Worksheets for Guiding Novices through the Visualization Design Process

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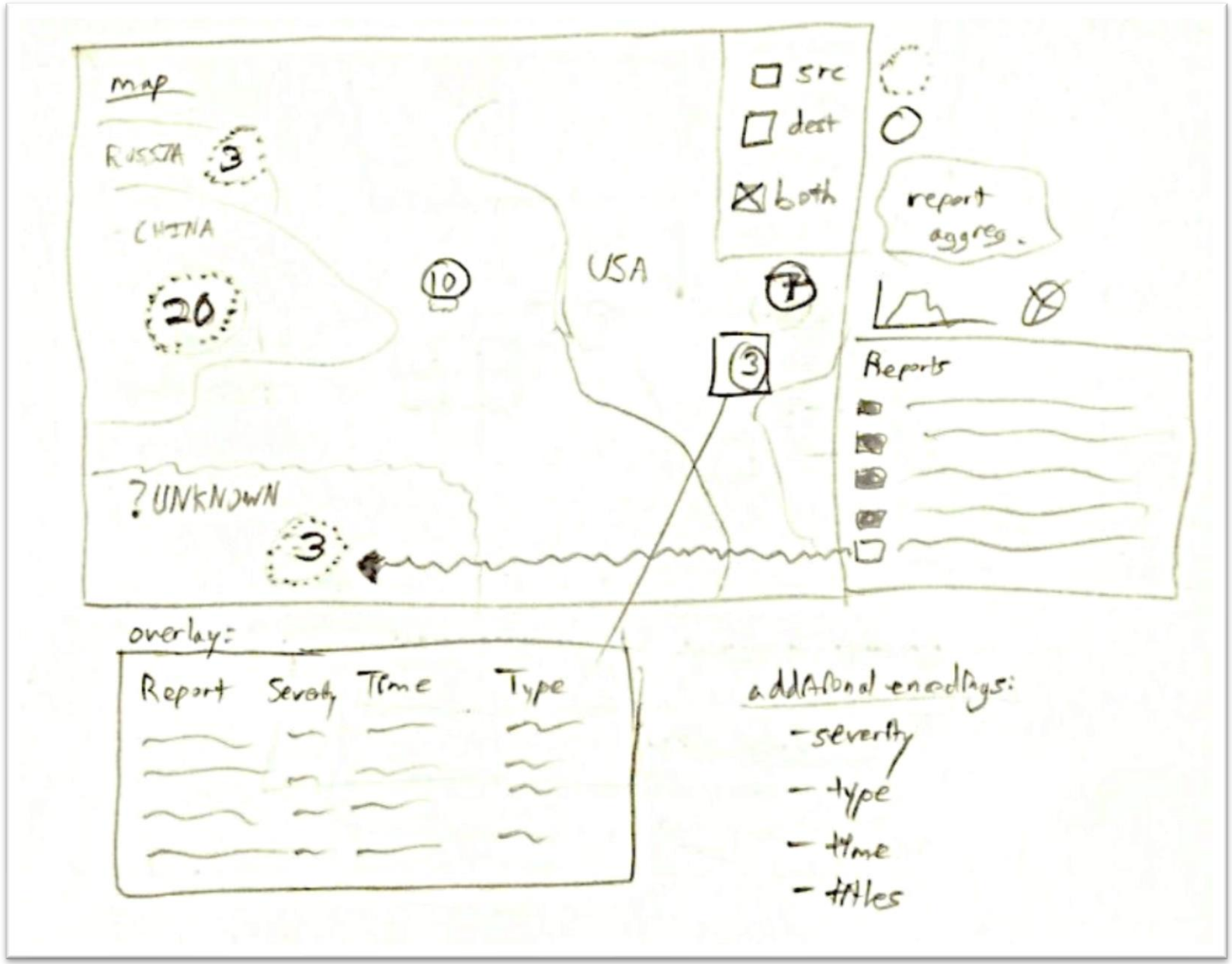
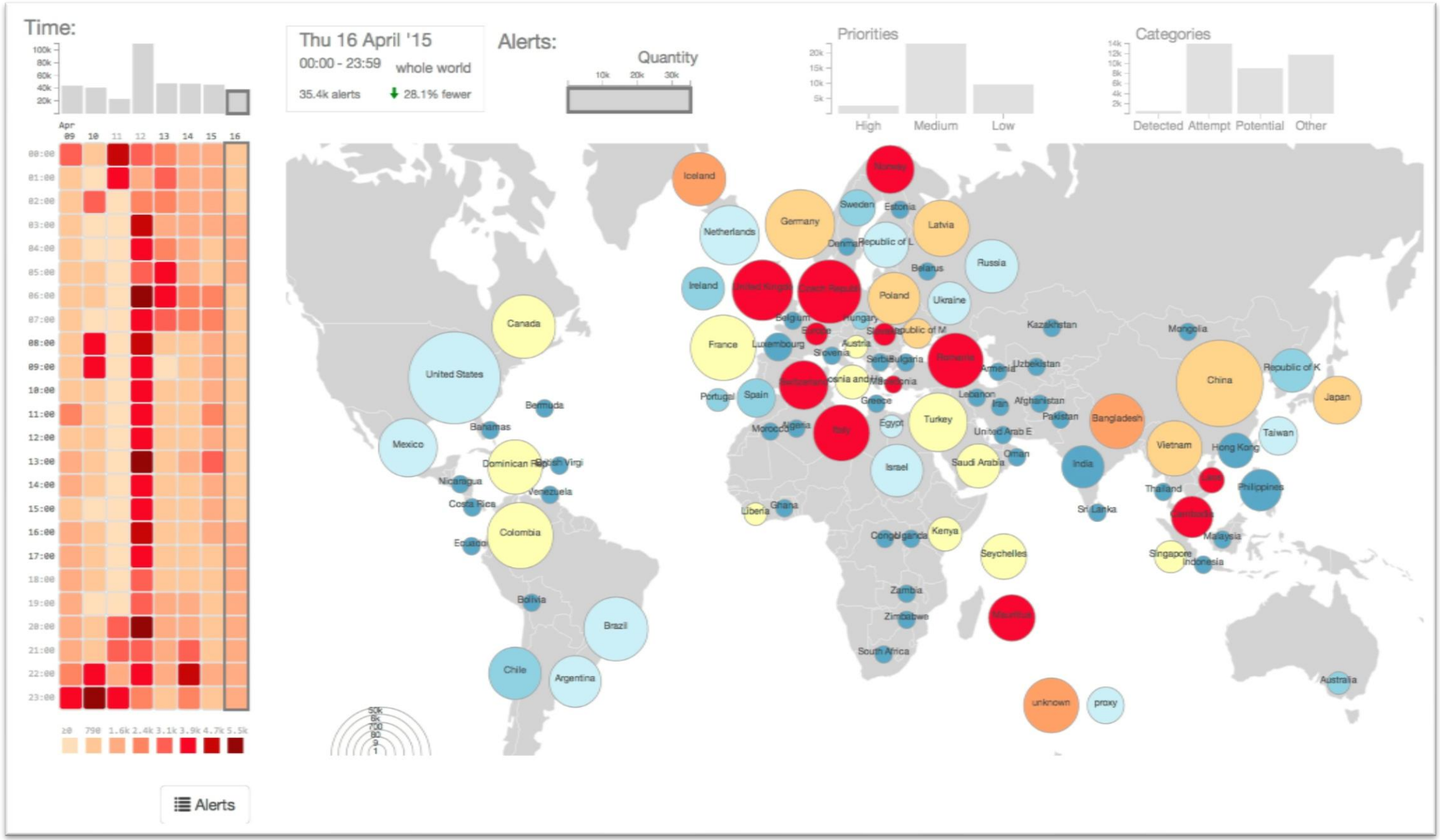
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
9	8/10/2011 9:46	20.360268	tcp	147.32.3.93	443	<?>	147.32.84.59	51790	FPA_FRPA	0	0	133	81929	67597	flow=Background-Established-cmpgw-CVUT
10	8/10/2011 9:46	3118.470947	udp	24.117.206.20	8697	<->	147.32.84.229	13363	CON	0	0	13	4328	840	flow=Background-UDP-Established
11	8/10/2011 9:46	1065.003052	tcp	94.208.78.74	50687	<?>	147.32.84.229	13363	FPA_RPA	0	0	156	14804	7699	flow=Background
12	8/10/2011 9:46	2.210671	udp	79.129.201.26	56877	<->	147.32.84.229	13363	CON	0	0	4	379	137	flow=Background-UDP-Established
13	8/10/2011 9:46	0.187434	tcp	147.32.86.194	2065	->	217.163.21.35	80	FSPA_FSPA	0	0	11	3872	1147	flow=Background-TCP-Established
14	8/10/2011 9:46	3599.972412	tcp	147.32.80.13	80	<?>	147.32.84.162	51769	PA_A	0	0	72157	61638544	60214264	flow=From-Background-CVUT-Proxy
15	8/10/2011 9:46	0.000307	tcp	74.200.246.228	80	<?>	147.32.84.59	49382	FA_RA	0	0	3	180	60	flow=Background-Established-cmpgw-CVUT
16	8/10/2011 9:46	0.000258	tcp	77.238.167.32	80	<?>	147.32.86.194	2060	FA_A	0	0	2	120	60	flow=Background
17	8/10/2011 9:46	37.925823	tcp	94.124.104.196	80	<?>	147.32.84.59	49500	PA_FRA	0	0	1921	2636496	2625276	flow=Background-Established-cmpgw-CVUT
18	8/10/2011 9:46	0.312088	tcp	98.127.111.126	51534	<?>	147.32.84.229	13363	FRPA_FPA	0	0	10	750	407	flow=Background
19	8/10/2011 9:46	2407.466797	udp	123.1.72.4	16562	<->	147.32.84.229	13363	CON	0	0	4	268	148	flow=Background-UDP-Established
