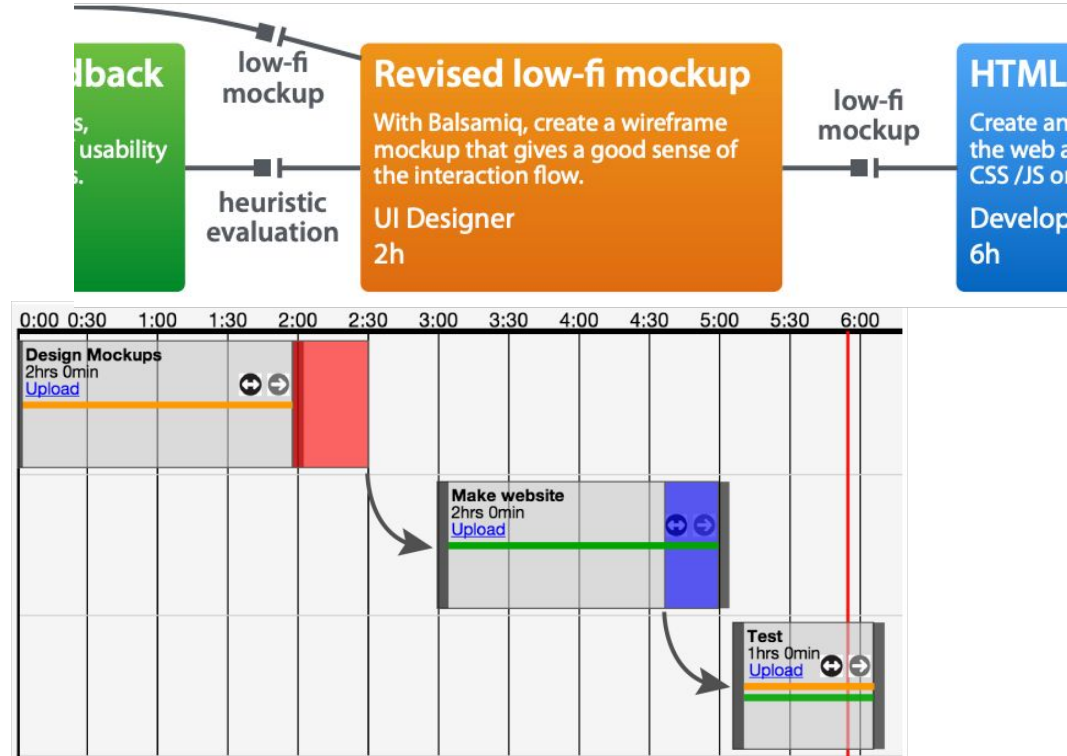


## CHALLENGES:

- Geographical dispersion
- Technology-mediated communication
- Fluid team membership

## SOLUTIONS:

- Blocks: expert(s) performing a task
- DRI: directly responsible individual
- Automatically adjust timing & notify



# COMPUTATIONALLY ENHANCED

- Because blocks are *modular* with clear boundaries, teams can be *combined* into organizations
- *Path search support* for team authoring: a goal in mind but not a strong idea of how to complete it
- Leverage blocks' shared input/output tags to search through the space of novel team combinations
- *Elastic* growth allows a single team abstraction to encompass a wide variety of actual runtime needs
- User specifies growth parameters for a block & DRI can request the expansion for user to approve
- *Pipelined* by streaming intermediate results as they are ready when user indicates this for a block
- Two beneficial effects to pipeline: work productively in parallel & encourages synchronous feedback

# Flash Team Examples

- Recruited from paid open crowdsourcing marketplace  
Upwork
- Three types of teams:
  - Napkin Sketch (Design, Web Programming and App Development)
  - Animation (Video Making)
  - Massive Online Open Course platform (Online education)

