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Analysis of User-Support Tickets in the Lifetime of the Blue Waters System

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Motivation

Paper Goals:

- Analyze tickets created by Blue Waters users
  - Quantitative analysis of tickets per system area, for each year
  - Qualitative analysis of tickets using Machine Learning techniques
- Provide guidance/reference for future large deployments

Paper Scope:

- Blue Waters lifetime, i.e., 2013-2021 – 9 years!
  - Two primary sponsors: NSF 2013-2019 & NGA 2019-2021
- Set of tickets created by all users, excluding Blue Waters staff

Paper Organization

I. Introduction
II. Ticket System Infrastructure
III. Evolution of Ticket Creation
IV. Ticket Management by Staff
V. Sentiment Analysis
VI. Conclusion, Future Work

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Ticketing System for Blue Waters

Ticketing Infrastructure: Atlassian Jira

- Used at NCSA for many other projects
- Mature, supported by vendor

Creation of user tickets:

- Regular e-mail to help+bw@ncsa.Illinois.edu
- Entry form on page in the Blue Waters Portal
- Ticket created by staff on behalf of user, if necessary
- Phone call to NCSA helpdesk, available 24/7

Tickets were stored in Jira *queues*

Ticketing System for Blue Waters (cont.)

One Jira *queue* for each Blue Waters area:

- BWADMIN: Administration
- BWINFOP: Info Provisioning
- BWAM: Allocation Management
- BWAPPS: Applications
- BWDSPCH: Dispatch (default)
- BWEXTNET: External Network
- BWHW: Hardware
- BWPMSP: Proj. Management
- BWPSP: Private Sector Program
- BWSTOR: Storage
- BWSS: System Software
- BWVIS: Visualization

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Tickets Created by Users

	2013	2014	2015	2016	2017	2018	2019	2020	2021	Sum
BWADMIN	134	200	285	381	336	198	171	145	45	**1,895**
BWINFOP	45	64	55	54	48	33	8	11	0	**318**
BWAM	222	496	524	562	657	658	494	146	52	**3,811**
BWAPPS	231	385	426	551	546	582	409	195	178	**3,503**
BWDSPCH	227	8	49	33	59	46	30	27	131	**650**
BWEXTNET	2	9	5	3	2	0	1	2	3	**27**
BWHW	18	5	0	1	0	1	0	0	0	**25**
BWPMSP	56	73	83	107	77	52	31	20	12	**511**
BWPSP	0	0	3	1	0	2	0	0	0	**6**
BWSTOR	110	178	151	191	154	243	208	85	47	**1367**
BWSS	78	36	32	18	3	2	0	1	0	**170**
BWVIS	0	27	23	15	18	5	2	3	0	**93**
Year Total	**1,123**	**1,521**	**1,636**	**1,917**	**1,900**	**1,822**	**1,354**	**635**	**468**	**12,376**

Large variation across different areas!

Tickets Created by Users (cont.)