20	8/10/2011 9:46	3495.29541	tcp	147.32.84.229	443	<?>	212.217.56.83	58258	PA_PA	0	0	287	24672	10309	flow=Background
21	8/10/2011 9:46	3591.918945	tcp	147.32.84.229	443	<?>	213.142.200.29	10004	PA_PA	0	0	4360	339588	125248	flow=Background
22	8/10/2011 9:46	3514.610352	tcp	147.32.84.229	13363	<?>	93.45.94.195	44977	PA_PA	0	0	310	52117	9301	flow=Background
23	8/10/2011 9:46	3599.977539	tcp	147.32.84.229	13363	<?>	83.78.136.90	52573	PA_PA	0	0	164	12065	5378	flow=Background
24	8/10/2011 9:46	507.347626	tcp	147.32.80.13	80	<?>	147.32.85.112	10885	FPA_FA	0	0	162760	137136528	132816366	flow=From-Background-CVUT-Proxy
25	8/10/2011 9:46	0.001105	udp	217.164.10.229	7797	<->	147.32.84.229	13363	CON	0	0	2	582	77	flow=Background-UDP-Established
26	8/10/2011 9:46	0	tcp	199.59.148.20	443	?>	147.32.84.184	51855	A_	0		1	60	60	flow=Background
27	8/10/2011 9:46	1288.713379	udp	77.100.246.74	6430	<->	147.32.84.229	13363	CON	0	0	18	1244	704	flow=Background-UDP-Established
28	8/10/2011 9:46	2292.730469	udp	58.72.174.152	1769	<->	147.32.84.229	13363	CON	0	0	16	3828	548	flow=Background-UDP-Established
29	8/10/2011 9:46	273.880157	tcp	83.137.254.245	49455	<?>	147.32.84.229	13363	PA_PA	0	0	121	14096	10430	flow=Background
30	8/10/2011 9:46	3572.482422	tcp	147.32.84.59	49238	<?>	74.125.232.215	443	PA_PA	0	0	1332	627474	282534	flow=Background-Established-cmpgw-CVUT
31	8/10/2011 9:46	0.000368	udp	147.32.84.138	42315	<->	147.32.80.9	53	CON	0	0	2	214	81	flow=To-Background-UDP-CVUT-DNS-Server
32	8/10/2011 9:46	0.000225	udp	147.32.84.138	42626	<->	147.32.80.9	53	CON	0	0	2	214	81	flow=To-Background-UDP-CVUT-DNS-Server