# Napkin Sketch Design Team

Napkin Sketch

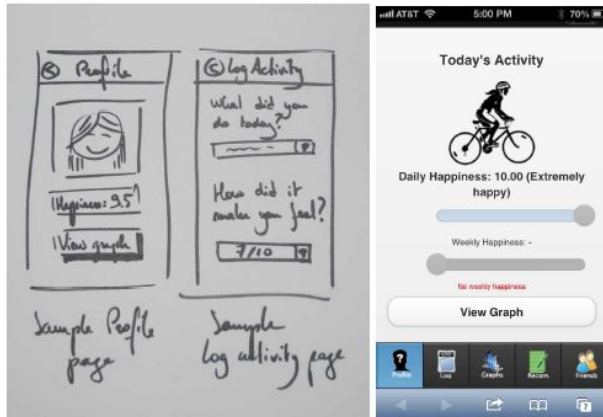
Low-fi mockup

Heuristic Evaluation

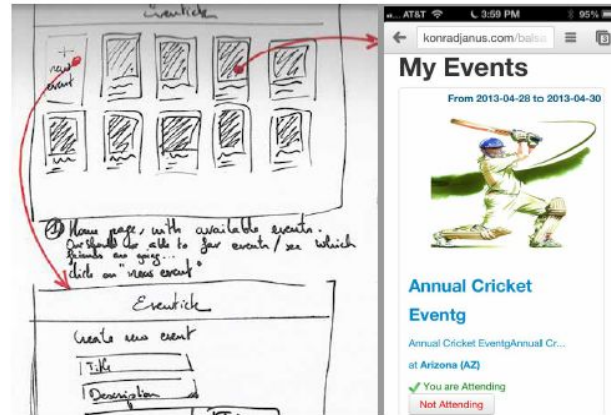
Hi-fi Prototype

User study report

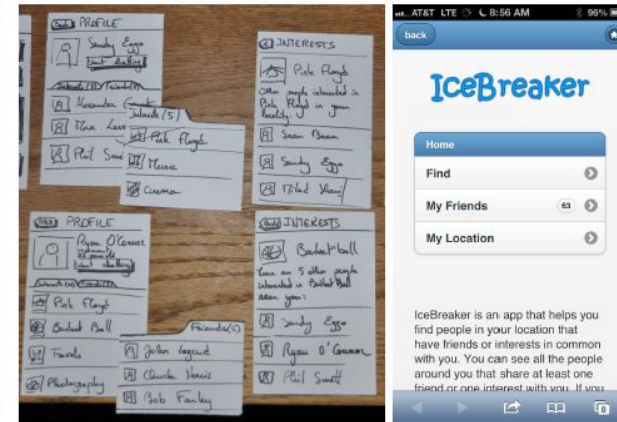
Final Prototype



**Happily:**An emotion tracking site



**Eventick:**A local event billboard site

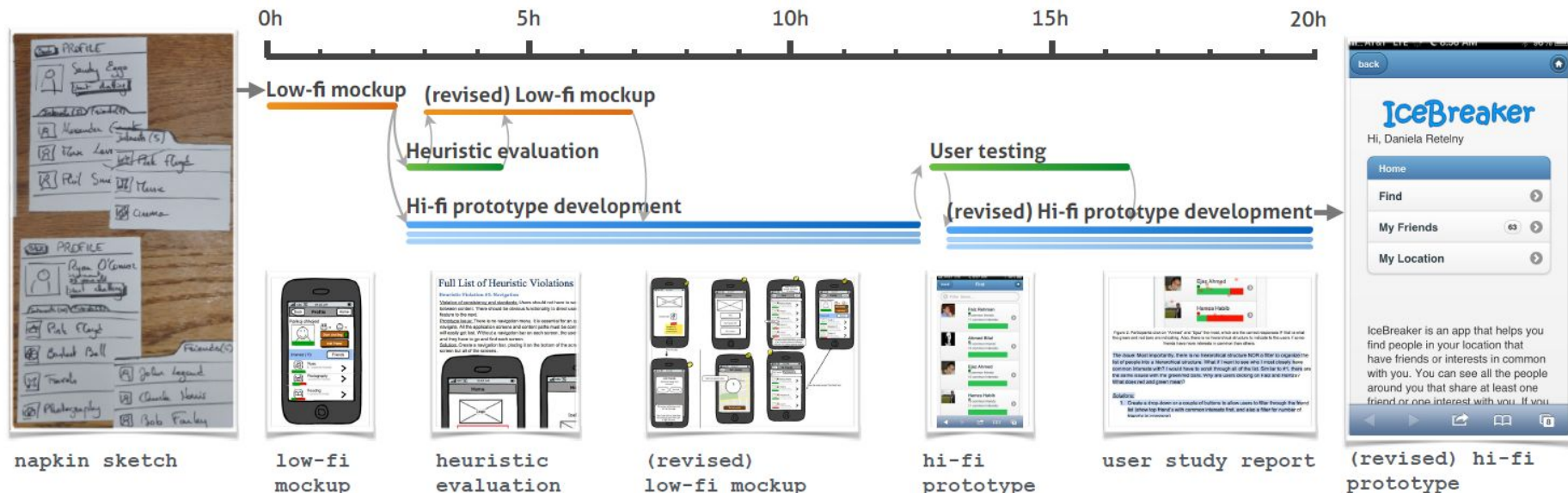


**Icebreaker:** A local social network site

Task	Type of Team	Roles	Time [hh:mm]	Median Wage	Total Cost
Happily App	Napkin Sketch	UX, UI, Dev	31:30	\$26.85	\$744.48
Eventick App	Napkin Sketch	UX, UI, Dev1, Dev2, Dev3	18:00	\$28.78	\$1,270.28
Icebreaker App	Napkin Sketch	UI, UX1, UX2, Dev1, Dev2	23:10	\$31.38	\$1,200.97

