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NOV. 28 – DEC. 2, 2022 | LAS VEGAS, NV

WPS205

Lessons learned from IT modernization and transformation

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An unexpected journey to application modernization



Department of Justice Alcohol, Tobacco and Firearms (DOJ ATF)

Disaster recovery challenge presented as opportunity to move to cloud (2017)

Cloud infrastructure evaluation aligned to foundational tenets

- ✓ High bar for security and compliance
- ✓ Resilient infrastructure for mission-critical data and applications
- ✓ Innovative platform services

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AWS GovCloud (US) unlocks cloud compliance and innovation at scale

AWS GOVCLOUD (US) ENABLES US GOVERNMENT AGENCIES, TECHNOLOGY PARTNERS, AND INTEGRATORS MANAGING CONTROLLED UNCLASSIFIED INFORMATION (CUI) AND SENSITIVE DATA TO MODERNIZE AND INNOVATE IN THE CLOUD

Key Value

Purpose-built to power sensitive and regulated high-value, mission-critical data and workloads

Inherited compliance controls reduce operational overhead and accelerate time to workload authorization (ATO)

Scalability optimizes performance for various deployment patterns; balances availability, durability, resiliency and cost

Leading partner ecosystem provides extensive, compliant COTS software and SaaS options

Ability to achieve sustainability goals without sacrificing performance

Suitable for born-in-the-cloud applications, migrated workloads, and hybrid models

ATF Enterprise primary environment in production on AWS GovCloud (US-West) 2019…

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A strategy for application modernization

Now: Compliant infrastructure and platform services as building blocks for ATF DevSecOps approach

- Data management/governance
- Containers and serverless
- Business process reengineering
- CI/CD pipeline

Future…



- Multi-region resiliency
- Machine learning
- Blockchain technologies

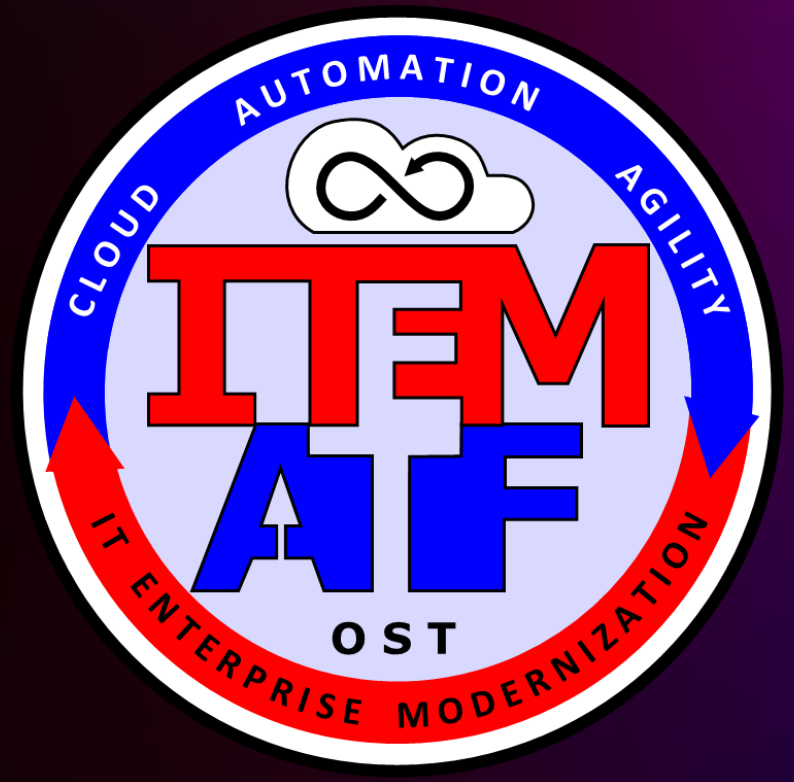
…we are just getting started

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Agenda

1. Why modernize?
2. Known challenges
3. Initial plans
4. Unexpected challenges and mistakes
5. Triage: Correcting course
6. Go-live experience, results, and looking ahead
7. Summary: Lessons learned



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Why modernize?



Te¢hni¢al Debt





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What stops if legacy systems go down?

ATF's case management

Criminal enforcement
Firearms, explosives, arson, etc.





Firearms/ explosives industry inspections

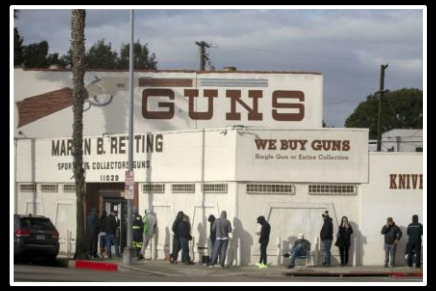
Nationwide gun sales
Background checks



Regulation of Firearms/Explosives

FFL/FEL* license applications
*Processing applications to become licensed **firearms/explosives** dealer*

**Federal Firearms Licensee*
Federal Explosives Licensee





NFA* regulated firearms
*Processing requests for **silencers**, **automatic weapons**, **rocket launchers**, etc.*

**National Firearms Act*

Firearms/ explosives imports

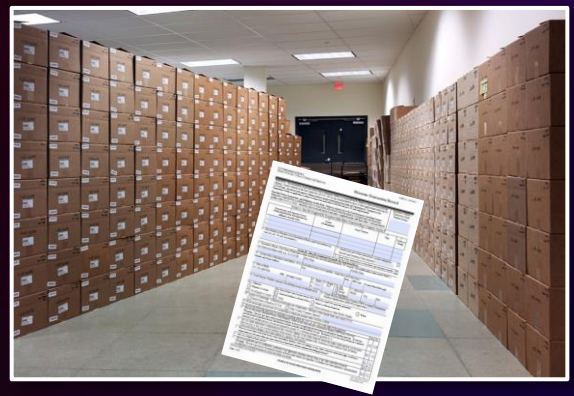


Tracing crime gun owners

Crime gun "tracing"
Investigating owner of guns used in crimes



Out-of-business records
Receiving, scanning, and searching millions of records from out of business companies



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Known migration challenges



Improvement
is still change





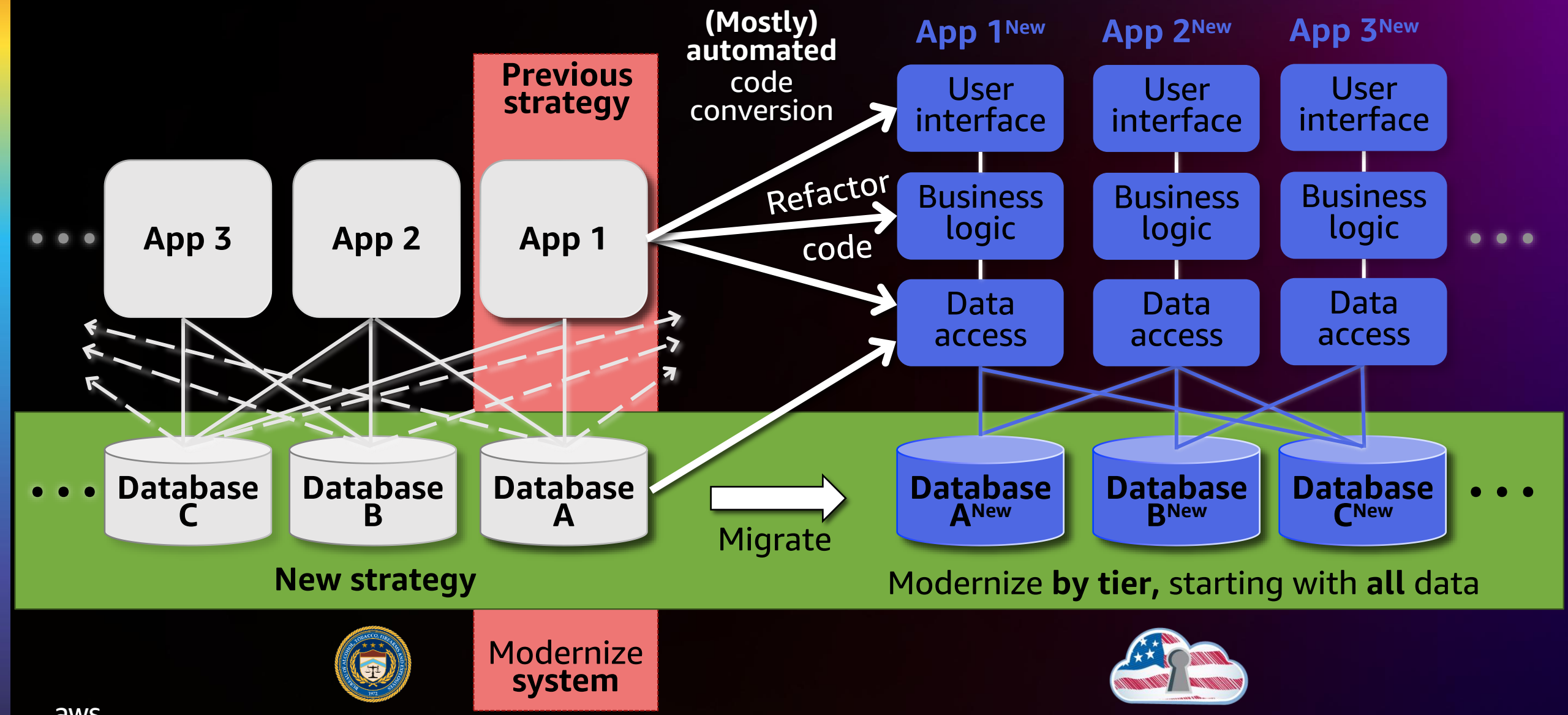




redhat
Linux

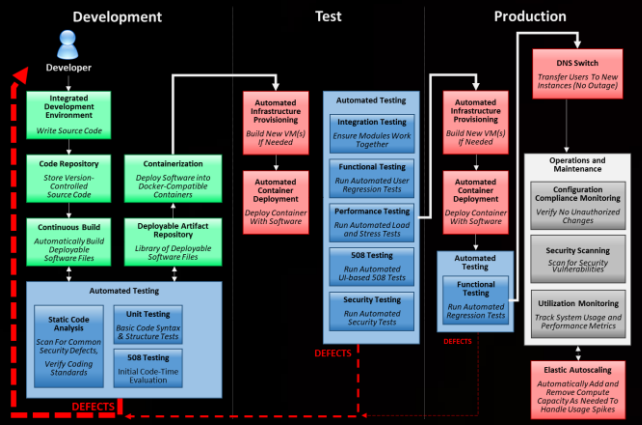
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Flipping our strategy

