

Data Analytics

Applications for Oversight

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National Science Foundation





Overview

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- Data Analytics in Government
- Applications in Grant Oversight
- Applications in Purchase Card Oversight



Greater Attention to Analytics in Government

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- DATA Act
 - Promotes data sharing across government agencies
 - Treasury data analytics center for OIGs – automated oversight
 - Government-wide structured data standards for financial reporting
 - USASpending data should be standardized and machine-readable
 - OIGs will audit data quality
- Improper Payments Elimination and Recovery Act (IPERA)
 - Amends the Improper Payments Information Act of 2002
 - IPERIA strengthens estimations
 - Strengthens detection, prevention, and recovery efforts
 - Pre-award and pre-payment checks with Do Not Pay
 - Annual risk assessments of covered programs
 - Published improper payment estimates with reduction targets
 - Goal to reduce improper payments by \$50B and recover \$2B in 2 yrs



Automated Oversight

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- Improved risk identification
 - 100% transaction review – limited statistical sampling
 - Automated business rules based on risks
 - Focus review on higher risks
- Key data analytics software techniques
 - Join databases (need linking field)
 - Summarize data (many to the few)
 - Apply risk indicators using computed fields
 - Develop risk profiles by institution, award-type, transaction-type
 - Summarize risk into one number
- Agencies and recipients can use similar data analytics techniques
 - Monitor grant spending
 - Identify anomalies early



Risk Identification

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- General risks
 - Certain contract and grant awards tend to be riskier than others
 - Smaller institutions tend to have weaker internal controls
- Specific risks
 - Something that happens in a process that stands out from normal activity
 - Large drawdown on a single date – end of a fiscal year
 - Spending out remaining grant and contract funds at end of the award
- Challenges
 - General risks can be more obvious
 - Specific risks can be harder to see. Benefits greatly from transaction level data.

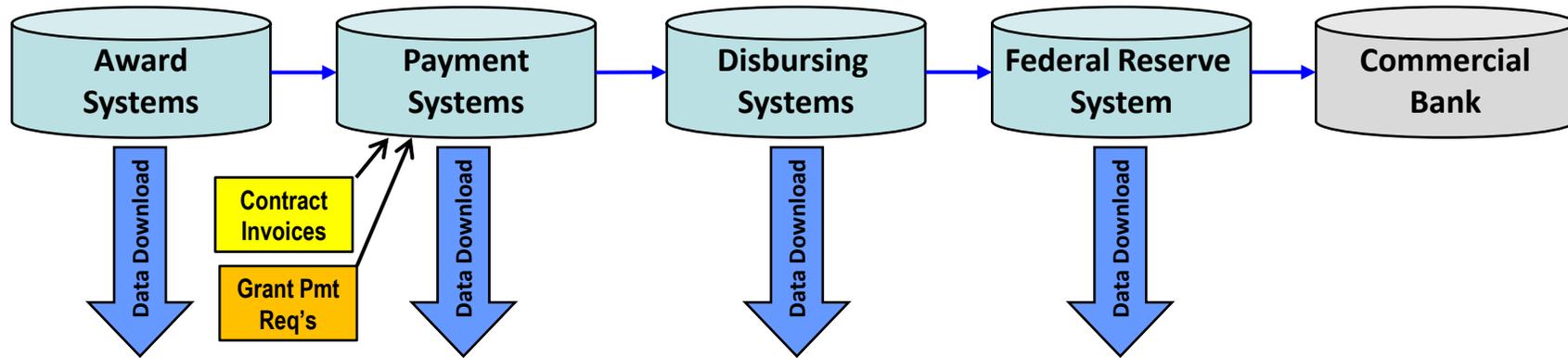
Framework for Data Analytics Using Government and Publicly Available Data