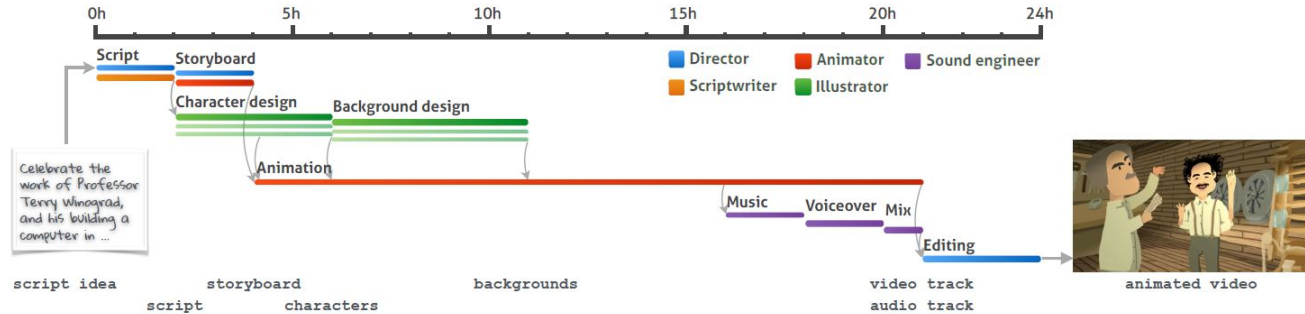


# Overview and timeline of Flash Teams for Napkin Sketch Design task



# Animation Task : Overview and Timeline

To explore the possibility of flash teams in supporting creative outputs in non-engineering domains



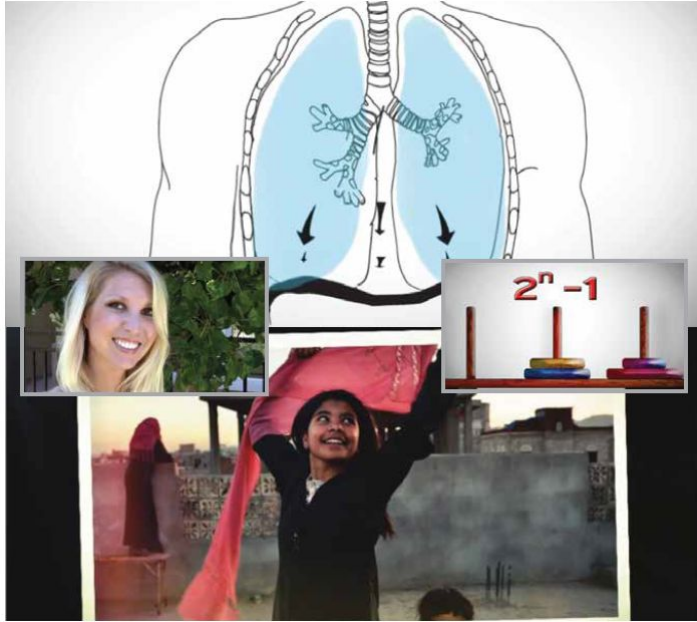
Conceptualization to Scripting to Creating the animated video within 48 hours

# Animation Task : Overview and Timeline

To explore the possibility of flash teams in supporting creative outputs in non-engineering domains



# Massive Online Open Course platform : Overview



- Compose multiple modular team structures to complete a large scale project in 1 day
- Singing from the Diaphragm MOOC
- Portrait Photography Skills MOOC
- Tower of Hanoi solving MOOC

Diaphragm MOOC	Education Content, Animation	Education, Content, Director, Animator, Actor, Voiceover	19:20	\$30.14	\$1,597.32
Photography MOOC	Education Content, Animation	Education, Content, Director, Animator, Actor, Voiceover	19:00	\$21.77	\$741.58
Tower of Hanoi MOOC	Education Content, Animation	Education, Content, Director, Animator, Voiceover	11:30	\$18.52	\$446.49
MOOC Platform	Napkin Sketch 1, Napkin Sketch 2, Napkin Sketch 3	UX1, UI1, Dev1, UX2, UI2, Dev2, UX3, UI3, Dev3	13:00	\$29.14	\$1,015.80

# Effectiveness of Flash Teams

- Field experiment was performed using a control to test the effectiveness of **Flash Teams VS Self Managed** Teams
- Flash Teams could leverage the computational methodology of the Foundry tool for designing the workflow, smooth coordination and handoff through the notifications system
- Flash Teams advantaged from **on-demand recruiting**
- Flash Teams were **significantly faster** than the self managed teams
  - Mean Completion Time for Flash Teams: 13:02 hours
  - Mean Completion Time for Self Managed Teams: 23:47 hours
  - Even the slowest flash team finished in fewer hours than fastest team in control condition

# Conclusion

- Flash Teams **shift the crowdsourcing narrative** from independent homogeneous workers to a team of experts from crowd managed through a **computational platform**
- Flash Teams view the crowd as **elastic**, on-demand set of **diverse** and **high-quality** participants
- Computational managing of flash teams gives end users the **flexibility** to create **modular team elements** to create larger organizations

# Discussion

- 1. Would you use the Foundry tool yourself? What type of job do you think is best suited for a flash team? What attributes does it have?**
- 2. What are ways to improve the structure of the flash teams? Can you see any weaknesses not discussed in the paper?**

An abstract network diagram on the left side of the slide, featuring a complex web of interconnected nodes and lines, resembling a molecular structure or a data network, rendered in black and white.