33	8/10/2011 9:46	3133.970947	udp	186.204.215.229	12677	<->	147.32.84.229	13363	CON	0	0	10	1218	908	flow=Background-UDP-Established
34	8/10/2011 9:46	619.352722	udp	147.32.84.229	13363	->	31.9.113.254	23320	INT	0		4	568	568	flow=Background-UDP-Attempt
35	8/10/2011 9:46	0.000227	udp	147.32.84.138	58276	<->	147.32.80.9	53	CON	0	0	2	214	81	flow=To-Background-UDP-CVUT-DNS-Server
36	8/10/2011 9:46	0.000272	udp	147.32.84.138	58867	<->	147.32.80.9	53	CON	0	0	2	214	81	flow=To-Background-UDP-CVUT-DNS-Server
37	8/10/2011 9:46	536.390381	tcp	109.183.212.236	61775	<?>	147.32.84.130	20	FPA_FA	0	0	23574	10855048	10056796	flow=Background
38	8/10/2011 9:46	12.067851	tcp	178.236.4.29	80	?>	147.32.86.141	2019	FA_	0		3	180	180	flow=Background
39	8/10/2011 9:46	3144.869629	udp	212.59.9.106	15036	<->	147.32.84.229	13363	CON	0	0	4	266	146	flow=Background-UDP-Established
40	8/10/2011 9:46	0.000162	udp	147.32.84.138	33302	<->	147.32.80.9	53	CON	0	0	2	214	81	flow=To-Background-UDP-CVUT-DNS-Server
41	8/10/2011 9:46	0.000163	udp	147.32.84.138	59866	<->	147.32.80.9	53	CON	0	0	2	214	81	flow=To-Background-UDP-CVUT-DNS-Server
42	8/10/2011 9:46	1.553285	udp	147.32.86.111	58314	<->	147.32.1.20	53	CON	0	0	2	336	73	flow=To-Background-UDP-CVUT-DNS-Server
43	8/10/2011 9:46	0.00029	udp	147.32.84.138	39703	<->	147.32.80.9	53	CON	0	0	2	214	81	flow=To-Background-UDP-CVUT-DNS-Server
44	8/10/2011 9:46	0.000289	udp	147.32.84.138	36312	<->	147.32.80.9	53	CON	0	0	2	214	81	flow=To-Background-UDP-CVUT-DNS-Server
45	8/10/2011 9:46	10.022196	tcp	79.78.83.0	60676	->	147.32.84.229	443	S_SA	0	0	16	1148	530	flow=Background-TCP-Established
46	8/10/2011 9:46	3241.262451	tcp	213.192.37.130	1108	<?>	147.32.84.229	13363	RPA_RPA	0	0	448	45540	24929	flow=Background