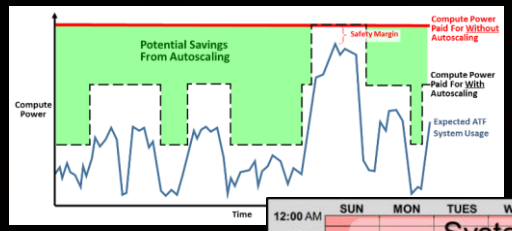


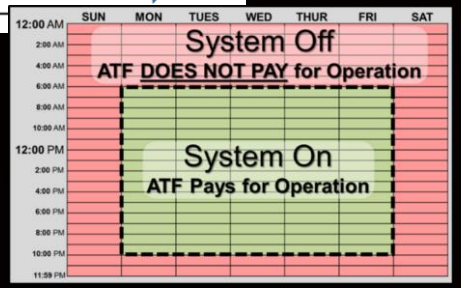
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IT governance: Technology is not enough

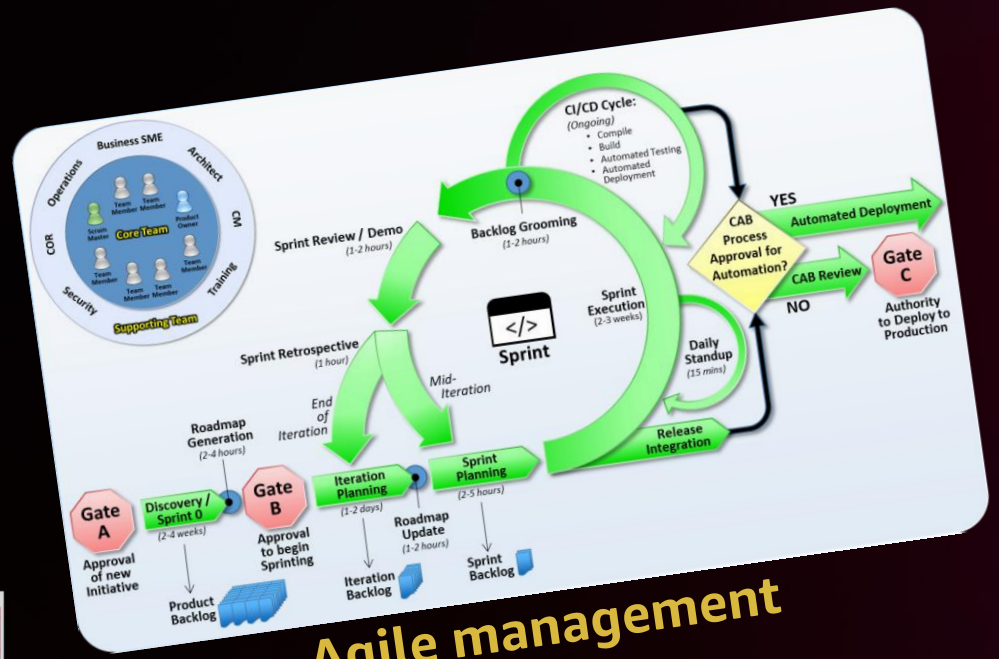


Deployment automation

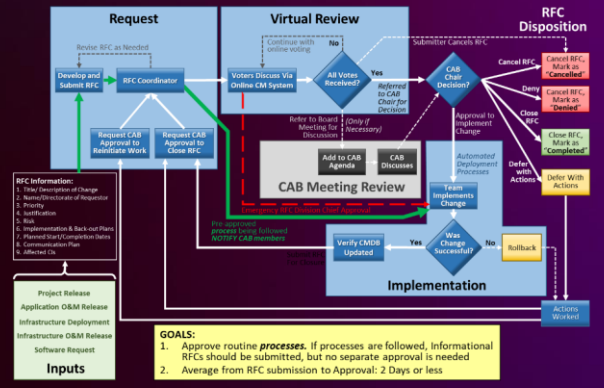




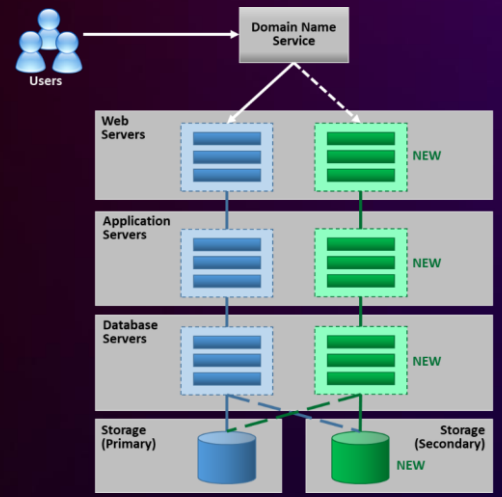
Auto scaling



Agile management



Process approvals



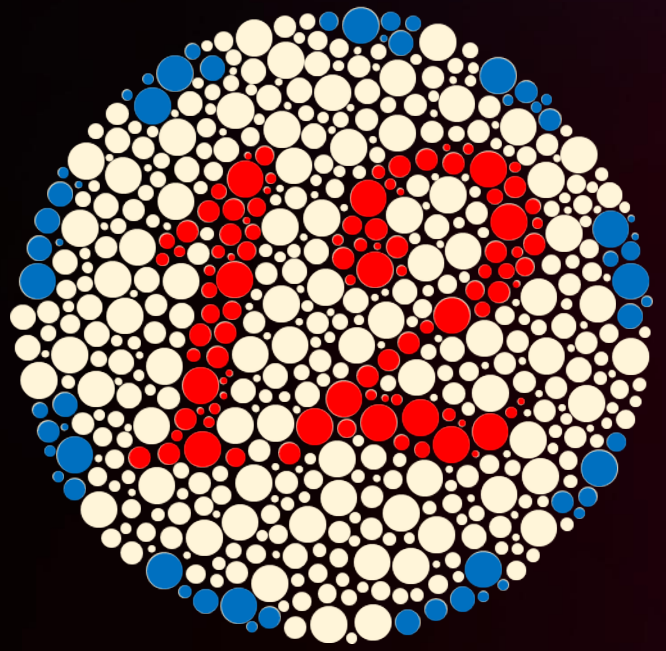
LIVE blue-green deployments

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Lesson learned: Unexpected challenges



New task:



Dead code

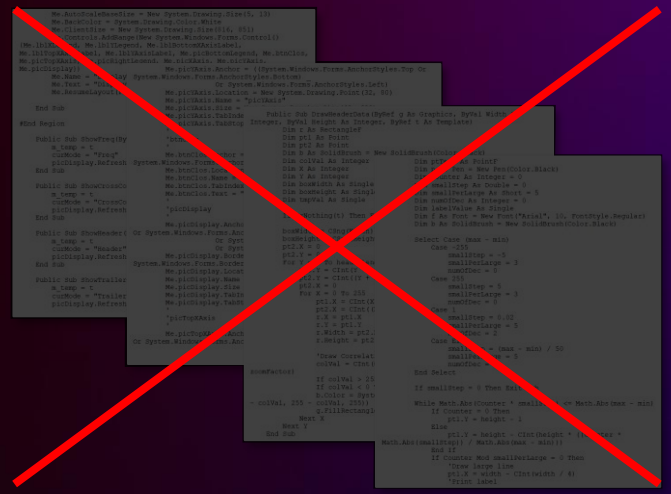
Unlisted scripts

End user DBAs

Additional scope

“So what?”

The source code **was** our requirements

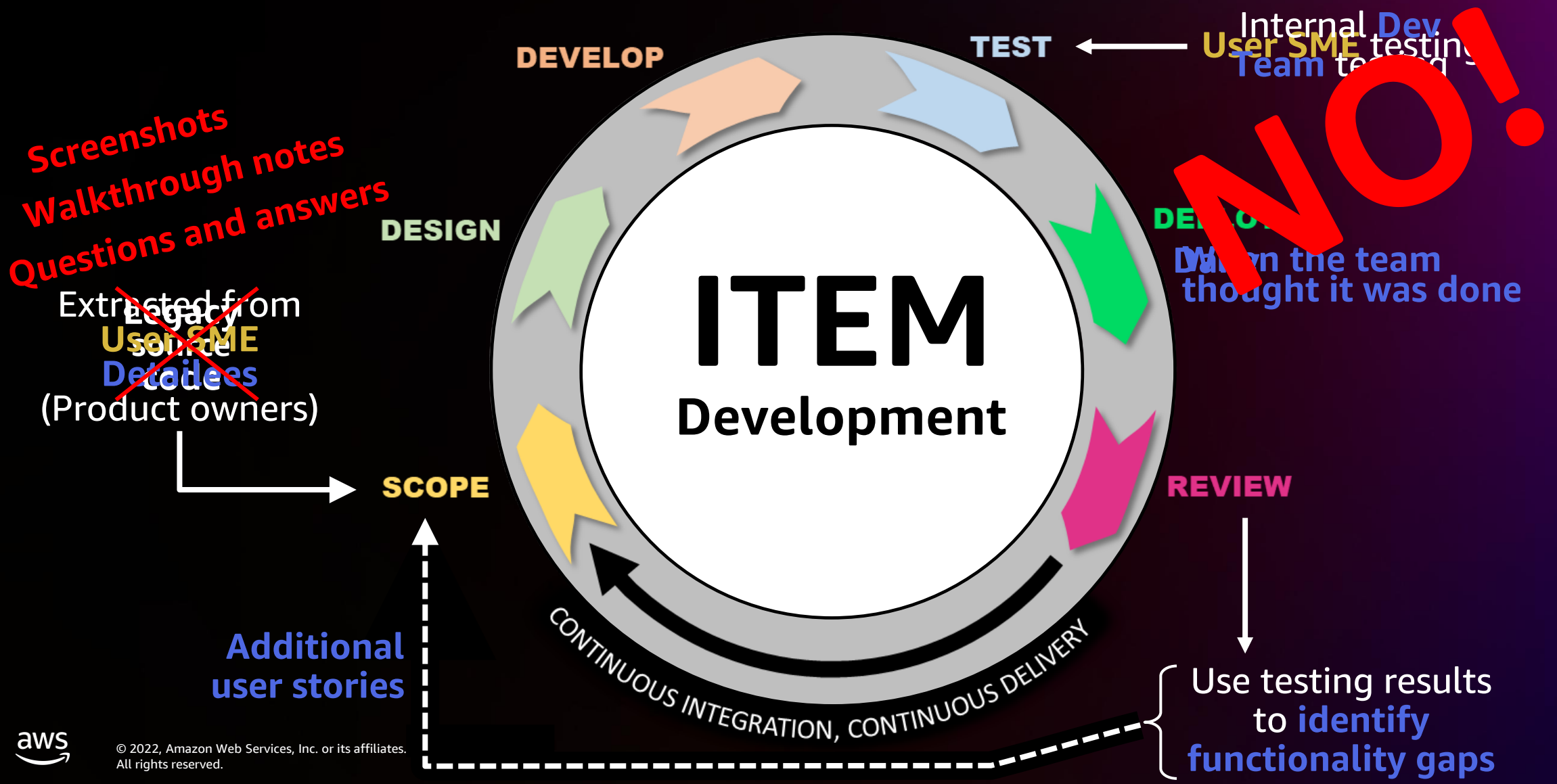


Our requirements were no longer usable

No automated conversion

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Lesson learned: Agile mistakes