# **Flash Organizations: Crowdsourcing Complex Work By Structuring Crowds As Organizations**

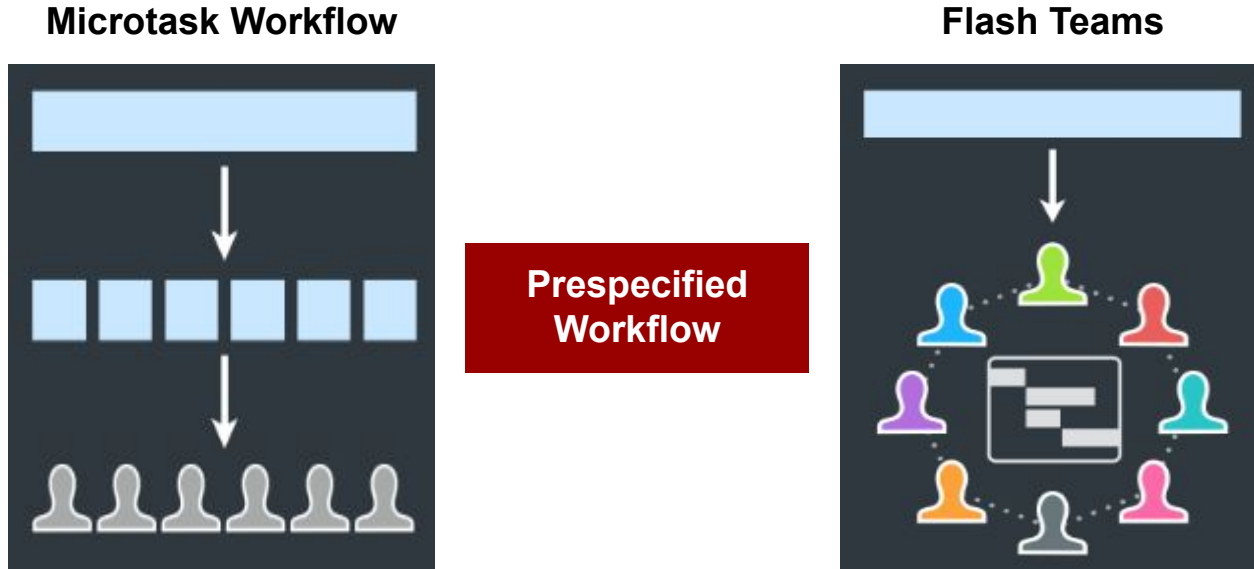
Melissa A. Valentine, Daniela Retelny, Alexandra To, Negar Rahmati, Tulsee Doshi, Michael S. Bernstein

Stanford University

Carnegie Mellon University



# Can we crowdsource tasks that are Complex and Evolving ??



Open ended goals are difficult to **articulate** and **modularize** into **prespecified workflows**

# Traditional Organizations always solve complex and open-ended tasks



- **Organization** is the most important social phenomenon of 20th Century (Weber)
- Organizations regularly coordinate high-level and open-ended tasks by arranging employees into **organizational structure**

**Flash Organizations** are based on the principles of **organizational structures**

# What are Flash Organizations??

The New York Times

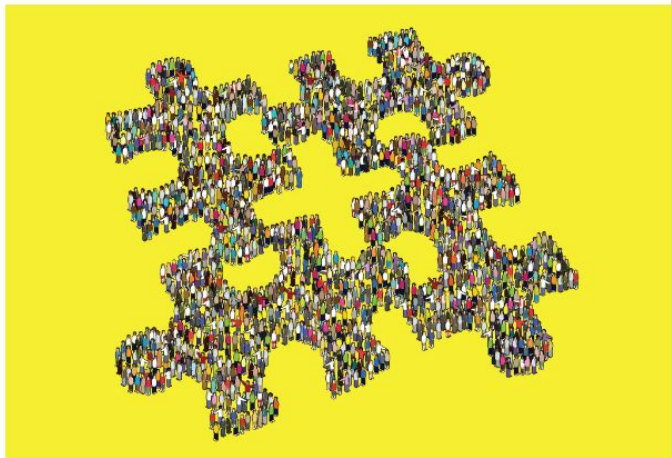
## *The Pop-Up Employer: Build a Team, Do the Job, Say Goodbye*

Collaborative Crowdwork

CHI 2017, May 6–11, 2017, Denver, CO, USA

## Flash Organizations: Crowdsourcing Complex Work By Structuring Crowds As Organizations

Melissa A. Valentine<sup>1</sup>, Daniela Retelny<sup>1</sup>,  
Alexandra To<sup>1,2</sup>, Negar Rahmati<sup>1</sup>, Tulsee Doshi<sup>1</sup>, Michael S. Bernstein<sup>1</sup>  
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Minh Ung/The New York Times