47	8/10/2011 9:46	0.000246	udp	147.32.84.138	42271	<->	147.32.80.9	53	CON	0	0	2	214	81	flow=To-Background-UDP-CVUT-DNS-Server
48	8/10/2011 9:46	0.000167	udp	147.32.84.138	44233	<->	147.32.80.9	53	CON	0	0	2	214	81	flow=To-Background-UDP-CVUT-DNS-Server
49	8/10/2011 9:46	0.000198	udp	147.32.84.138	37967	<->	147.32.80.9	53	CON	0	0	2	214	81	flow=To-Background-UDP-CVUT-DNS-Server
50	8/10/2011 9:46	0.000332	udp	147.32.84.138	42977	<->	147.32.80.9	53	CON	0	0	2	214	81	flow=To-Background-UDP-CVUT-DNS-Server
51	8/10/2011 9:46	0	udp	147.32.80.9	53	->	147.32.86.111	54230	INT	0		1	141	141	flow=From-Normal-V42-UDP-CVUT-DNS-Server
52	8/10/2011 9:46	0.466502	udp	147.32.86.111	55314	<->	147.32.80.9	53	CON	0	0	2	262	80	flow=To-Background-UDP-CVUT-DNS-Server
53	8/10/2011 9:46	3597.08374	tcp	80.37.198.143	37418	<?>	147.32.84.229	443	PA_PA	0	0	2018	204111	110036	flow=Background
54	8/10/2011 9:46	12.067648	tcp	178.236.4.29	80	?>	147.32.86.141	2017	FA_	0		3	180	180	flow=Background
55	8/10/2011 9:46	12.067688	tcp	178.236.4.29	80	?>	147.32.86.141	2016	FA_	0		3	180	180	flow=Background
56	8/10/2011 9:46	3565.899658	udp	72.73.36.9	50360	<->	147.32.84.229	13363	CON	0	0	210	14490	8190	flow=Background-UDP-Established
57	8/10/2011 9:46	2827.166992	udp	147.32.84.229	13363	<->	76.112.233.145	6601	CON	0	0	14	1052	603	flow=Background-UDP-Established
58	8/10/2011 9:46	25.455866	udp	147.32.84.229	13363	->	118.168.132.221	53663	INT	0		5	370	370	flow=Background-UDP-Attempt
59	8/10/2011 9:46	557.653076	tcp	147.32.84.59	57601	<?>	69.63.190.10	443	FPA_FPA	0	0	513	379123	51557	flow=Background-Established-cmpgw-CVUT