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Big picture: Analyze processes

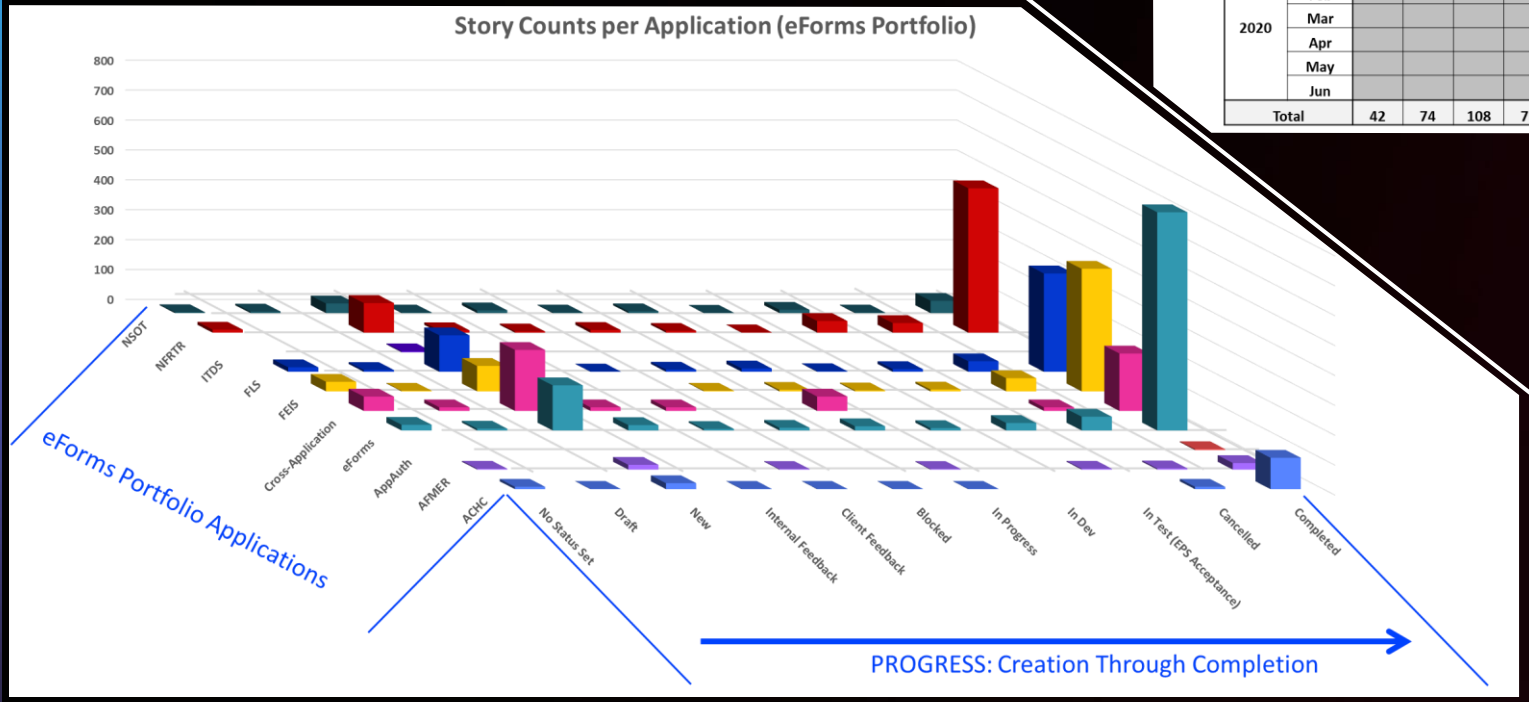
Analyze backlog:

How much work-in-progress (WIP) is there?

Where is all WIP in the process?

Stories **COMPLETED IN** Month

Stories **STARTED IN** Month		2018				2019												2020						Total
		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
2018	Aug	15	2	4																				21
	Sep	25	63	35	4	3				12		12						3				60	2	219
	Oct		5	32	10	4	4	5		2								1					1	64
	Nov			23	34	11	11	3											1		1		4	88
	Dec				14	27	20	9	1		3		1		2		1	2	6	2		3	6	97
2019	Jan					13	17	22	1	9	15	1		2	1		2	3	19	3	1	4	4	117
	Feb						17	25	5	9	19							2	15	4	1	2	6	105
	Mar							12	9	17	25	4	2	5	5			8	12	3	1	4	14	121
	Apr								1	20	26			2	2		4	1	8	2	2	4	12	84
	May									43	71	1	1	2	4		2	7	9	9	3	11	17	180
	Jun										12	1	2	1	8	1	2	11	3	2	2	2	9	56
	Jul											1		1	5	1	1	11	13	8	2	6	16	65
	Aug													1	5		3	6	12	1	4	1	3	36
	Sep													1	6	2	3	15	11	3	13	1	3	58
	Oct																6	19	10		1	4	12	52
	Nov															3	5	10	28	5	2	4	8	65
	Dec																2	20	29	6	3	7	6	73
2020	Jan																	21	41	7	7	14	10	100
	Feb																		12	21	6	7	4	50
	Mar																			3	20	5	5	33
	Apr																				19	25	10	54
	May																					10	36	46
	Jun																						39	41
Total		42	74	108	76	62	69	82	18	127	245	58	10	24	62	15	44	180	350	143	155	333	377	2665



Analyze process flows:

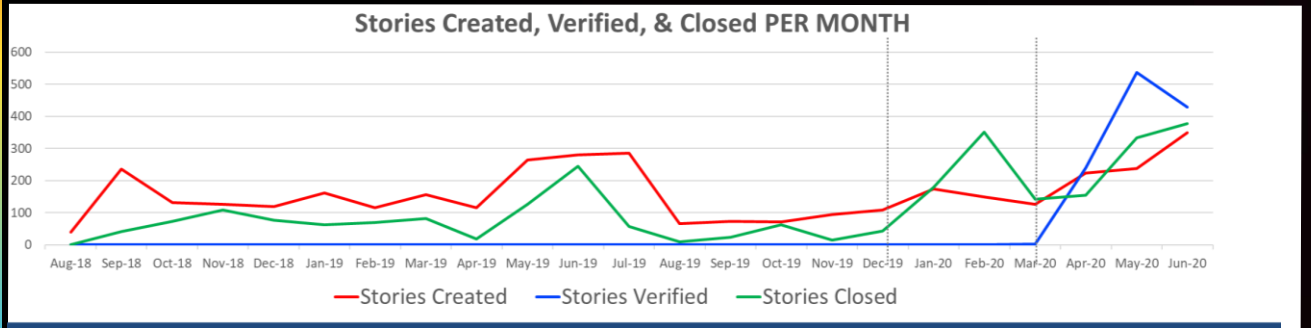
How efficiently does work flow?

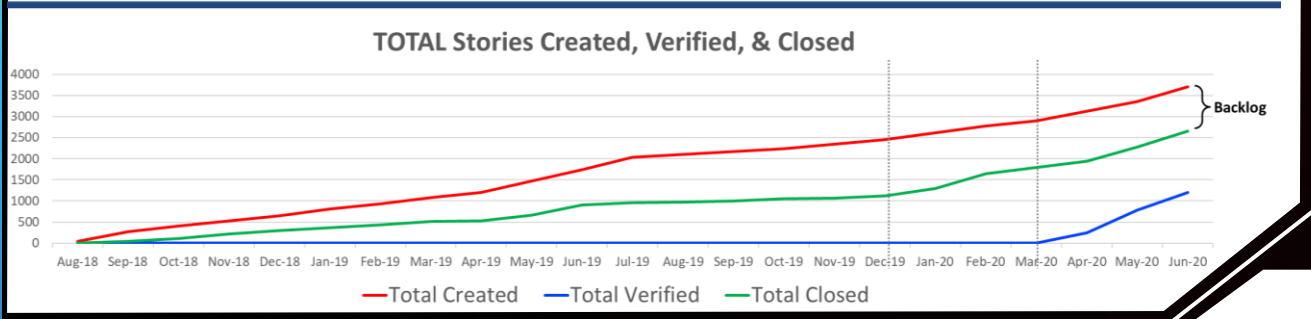
What causes the bottlenecks?

Rework

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Improve *accuracy* of backlog





Process change to fix:

Require ATF SME to **verify *every user story***

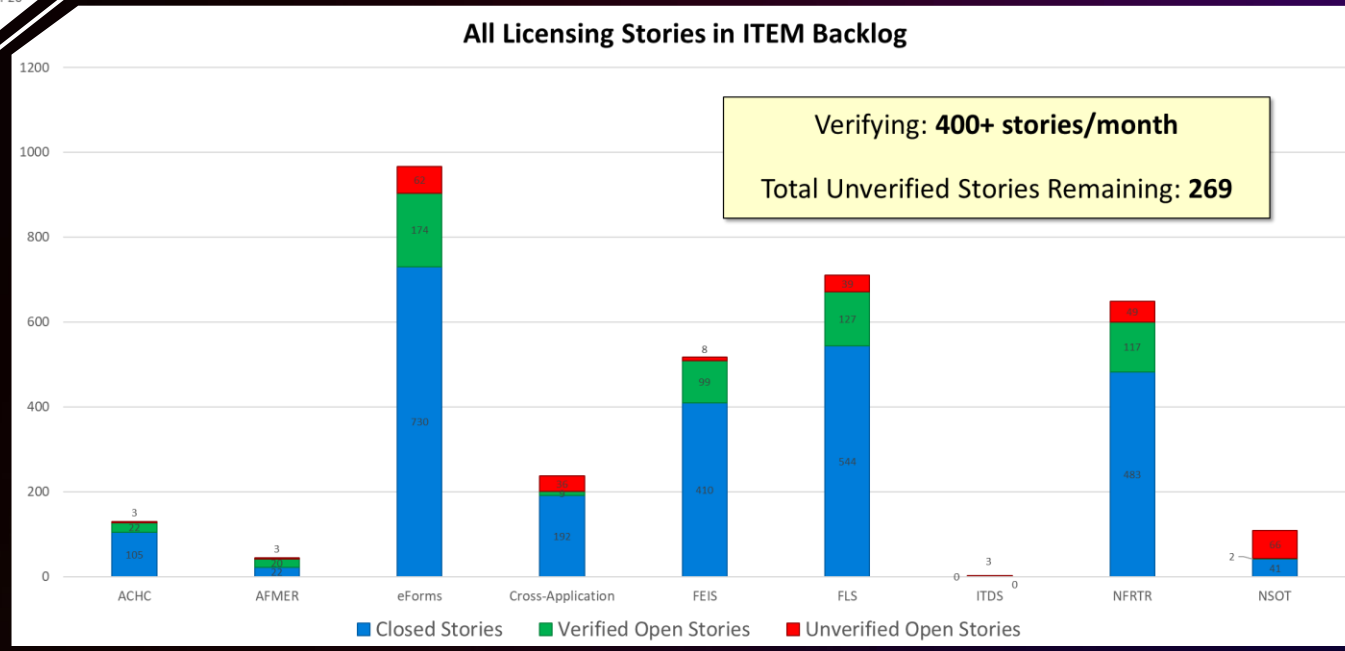
Correct description and details

Correct acceptance criteria

Major process flaw:

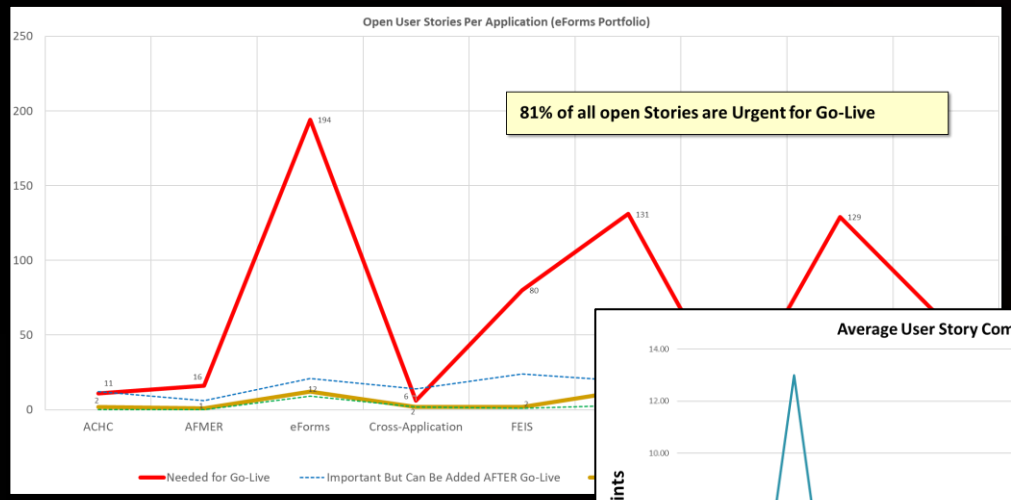
No verification loop for stories

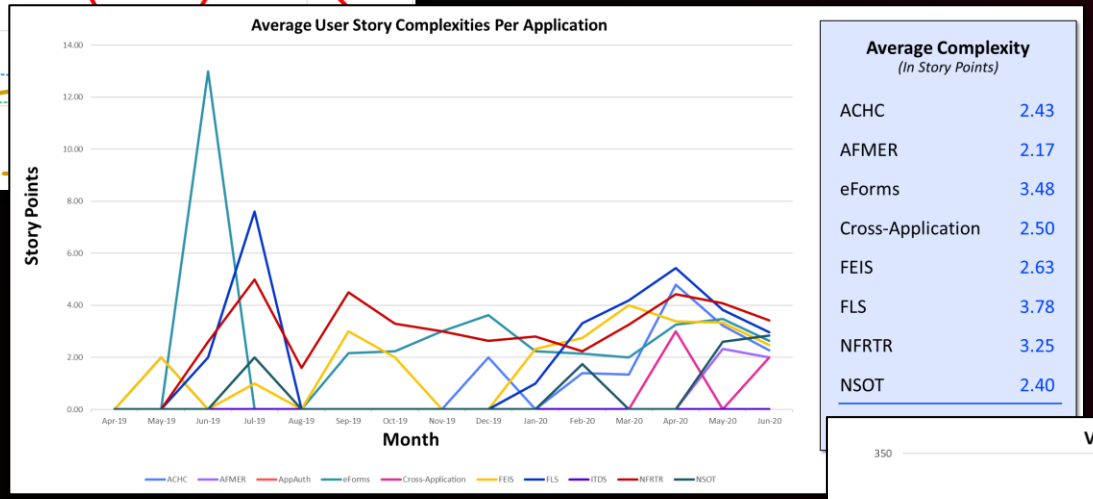
All stories were unreliable



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Quantify the *knowns*





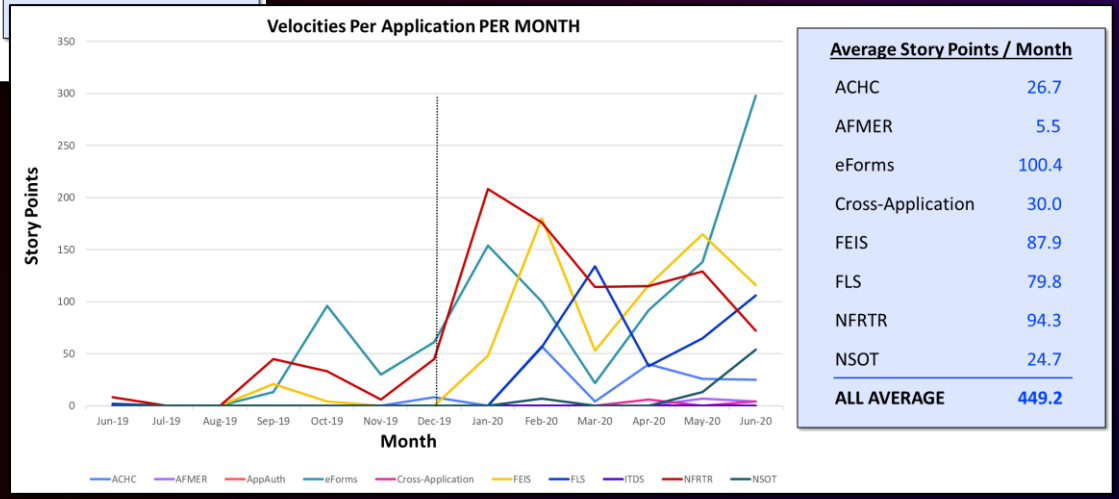
Average Complexity (In Story Points)	
ACHC	2.43
AFMER	2.17
eForms	3.48
Cross-Application	2.50
FEIS	2.63
FLS	3.78
NFRTR	3.25
NSOT	2.40

Analyze performance metrics

- Average **complexity** of completed stories per application
- Team **velocity** per application

Prioritize stories:

- **Required** for go-live
- **Wanted** for go-live
- After go-live
- Someday (wish list)



Average Story Points / Month	
ACHC	26.7
AFMER	5.5
eForms	100.4
Cross-Application	30.0
FEIS	87.9
FLS	79.8
NFRTR	94.3
NSOT	24.7
ALL AVERAGE	**449.2**

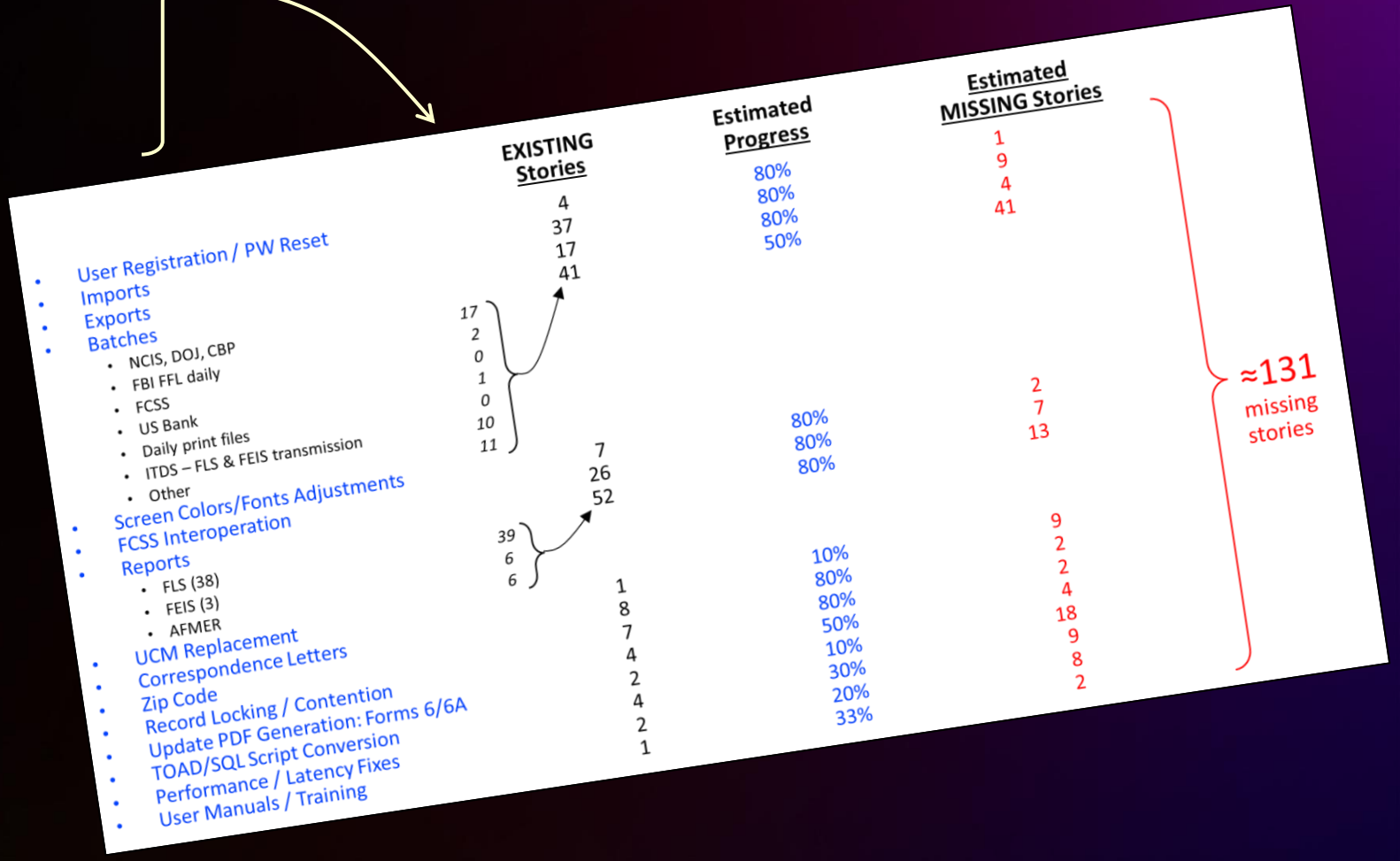
NOTE: Best practice is to not compare story points/velocities across teams. (Sometimes you have to work with what you have – just be conscious of limitations.)