By Noam Scheiber

July 12, 2017

- **Crowd** structured like organizations
- Can perform **complex** tasks
- **Globally** distributed professional workforce
- **Rapidly** assembled
- Easier **scalability**
- Faster **deployments**

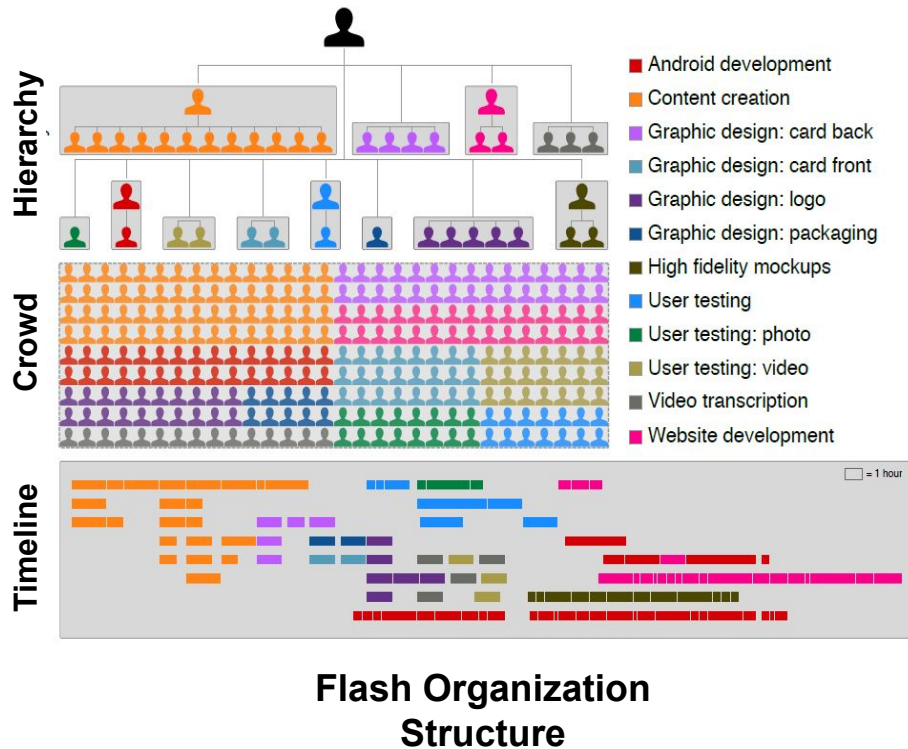
# What are the challenges of Flash Teams ??

- **Asset specificity** i.e. ability to develop effective collaborative patterns between organizational members
- **Task based reconfiguration** of teams

**Flash Organizations** exhibits the potential of crowdsourcing by solving complex and open-ended tasks

- **Structure, hierarchies, roles** encode responsibilities and information flow thus eliminating the need of pre specified pipelines
- **Computational management** and **open-call recruitment** to achieve the scalability of crowdsourcing

# Characteristics of Flash Organization



- ***Asset Specificity*** based on role structures
  - **Coordination** based on **roles structures** to encode interdependencies
  - **Quick organization** of structure based on knowledge of the roles rather than interpersonal knowledge
- ***Task Based Reconfiguration*** of teams
  - System enables reconfiguration through **version control**
  - Workers **replicate** (branch) current organizational structure and then propose changes (pull requests)
  - **Hierarchical system** maintained for change in roles and tasks

# Discussion #1

- Give an example of a real life scenario where "asset-specificity" is not exhibited?

# Flash Organizations are computationally formed and reconfigured using **Foundry** tool

## StanfordHCI/ **foundry**



Foundry is an interactive, real-time Javascript interface that allows flash teams to be assembled by anyone and tracked in real...

👤 12 Contributors    ⌚ 49 Issues    ☆ 28 Stars    🍴 13 Forks



- **Foundry** is an interactive interface that enables **real-time assembling** and **tracking** of tasks in flash teams
- Represents a Flash Organization as a set of **nested hierarchical roles**
- Uses **open call hiring** for task execution (eg: UpHiring platform)
- Each role is indicated with position of crowd-worker, **task specifics**, **expertise** and **hierarchy**