	2013	2014	2015	2016	2017	2018	2019	2020	2021	Sum
BWADMIN	134	200	285	381	336	198	171	145	45	**1,895**
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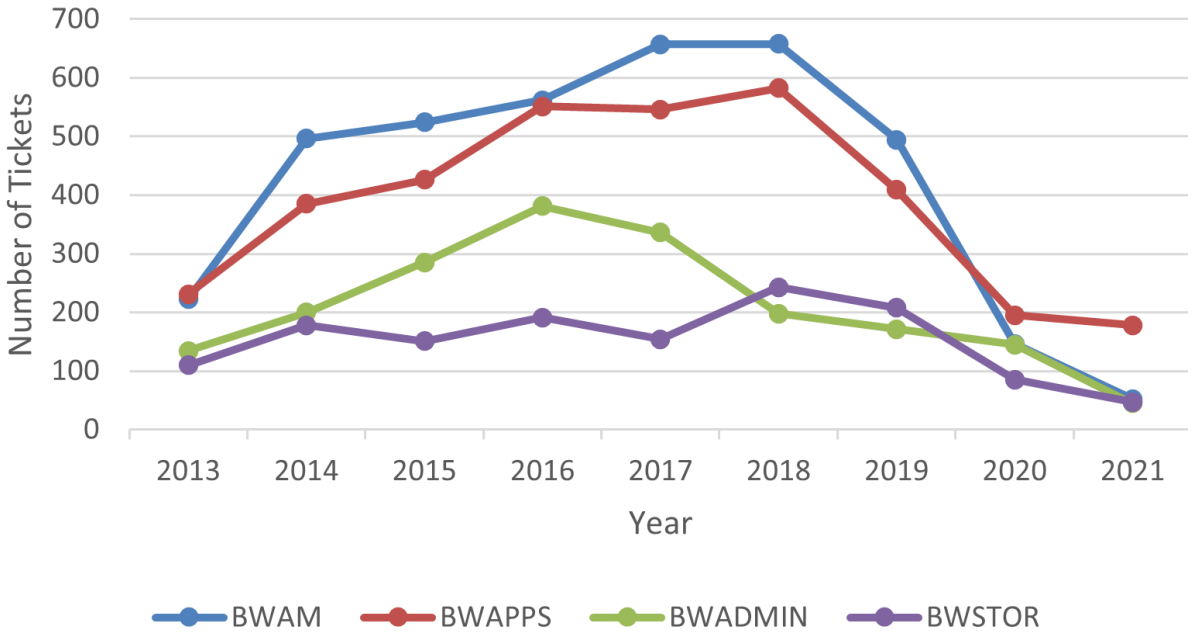
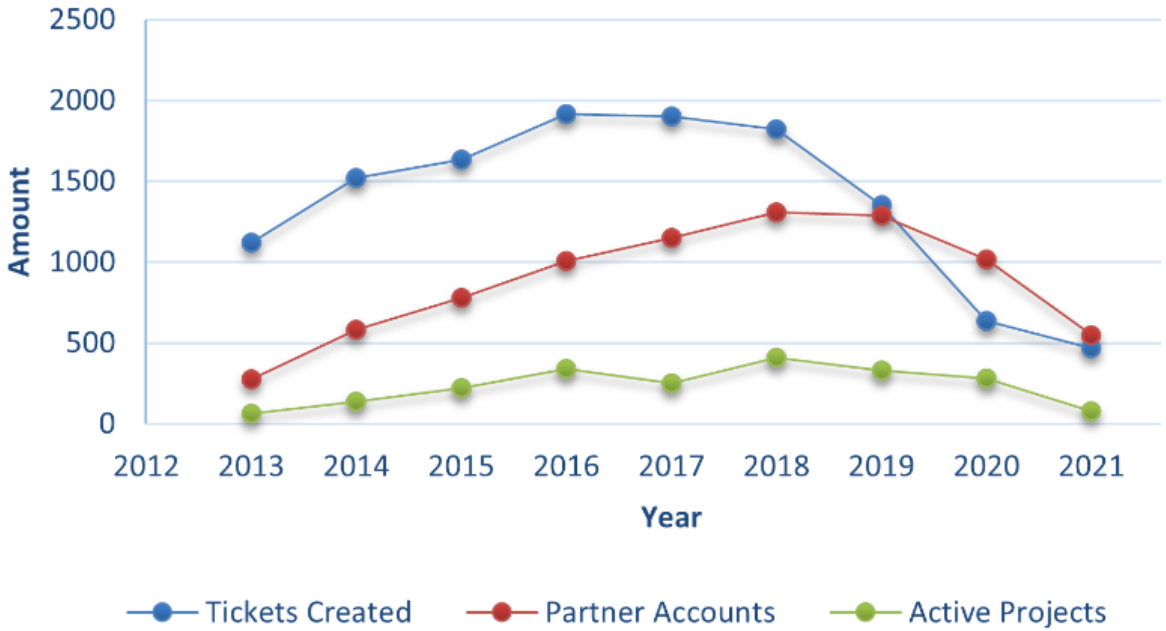
59%

Tickets Created by Users (cont.)

Top-4 queues: more than 85% of total tickets



Tickets, Accounts & Projects



- Number of tickets "follows" accounts & projects – as expected!

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Ticket Management by Staff

Three metrics to evaluate quality-of-service of staff:

- Time to produce a first response to a ticket
- Time to fully resolve a ticket
- Time to create a new requested account