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Estimate the unknowns

Known unknowns

- **"Punch List"** – Major business functions that **we knew we had not fully captured in stories**
  - Amount of known work already captured
  - SMEs estimate % of total work captured
  - Calculate **number of missing stories**



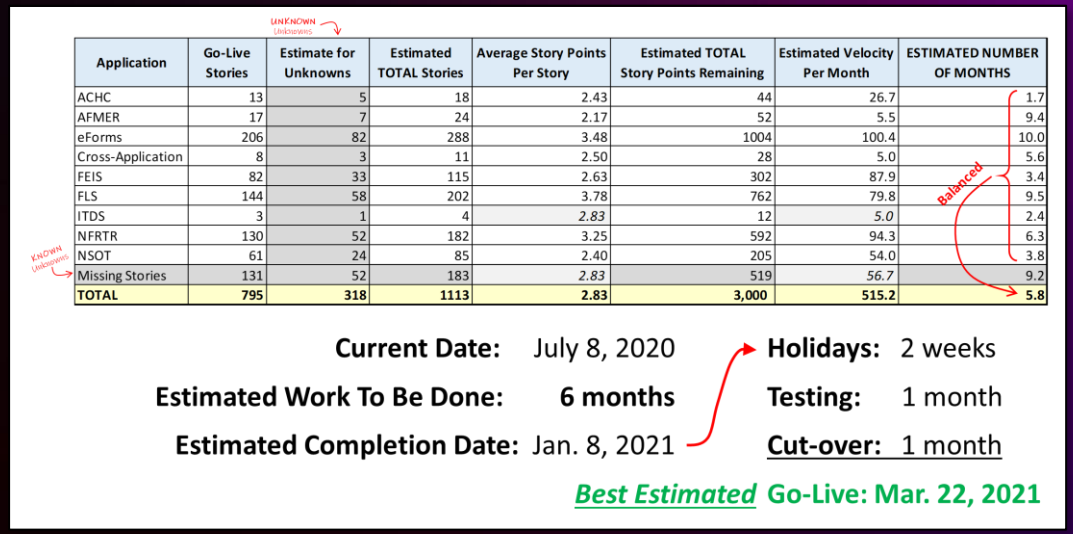
Unknown unknowns

- **There will always be surprises**
- Plan for stories over and above the Punch List
- Add additional error factor of 30% to all applications and Punch List items

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Project rough initial go-live date

- I would not provide a **planned** go-live date
  - **Too many unknowns** to provide any guarantee
- Provided only a **best estimated** date:
  - Based on best information available:
    - Estimate of **known** work
    - Estimate of **unknown** work
    - Team's historical work trends
- Describe **plans for reducing unknowns**
  - Work toward **incrementally smaller margins of error** in future estimates



Application	Go-Live Stories	Estimate for Unknowns	Estimated TOTAL Stories	Average Story Points Per Story	Estimated TOTAL Story Points Remaining	Estimated Velocity Per Month	ESTIMATED NUMBER OF MONTHS
ACHC	13	5	18	2.43	44	26.7	1.7
AFMER	17	7	24	2.17	52	5.5	9.4
eForms	206	82	288	3.48	1004	100.4	10.0
Cross-Application	8	3	11	2.50	28	5.0	5.6
FEIS	82	33	115	2.63	302	87.9	3.4
FLS	144	58	202	3.78	762	79.8	9.5
ITDS	3	1	4	*2.83*	12	*5.0*	2.4
NFRTR	130	52	182	3.25	592	94.3	6.3
NSOT	61	24	85	2.40	205	54.0	3.8
Missing Stories	131	52	183	*2.83*	519	*56.7*	9.2
TOTAL	**795**	**318**	**1113**	**2.83**	**3,000**	**515.2**	**5.8**

Estimated number of 2-week sprints to finish functionality for go-live

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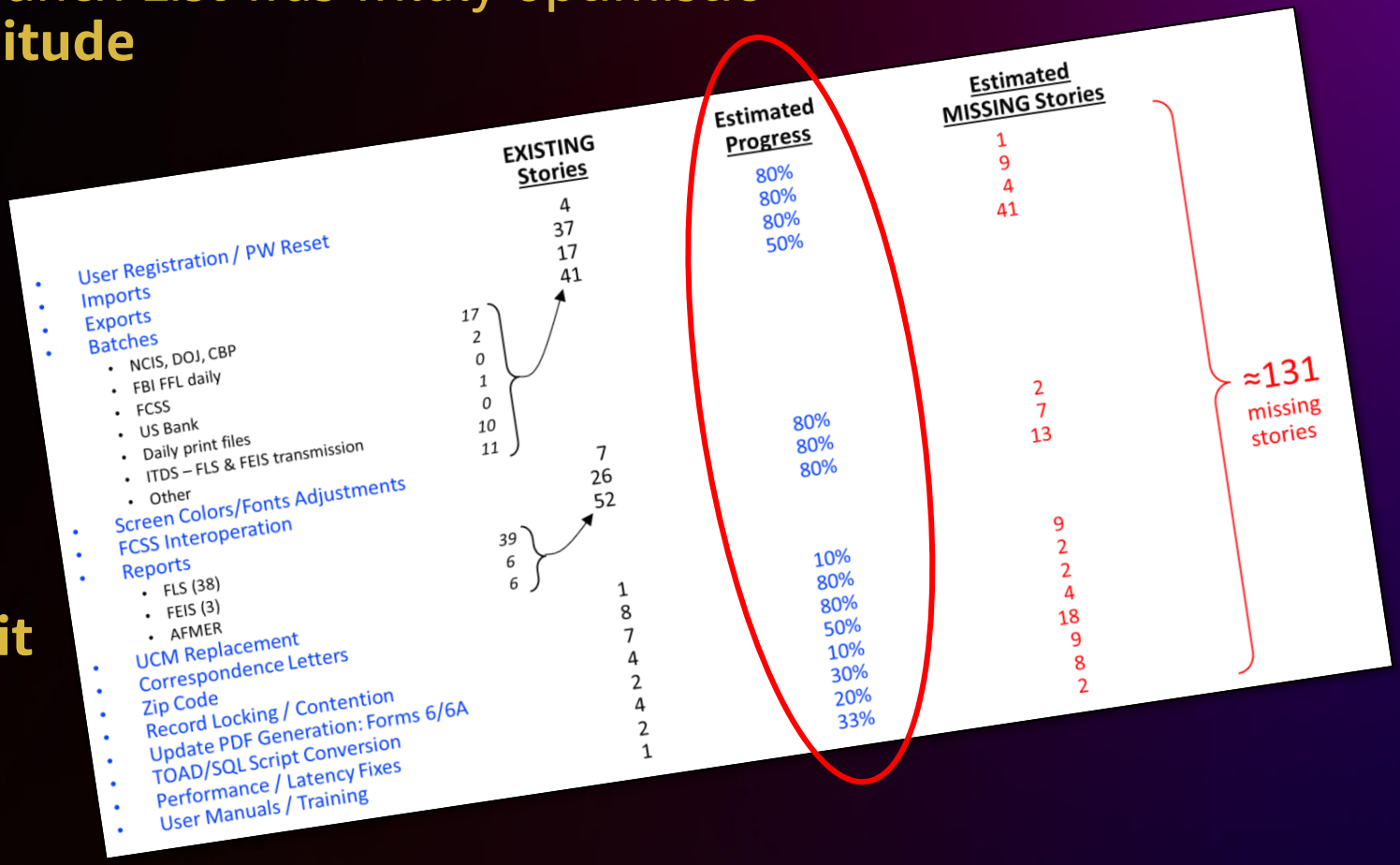
Lesson learned: Your pessimism is optimistic

The “estimated progress” on our Punch List was wildly optimistic
We were off by an order of magnitude

Far more “missing stories” than we had estimated

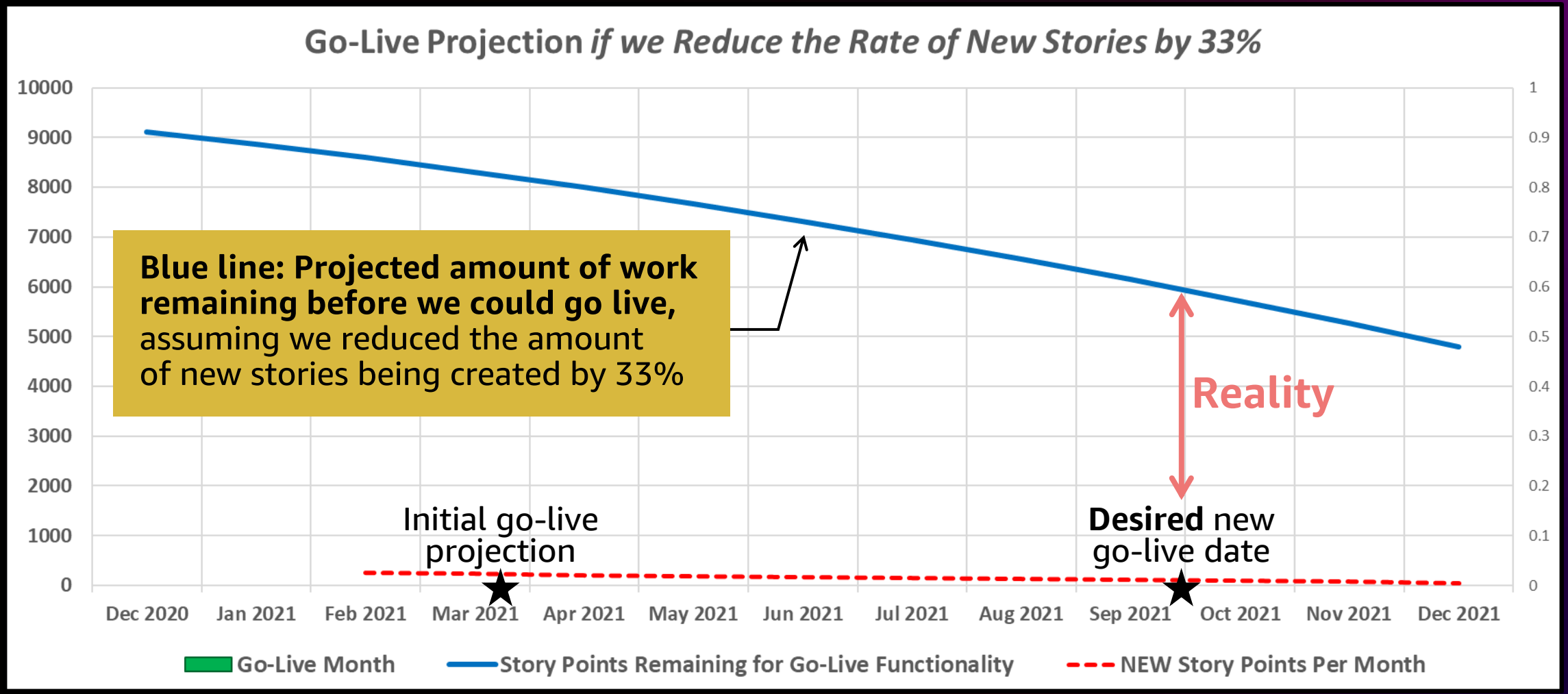
Projected “go-live” kept shifting

Be very pessimistic with your estimated progress, then reduce it



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Follow the data, and face reality