# On Demand Assembly of Crowdsourced Experts: Pipeline of Foundry

Task Add, Timeline and Task Details



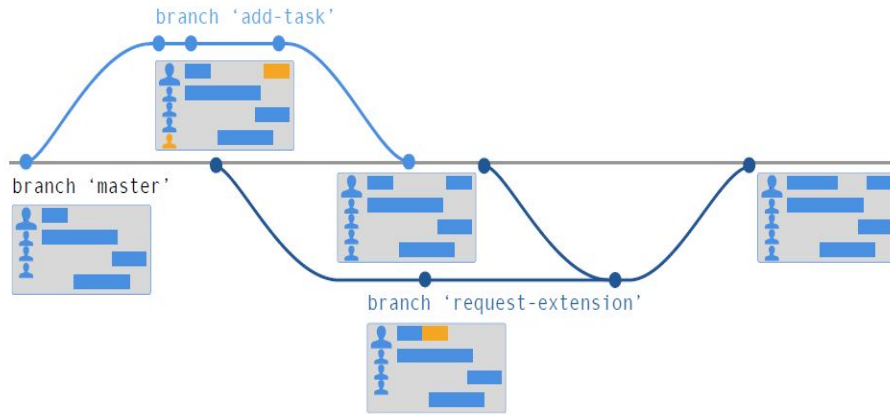
Online Hire and Rapid Onboarding

The screenshot displays a task management interface. On the left, a sidebar shows a 'Google Drive™ folder' and a list of team roles: 'UX researcher', 'UI designer', and 'Web developer'. The main area features a timeline with tasks: 'HOMEPAGE & LOGIN WIREFRAMES' (completed), 'NEWS FEED WIREFRAMES' (completed), 'QUESTION & ANSWER WIREFRAMES' (3 HRS 35 MIN), and 'USER PROFILE WIREFRAMES' (3 HRS 42 MIN). A detailed view of the 'Homepage & Login Wireframes' task is shown, indicating it is not started and has a duration of 2:30. The task description states: '30 minutes of this task are allocated for reading the requirements and reviewing the previous materials. Click the start button when you are ready to review. The goal of this task is to: Create wireframes for the homepage and login pages of the web application using balsamiq. Please make sure to review the project specification document first. When you are complete, upload the .bmmi files for the wireframes as well as a PDF version. Specifically, you are expected to produce the following deliverables: homepage wireframes, login wireframes'. At the bottom, there are buttons for 'Deliverables', 'Hire', 'Options', 'Edit', 'Delete', and 'Start Task'.

The screenshot shows the 'FOUNDRY HIRING PORTAL'. The project is 'Question and Answer Web Application'. A task 'Homepage & Login wireframes' is available. The user is at position No. 1 in the hiring queue. The deadline to accept the position is 10 minutes. There are buttons to 'Accept this position' and 'Decline this position'. A message states: 'Congratulations! You are at No. 1 position in the hiring queue for the UI Designer 2 role to work on the hiring queue. How... Please read the following information carefully. You should complete the entire registration process (the hiring queue. How... Please do not close this removed from the hiring queue. As stated in the job description, oDesk. For your reference...'. A task card for 'HOMEPAGE & LOGIN WIREFR...' (2 HRS 30 MIN) is shown. A 'Your Task' section explains: 'This is YOUR task. You can now end this tour, and click on the task rectangle and click start to read about your task, and start tracking work time. Note that time for reviewing the previous materials, etc. are accounted for as work time. Pay close attention to the task description, the 'inputs' (what other workers have handed off to you), and the deliverables you are expected to create.' Below this, another task card for 'USER PROFILE WIREFRAMES' (2 HRS 45 MIN) is visible.



# Reconfiguring and adapting organizational structure



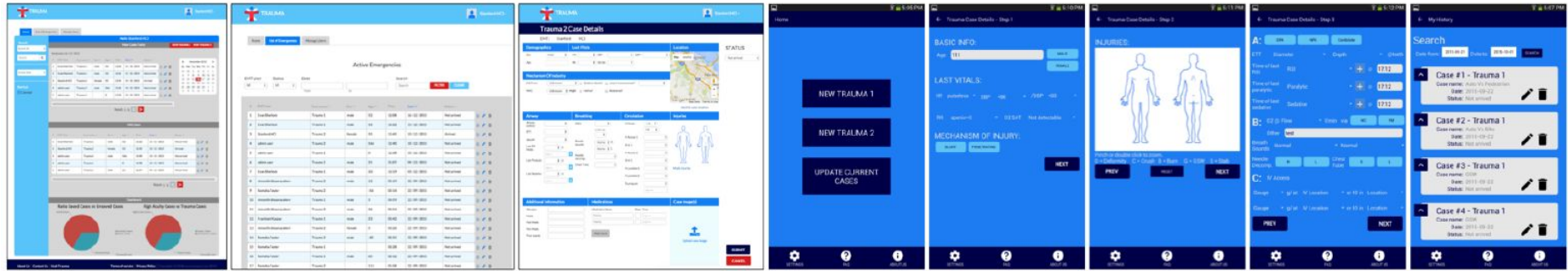
- Foundry enables **rapid reconfiguration** of organizational structure by **branch and merge** technique
- Branch and Merge technique is based on the **distributed version control**
- Any member can make a branch of the current structure and suggest edits to be merged in the master branch