[McKenna, Staheli, Fulcher, Meyer 2016]



[McKenna, Staheli, Fulcher, Meyer 2016]

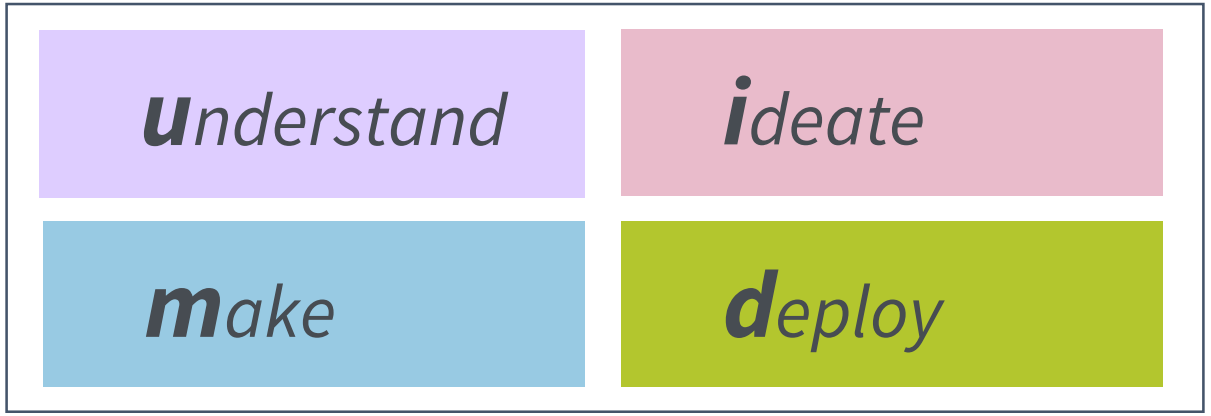
Teaching with Worksheets

- created worksheets to guide students
- worked with students on class projects
- conducted interviews to evaluate what worked well and what could be improved