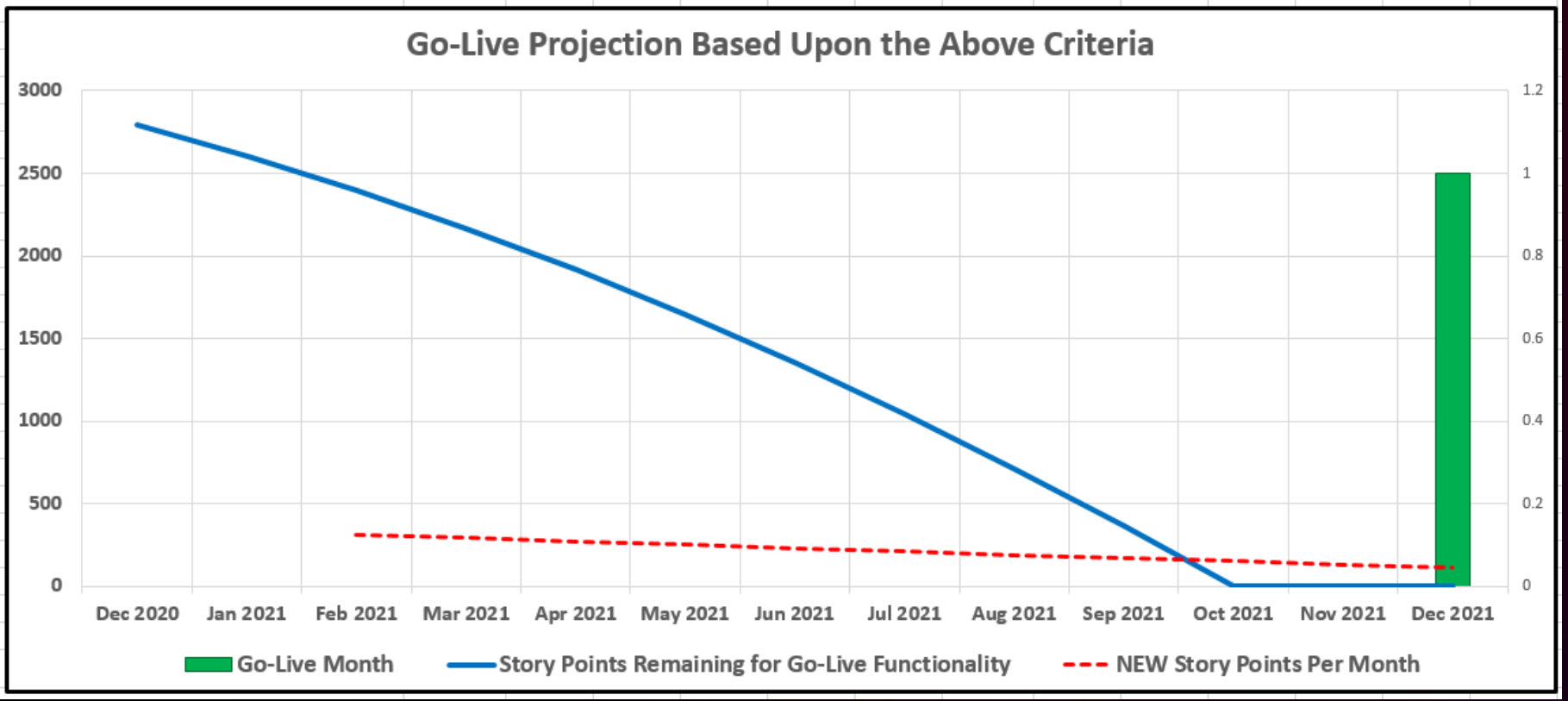


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Model different scenarios

Percentage of REQUIRED stories to include in go-live:	100%	(0% removed)	TARGETS:	70%
Percentage of WANTED stories to include:	6%	(94% removed)		0%
Average team MONTHLY VELOCITY (in Story Points):	500			500
NEW STORY POINTS: First month limit	310	(Average has been **390/month**)		250
Decrease in NEW Story Points PER MONTH	-20			-20
Months for UAT/Remediation/Cut-over activities	2	(1 or 2)		2

	Dec 2020	Jan 2021	Feb 2021	Mar 2021	Apr 2021	May 2021	Jun 2021	Jul 2021	Aug 2021	Sep 2021	Oct 2021	Nov 2021	Dec 2021
New Story Points Created		310	290	270	250	230	210	190	170	150	130	110	90
Story Points Remaining for Go-Live Functionality	2794	2604	2394	2164	1914	1644	1354	1044	714	364	0	0	0
Go-Live Month													1



ITEM go-live scenario:

~~September 2021~~

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Hard decisions – accepting less

Reduce existing go-live requirements:

- Priority 1 for go-live: **Select 30%** to defer until after go-live
- Priority 2 for go-live: **Defer all** until after go-live

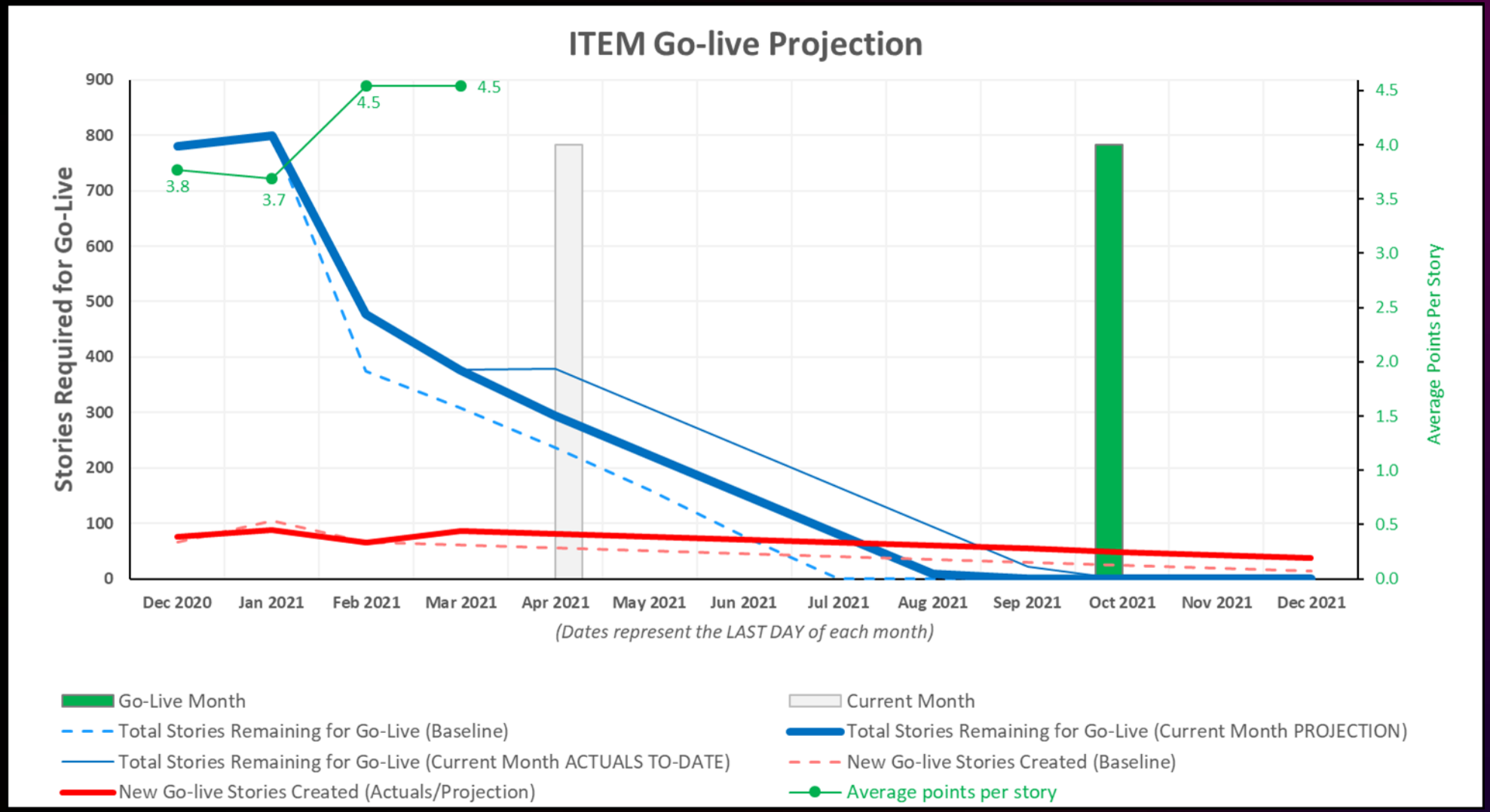
Focus on increasing development team velocity:

- Automated regression testing
- Daily releases to test
- **Increase team size**

Bottom-line decision: We would go live **without completing all "minimum" functionality**

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Daily automated forecast updates



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April 1, 2021

Assess mission impact of missing functionality

For each required for go-live story, we documented:

Text description: **User impact** if story is not completed by go-live

Numerical user-impact **rating** on the following scale:

Worst

- **4** **Blocks some or all** major business processes
- **3** Significant impact on **common processes**, but does not block major business processes
- **2** Impact (up to blocking) **relatively infrequent business processes** or data use cases
- **1** **Minimal impact** to users

Best

- **0** **No impact** if the story isn't finished by go-live

Text description: **Potential workarounds** if story is not completed by go-live

Numerical workaround **rating** on the following scale:

Worst

- **0** **No Workaround**
- **1** Workaround has **major impact** on productivity
- **2** Workaround has **impact** on productivity
- **3** Workaround has **minimal impact** to users

Best

- **4** Workaround has **hardly any impact** on users

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Rank stories by their business impact

We divided stories into 7 Business Impact categories based upon real effects upon ATF mission if we went live without them working:

User Impact (Worst ↑ / ↓ Best)	Workaround: Best ← 4	3	2	1	0 → Worst
4	2	1	1	7	151
3	0	6	44	7	13
2	2	6	8	1	2
1	11	5	2	1	0
0	7	0	0	0	0

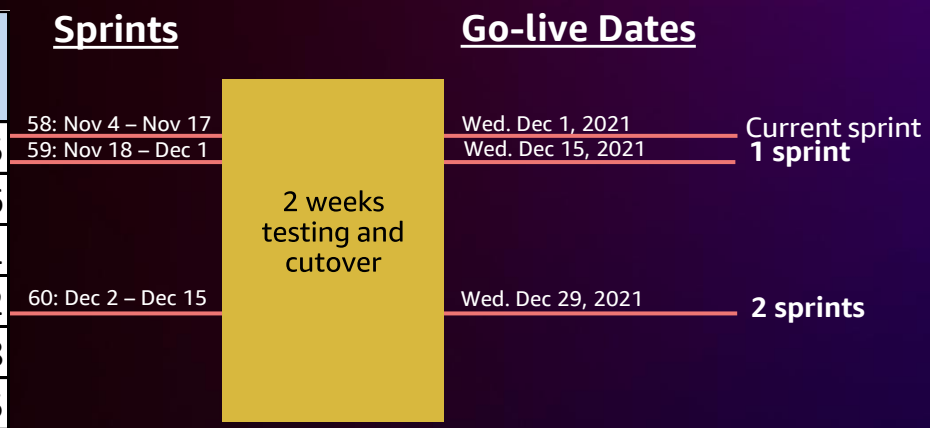
Business Impact Rank
7
6
5
4
3
2
1

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Trade-off analysis: Business impact vs. date

"What impact will there be to ATF's mission if we go live on X date?"