# Flash Organization Examples

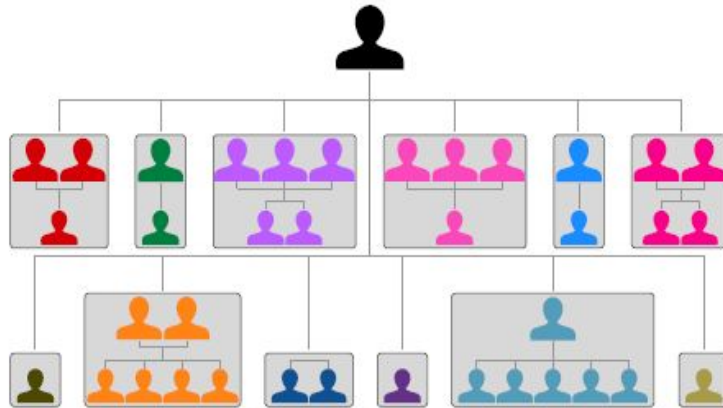
	EMS Report	True Story	Workshop Planning
Leader	Medical Resident	Storytelling Podcast Team	Tech Employee of a large company
Task	Develop prototype app for EMTs to transfer patient information en-route to the hospital	Design and manufacture a storytelling card game with accompanying mobile application	Develop a workshop planning portal following enterprise standards and branding

**Three different field study was defined to be run in Flash Organization format and was run by outside neutral leader for six weeks using the Foundry tool to achieve the desired task**

# EMS Trauma Report: Overview and Final Product



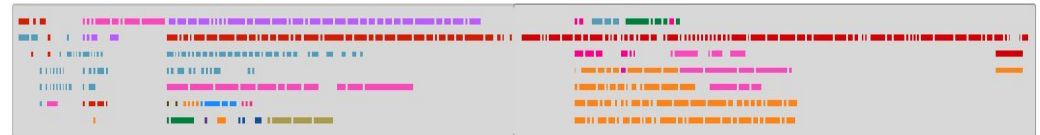
## Android and Web Application



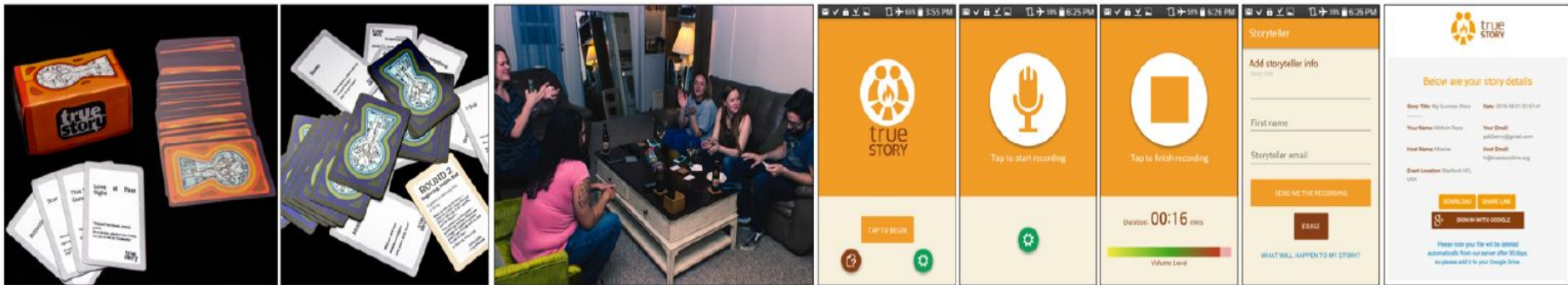
EMS Report

**31 Crowd Workers**  
**9 Teams , 3 Individuals**  
**11 Team Leads**

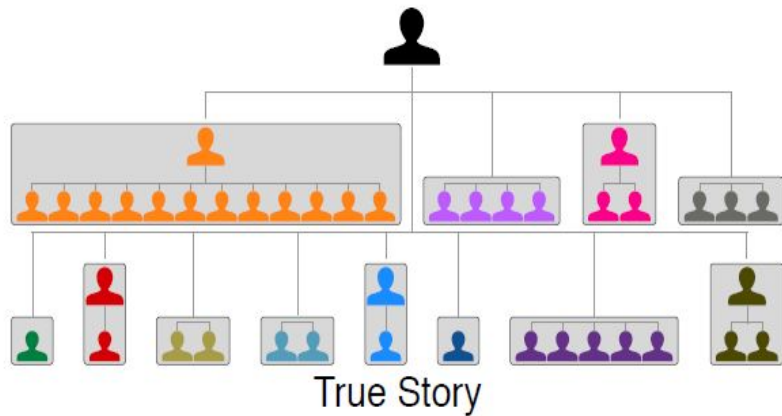
**390 Tasks**  
**46 days**  
**Total Dev Time = 1671 hrs**