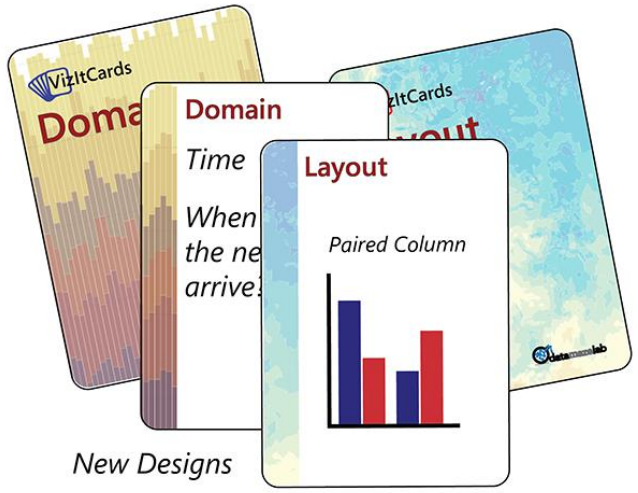
Previous Work

design activity framework

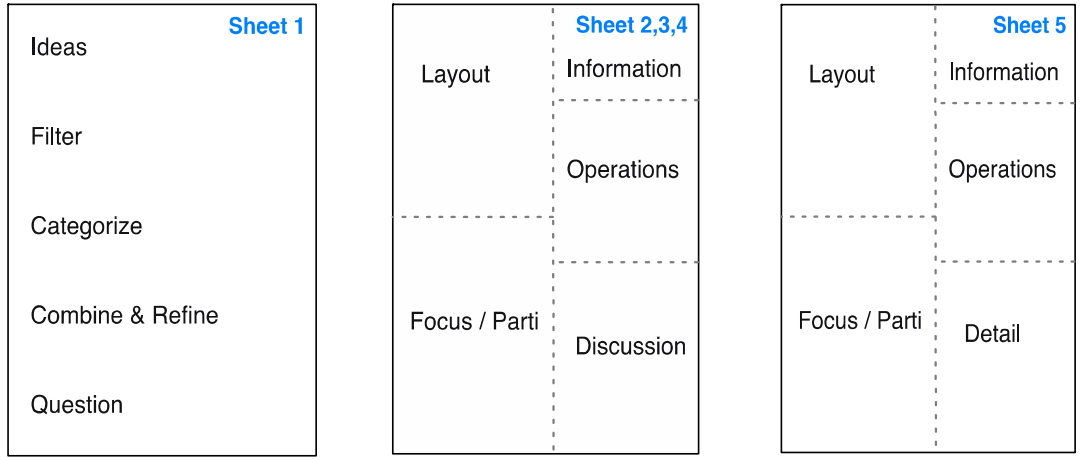
[McKenna, Mazur, Agutter, Meyer 2014]



prescriptive choices [He, Adar 2017]