Business Impact Rank	Number of Stories	Story Points*	Avg Points Per Sprint	Sprints *(from 11/3)*	Cumulative Sprints
7	126	491	281	1.75	1.75
6	15	59	281	0.21	1.96
5	11	43	281	0.15	2.11
4	37	144	281	0.51	2.62
3	26	101	281	0.36	2.98
2	5	20	281	0.07	3.05
1	23	90	281	0.32	3.37



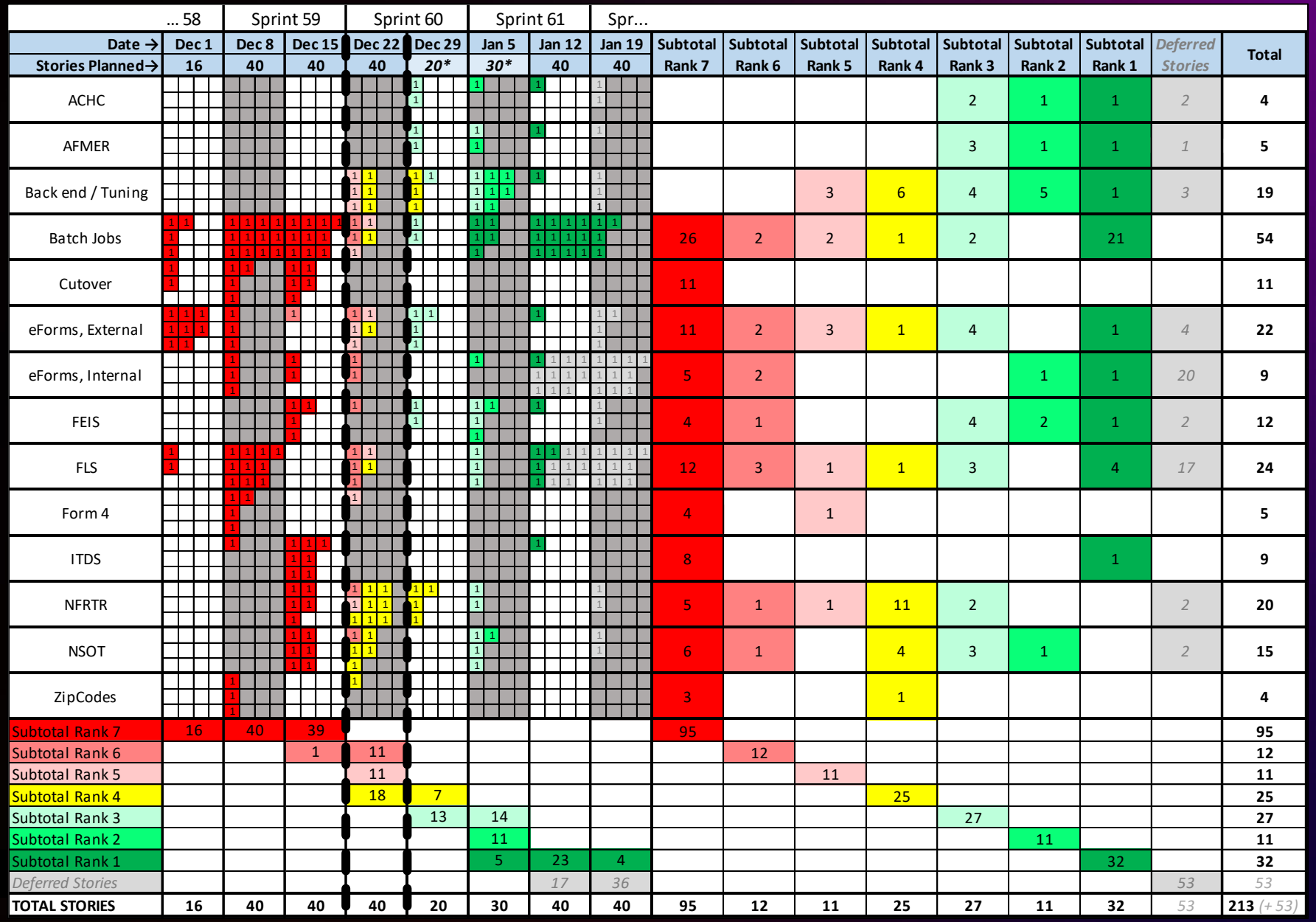
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Map the home stretch to go-live

Every “required” story was plotted on a timeline, ranked by business impact

Every timeline square represented one story completed in the 7-day period ending on the column’s date

Every week included the number of stories planned based upon the team’s expected velocity



	… 58	Sprint 59		Sprint 60		Sprint 61		Spr…								
Date →	Dec 1	Dec 8	Dec 15	Dec 22	Dec 29	Jan 5	Jan 12	Jan 19	Subtotal Rank 7	Subtotal Rank 6	Subtotal Rank 5	Subtotal Rank 4	Subtotal Rank 3	Subtotal Rank 2	Subtotal Rank 1	Deferred Stories	Total
Stories Planned→	16	40	40	40	*20**	*30**	40	40									
ACHC													2	1	1	*2*	**4**
AFMER													3	1	1	*1*	**5**
Back end / Tuning											3	6	4	5	1	*3*	**19**
Batch Jobs									26	2	2	1	2		21		**54**
Cutover									11								**11**
eForms, External									11	2	3	1	4		1	*4*	**22**
eForms, Internal									5	2				1	1	*20*	**9**
FEIS									4	1			4	2	1	*2*	**12**
FLS									12	3	1	1	3		4	*17*	**24**
Form 4									4		1						**5**
ITDS									8						1		**9**
NFRTR									5	1	1	11	2			*2*	**20**
NSOT									6	1		4	3	1		*2*	**15**
ZipCodes									3			1					**4**
Subtotal Rank 7	16	40	39						95								**95**
Subtotal Rank 6			1	11						12							**12**
Subtotal Rank 5				11							11						**11**
Subtotal Rank 4				18	7							25					**25**
Subtotal Rank 3					13	14							27				**27**
Subtotal Rank 2						11								11			**11**
Subtotal Rank 1						5	23	4							32		**32**
Deferred Stories							*17*	*36*								*53*	*53*
TOTAL STORIES	**16**	**40**	**40**	**40**	**20**	**30**	**40**	**40**	**95**	**12**	**11**	**25**	**27**	**11**	**32**	*53*	**213** *(+ 53)*

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Go-live experience

December 23, 2021: So slow it was not usable. Major features not working.

Did not fail back. Failed **forward** to improved releases:

Doubled database instance sizes within 30 minutes
13 production deployments in first day
21 production deployments in first week

Industry user, 3 weeks after go-live:

"I was worried when I logged in the first time, but it improved so fast."

"Not the same system it was 3 weeks ago… It is clearly being upgraded."

ATF users:

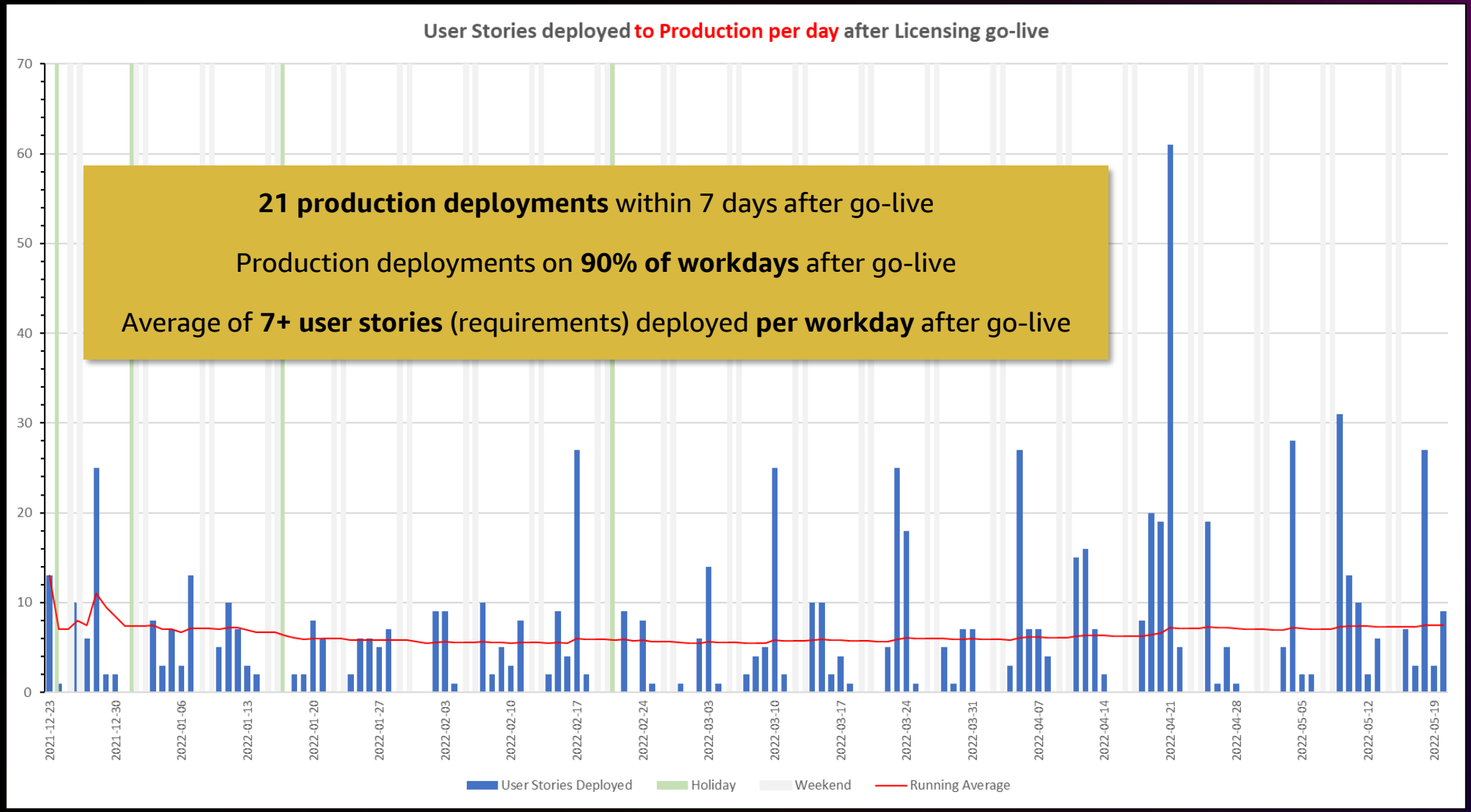
ITEM versions are "leaps, bounds, Grand-Canyon-style progress" over legacy systems

Frustrated – they see features in the backlog and want them faster

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Continuous improvement: From theory to reality



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ITEM results: Success or failure?