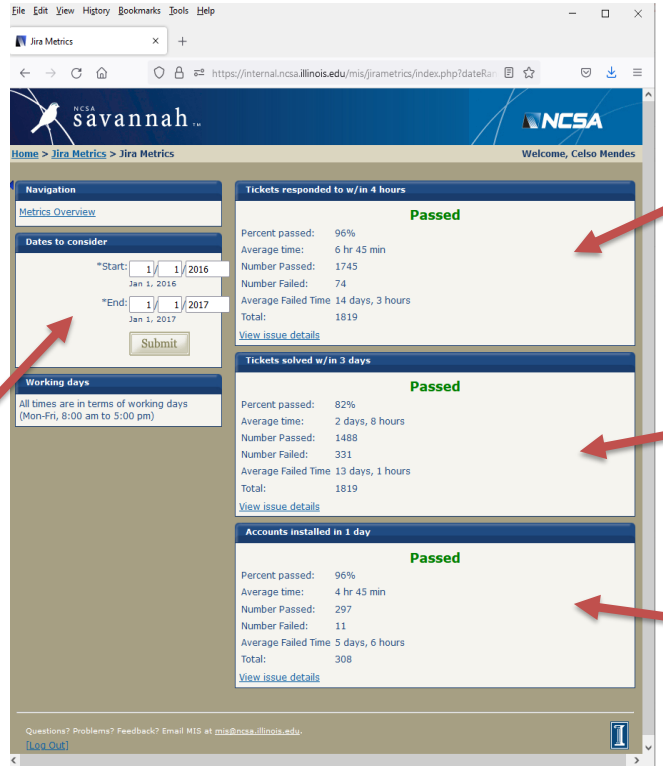
All three metrics had contracted thresholds to be achieved

- Contract: minimal percentage of tickets meeting criteria

  e.g. at least 80% of tickets resolved in up to 3 days (day: 8:00am-5:00pm)

Tool for Evaluating Ticket Handling: Metric Page

- Web-based tool developed internally, in PHP
- Automatic metric computing
- Used weekly in Jira reviews



First response

Ticket resolution

Account creation

Selection of time-period

Ticket Resolution Assessment

Ticket resolution time: key metric for user's effectiveness

- Average resolution times across all queues:

	2013	2014	2015	2016	2017	2018	2019	2020	2021
Average Resolution Time (Business Hours)	43	31	26	26	25	30	36	16	16
Percentage of tickets resolved in less than 3 days	80%	80%	85%	83%	82%	80%	84%	88%	89%

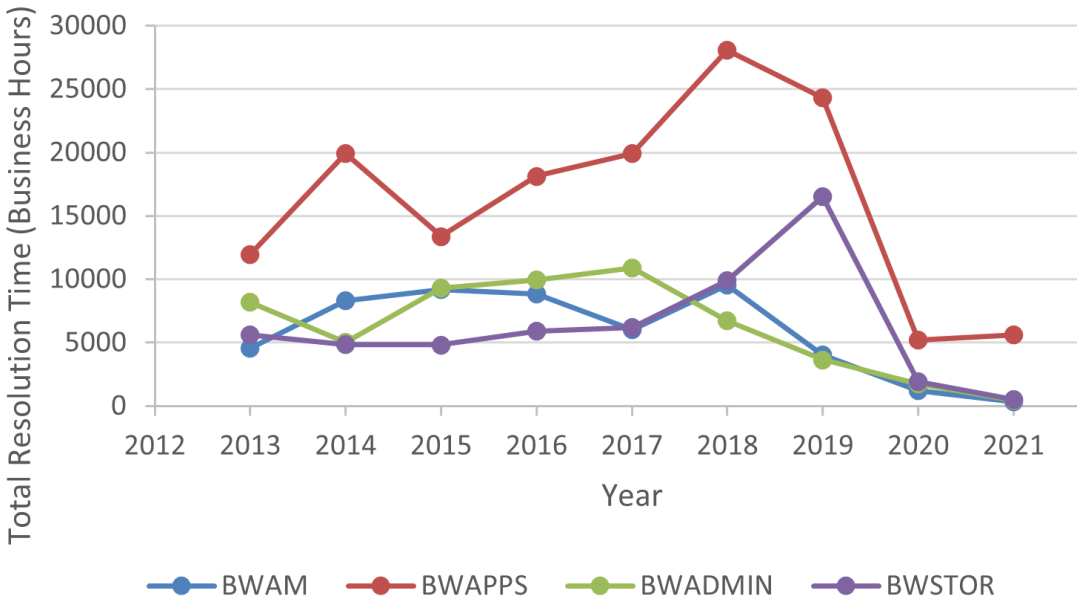
< 1 week
(5 x 9 hours)

> 80%
Always!

- Average resolution times per queue – in the paper

Ticket Resolution Assessment (cont.)

Top-4 queues with total “aggregate resolution time” ≈ staff effort



BWAPPS ≈ 3 X BWAM

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Sentiment Analysis of Tickets

Goals:

- Assess, in automated form, the “sentiment” of Blue Waters users
- Track how it varied across the system lifetime

Method:

- Employed Natural Language Processing (NLP) techniques
- Based on Machine Learning – fully automated process
- Implemented with Sentiment Analysis (SA) over text contained in Jira tickets from the entire period of Blue Waters operation

Sentiment Analysis of Tickets (cont.)