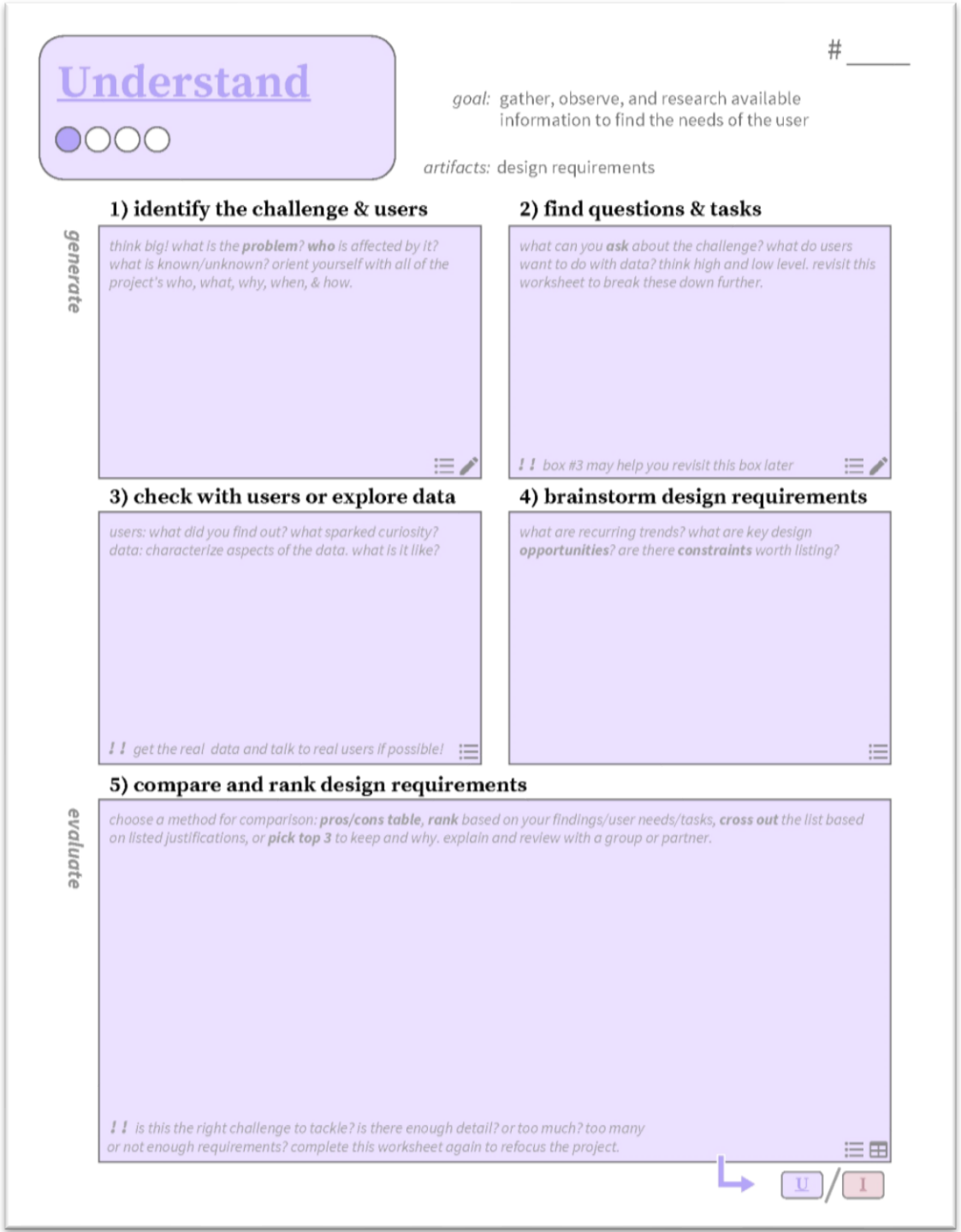


guided steps [Roberts, Headleand, Ritsos 2016]