By every traditional waterfall measure, **ITEM was a failure**: Budget, schedule, scope

ATF executive leadership: **ITEM was an unmitigated success**. Why?

Communication: Every leadership decision was made with **full information and transparency**

We identified challenges, communicated them immediately, and **adapted** to overcome them

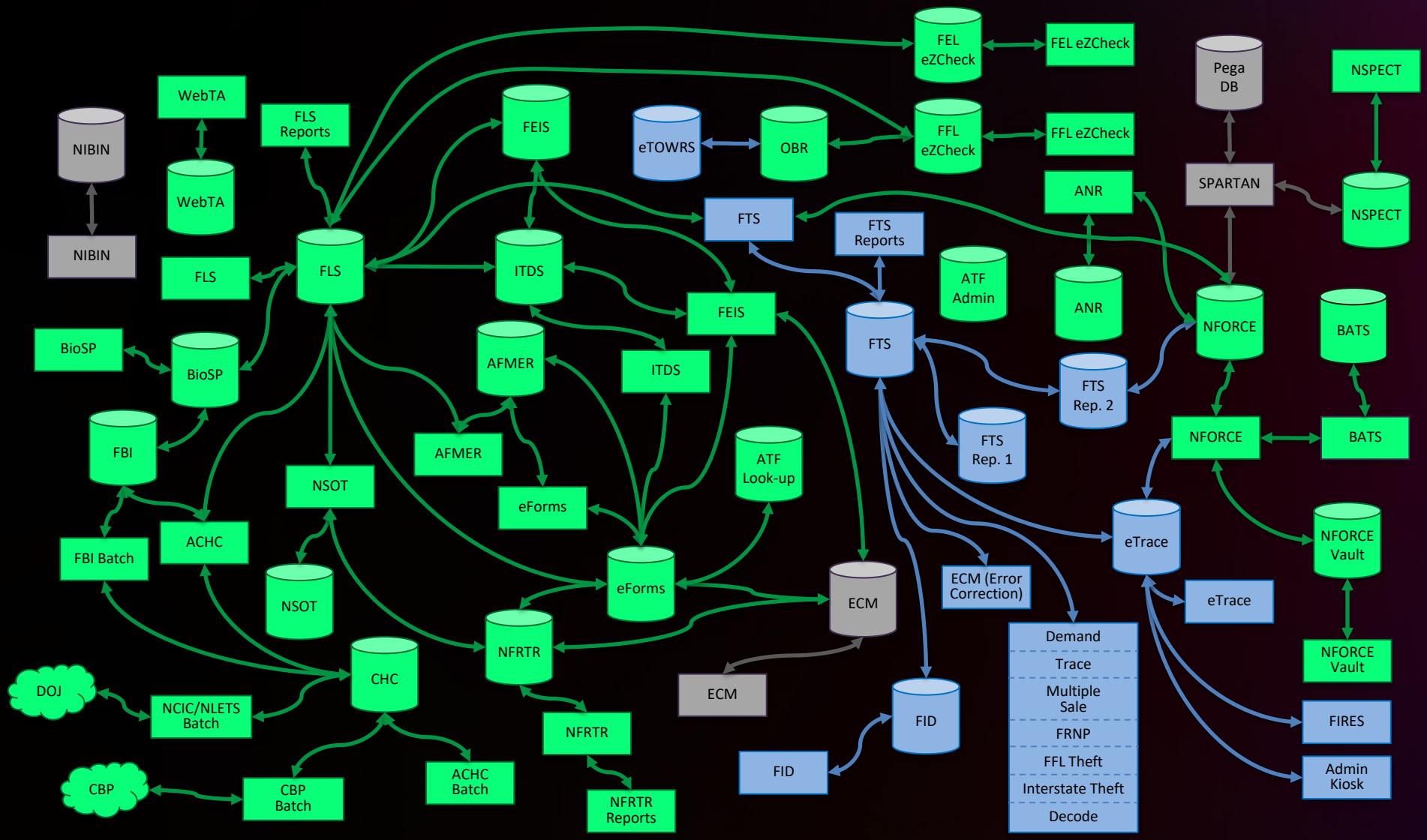
Former Federal CIO Maria Roat called it one of the largest federal government modernization successes

Practical results	Legacy *(CY 2021)*	ITEM *(CY 2022)*	Increase
Users			
Unique users	188,000	468,000	250%
Unique user logins	2,300	330,000	14,300%
Performance			
Max simultaneous users	≈100	4,500+	4,500%
eForms usage			
eForms submitted by users	14,000	665,000	4,700%
Agility			
Production deployment frequency	*(At best)* monthly	90% of workdays	

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Major ATF systems: Migration status



Each shape is an application or database of ATF's major mission systems.

Shows the **complexity** of ATF's mission systems and the many interconnections between them.

Shows the **successes** we have had and **progress** we are making.

Color Legend:

- **Successfully migrated by ITEM**
- **Tracing migration in progress by ITEM**
- **Migration in progress by non-ITEM team**

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Lessons learned

At the beginning of major IT modernization initiatives

1. Get user **subject matter experts** dedicated to the development effort
2. Build an **enterprise CI/CD environment** and provide it as a service to development teams
3. Mandate application development teams **use CI/CD**
4. **Automate everything** (code deployment pipeline, testing, infrastructure provisioning, etc.)
5. Rebuild your **IT governance** policies and processes around CI/CD and frequent deployments

After go-live

1. Immediately switch to **continuous improvement**
2. **Set a goal** of 1 mid-day production per day

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ATF's recovery steps summarized

(a.k.a. Agile management best practices for your programs)

1. Get **business subject matter experts** as Product Owners
2. Analyze and manage **process** efficiency
3. Ensure **accuracy** of your backlog
4. **Estimate the knowns** in your backlog
5. **Estimate the unknowns** that are not yet in your backlog (known functions which are not yet captured, plus allowance for the unexpected)
6. Project **rough initial go-live dates**, and continuously refine as more is learned
7. Follow the data and **face reality** (complete transparency with executive leadership)

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ATF's recovery steps summarized (cont.)

(a.k.a. Agile management best practices for your programs)

8. Model different **scenarios** (what effect do they have on go-live?)
9. Hard decisions: **Accepting less**
10. Assess the **business impact** of incomplete functionality
11. **Rank stories** based upon their business impact
12. Negotiate go-live **dates versus business impact** of unfinished functionality
13. Map the home stretch: Track completion of **final high-impact stories**
14. Pick your go-live date and **stick to it**

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Looking ahead

Finish last migrations



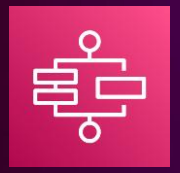
Shut down
ATF datacenter

Enhancements



Continuous
improvement

Process automation



AWS Step Functions

Break down microservices



Application integration

Machine learning (within regulatory constraints)



Amazon DevOps Guru



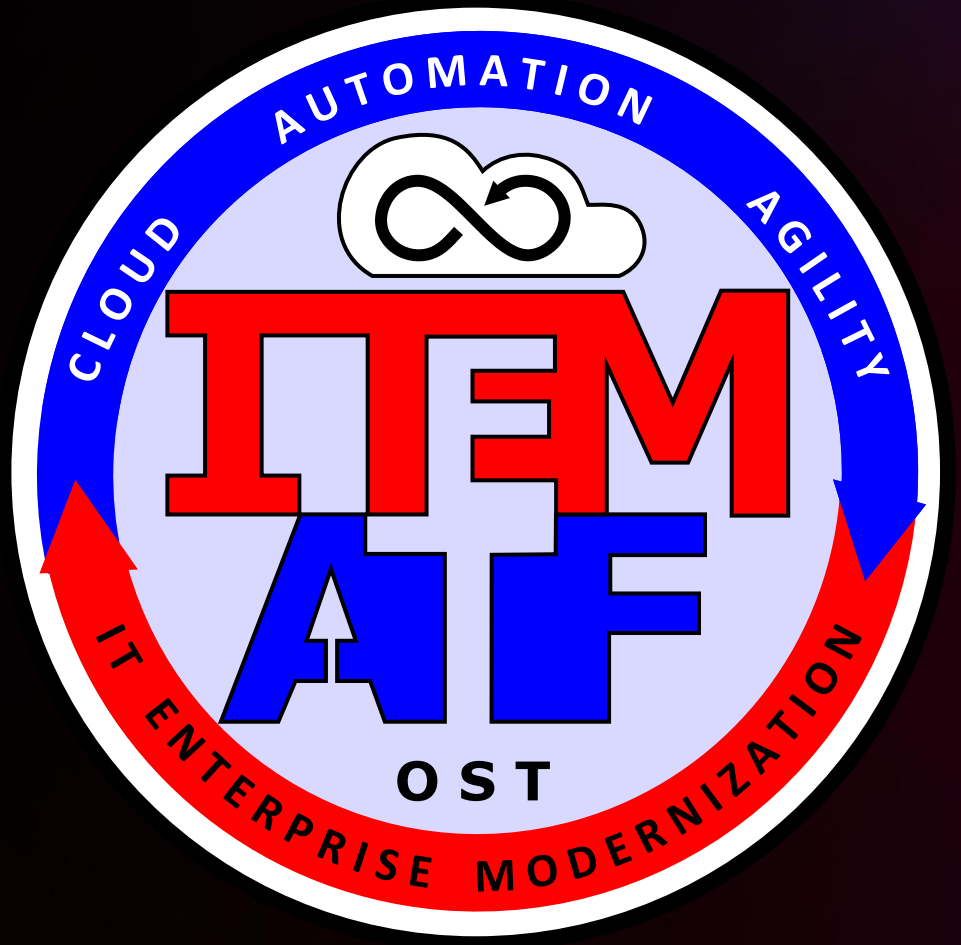
Amazon CodeGuru

Serverless



AWS Lambda

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Questions?

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Thank you!

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