# True Story: Overview and Final Product

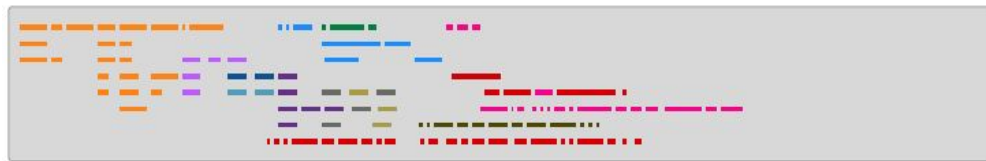


## Android and Web Application

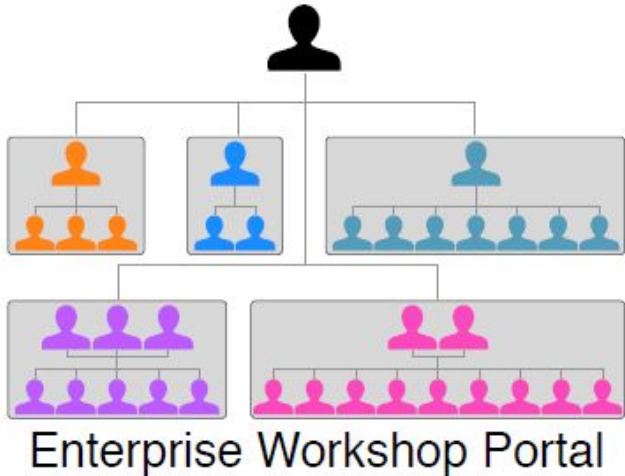
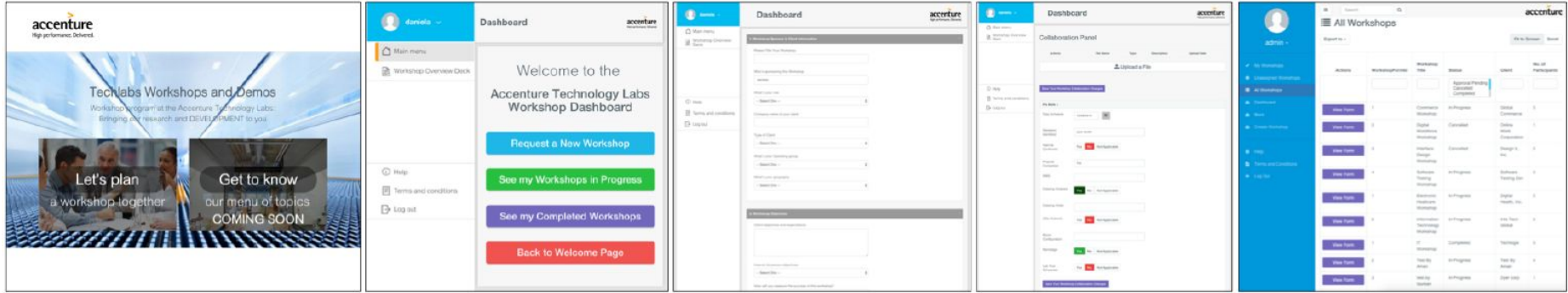


**37 Crowd Workers**  
**10 Teams , 2 Individuals**  
**3 Team Leads**

**122 Tasks**  
**41 days**  
**Total Dev Time = 292 hrs**



# Enterprise Workshop: Overview and Final Product



## Web Application

**37 Crowd Workers**  
**5 Teams**  
**8 Team Leads**

**127 Tasks**  
**35 days**  
**Total Dev Time = 1297 hrs**



# Manual Hiring VS Automated Hiring

		EMS Report	True Story	Enterprise	All Projects
Automated Hires	Count	25	29	21	75
	Median Time	0:13:40	0:12:40	0:15:13	0:13:40
Manual Hires	Count	6	8	6	20
	Median Time	25:14:19	19:28:41	5:55:51	14:48:45

Using Foundry to manage hiring computationally  
median hiring time was less than **14 minutes**

# Manual Hiring VS Automated Hiring

		EMS Report	True Story	Enterprise	All Projects
Automated Hires	Count	25	29	21	75
	Median Time	0:13:40	0:12:40	0:15:13	0:13:40
Manual Hires	Count	6	8	6	20
	Median Time	25:14:19	19:28:41	5:55:51	14:48:45

Manual Hiring process took a median time of **14+ hours**

# Flash Organizations continuously reconfigured their structure to changing demands

	EMS Report	True Story	Enterprise	All Projects
# of Pull Requests	335	113	118	566
Mean Changes per Day	7.3	2.8	3.4	4.5

Reconfigurations were performed both **Top-Down** and **Bottom-Up**



# Conclusion

- **Computationally managed organizational structures with on-demand global workforce can be effectively utilized to solve complex and open-ended tasks previously out of reach for crowdsourcing**
- **Flash Organization infrastructure are flexible and scalable hence they can grow, shrink and rearrange in limited time**
- **Flash Organization would offer traditional organization the concept of computationally manageable “fluid-teams” to optimize their workflow and better utilize their global expertise workforce**

## Discussion #2

- What are the benefits of flash organization from employer and employee perspective?
- What are the challenges faced by the flash organizations and how to address it??