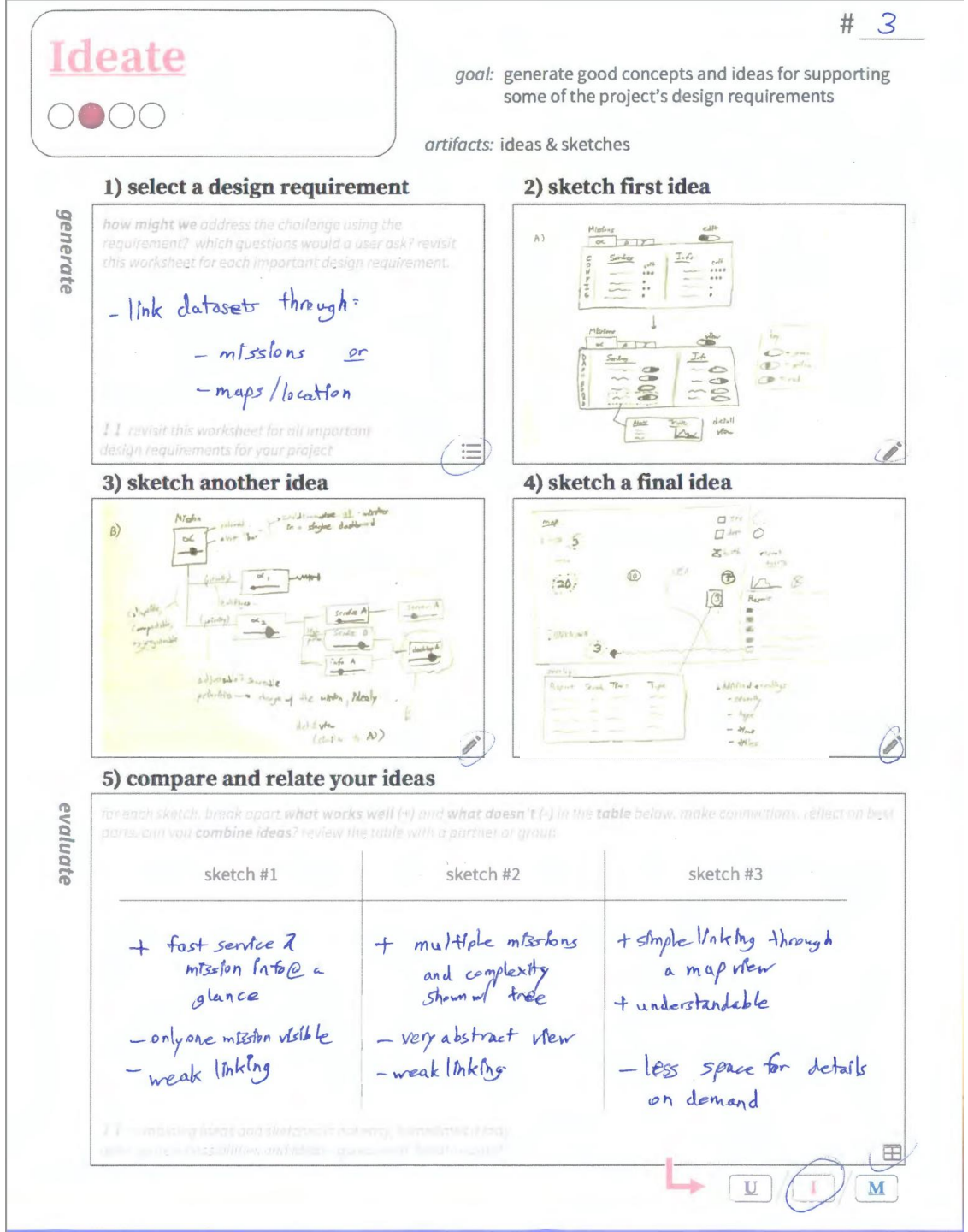
Worksheets

- 4 generative steps
- 1 evaluative step
- helper text & hints



Worksheets

- example for a cyber security dashboard



3

Ideate

goal: generate good concepts and ideas for supporting some of the project's design requirements

artifacts: ideas & sketches

generate

1) select a design requirement

how might we address the challenge using the requirement? which questions would a user ask? revisit this worksheet for each important design requirement.

- link dataset through:
  - missions or
  - maps / location

! ! revisit this worksheet for all important design requirements for your project

2) sketch first idea

3) sketch another idea

4) sketch a final idea

evaluate

5) compare and relate your ideas

for each sketch, break apart **what works well (+)** and **what doesn't (-)** in the table below. make connections. reflect on best parts. can you **combine ideas**? review the table with a partner or group.

sketch #1	sketch #2	sketch #3
+ fast service & mission info @ a glance - only one mission visible - weak linking	+ multiple missions and complexity shown w/ tree - very abstract view - weak linking	+ simple linking through a map view + understandable - less space for details on demand

U I M

Teaching with the Worksheets

- graduate course:
  - lecture on visualization design
  - mentored 6 group projects
  - interviewed 11 students

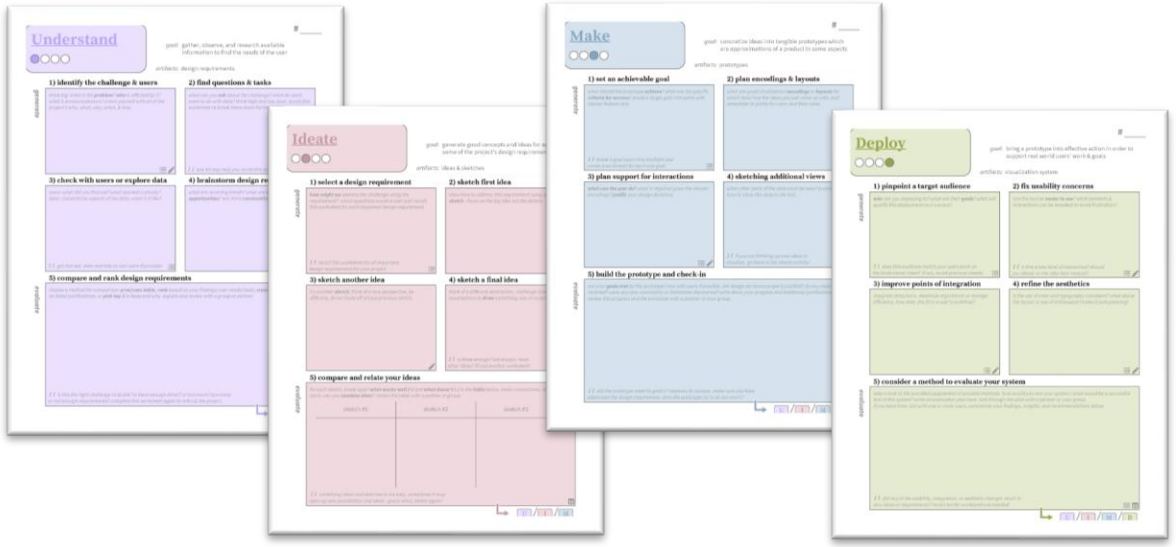
- most helpful worksheets: *understand* and *ideate*
  - “helped to get the project off the ground”
  - “critique of one’s own design was most helpful”

- steps: “it’s like a checklist to make sure everything is covered”

Discussion

- improvements to the worksheets:
  - another format, textual checklist
  - simplify the design
- additional worksheets:
  - exploring data
  - structuring code
- paper vs digital sketching

Thank You!



http://design-worksheets.github.io/

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visualization design lab

Lucid