Technique for Analysis:

- Analyze text in a ticket, word-by-word, then compute ticket score by composing values based on VADER lexicon (*Hutto & Gilbert, 2014*)
- Sentiment score: real number in [-1.0, +1.0]
  - score < -0.1: Negative sentiment
  - -0.1 ≤ score ≤ +0.1: Neutral
  - +0.1 < score: Positive sentiment
- Average scores are derived across tickets of a given queue and year
- Two type of analysis: (a) all comments; (b) only reporter's comments

Sentiment Analysis of Tickets (cont.)

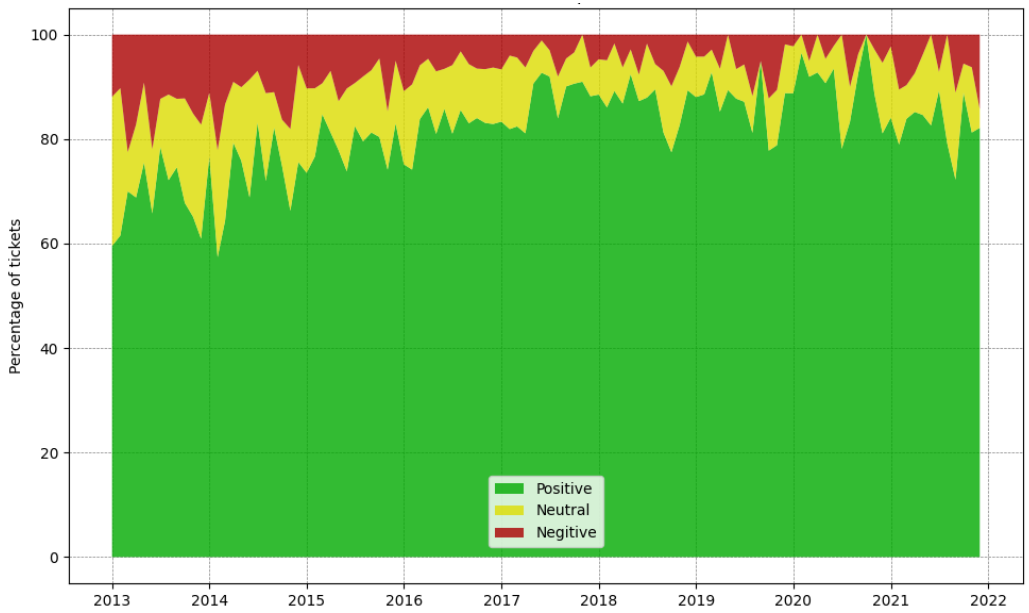
Results of analysis (b) - text in comments from ticket reporter only:

Year	Number of Tickets	Positive (%)	Neutral (%)	Negative (%)
2013	1,123	67.02	11.35	21.63
2014	1,521	70.55	12.75	16.70
2015	1,636	74.33	10.91	14.77
2016	1,917	78.55	9.18	12.27
2017	1,900	83.41	7.23	9.36
2018	1,822	82.01	8.36	0.63
2019	1,354	85.21	6.73	8.06
2020	635	86.44	5.68	7.89
2021	374	80.75	5.88	13.37

Positive sentiment Improves!

Sentiment Analysis of Tickets (cont.)

Results of analysis (b) - text in comments from ticket reporter only:



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Conclusion

Quantitative analysis of Blue Waters tickets:

- Jira infrastructure at NCSA: 12 *queues*
- System lifetime (2013-2021): 12,376 user tickets created
- 85% of all tickets were in {BWADMIN, BWAM, BWAPPS, BWSTOR}
- BWAM: greatest ticket count; BWAPPS: greatest total resolution time
- Consistently, most tickets were resolved in less than three business days, despite increasing ticket volume across the years
  - Result of careful planning and good allocation of staff to handle the job

Conclusion (cont.)

Sentiment Analysis of Blue Waters tickets:

- Based on Machine Learning – automated process
- Ticket score computed from text contained in ticket's comments
- Score values: -1.0 (Negative), 0.0 (Neutral), +1.0 (Positive)
- Increasingly positive scores observed in Blue Waters tickets

Potential Future Work:

- Correlate Sentiment score with other ticket's attributes
- Explore uses of Sentiment scores on a routine basis

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THANK YOU!

- Questions?

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