Award-level Data

Grants, Contracts

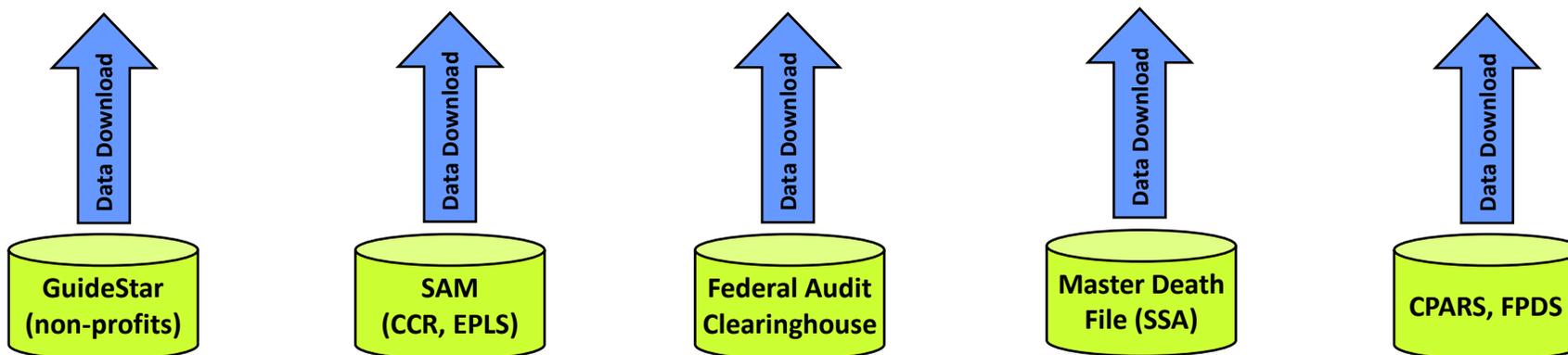
Transaction-level Data

Payee, Contract No, CLINs, Payment Amount, Date



Oversight Review by

- Auditors
- Investigators
- Agencies



Examples of systems that can help validate payment transactions



Contract Audit Tests

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- Payments to vendors not registered in CCR
 - CCR may not fully update payment system vendor table.
 - Too great of focus on avoiding prompt payment penalty interest.
- EFT/Bank Account information changes for vendor
 - Changes are made in CCR, but may not be made by an authorized person
 - EFT/Bank Account information in payment system may not equal CCR
- Excessive shipping charges
 - Test reasonability of claims
 - Shipping costs can be paid from an open allotment – may not be system edits
- Duplicate payments
 - Same invoice no. (almost the same), invoice date, contract no.
 - Too great of focus on avoiding prompt payment penalty interest
- Summarize disbursing or payment file
 - Vendors with just a few invoices would be of interest
 - Vendors with several bank account changes



U.S. Financial Assistance Overview

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- \$600 billion in awards
 - 88,000 awardees and 26 Federal grant making agencies
 - Project and research, block, and formula
- Outcomes are designed to promote public good
- Challenges
 - Limited visibility of how Federal funds are spent by awardees
 - Support for funding requests much less than for contracts
- American Recovery and Reinvestment Act (2009)
 - \$840 billion of assistance to stimulate the economy
 - Greater accountability and transparency over spending than ever
- Opportunities to enhance oversight with less
 - Automated oversight



Framework for Grant Oversight

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- Data analytics-driven, risk-based methodology to improve oversight
 - Identify institutions that may not use Federal funds properly
 - Techniques to surface questionable expenditures
- Life cycle approach to oversight
 - Mapping of end-to-end process to identify controls
 - 100% review of key financial and program information
 - Focus attention to award and expenditure anomalies
- Complements traditional oversight approaches
 - Techniques to review process and transactions are similar
 - Transactions of questionable activities are targeted
- Recipients and Agency Officials can use data analytics
 - Identify high risk activities through continuous monitoring



Grants Differ From Contracts

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GRANTS

Promote services for the
Public Good

- Merit review (competitive)
- Multiple awardees
- Award budget
- No government ownership
- Grant payments
 - Summary drawdowns
 - No invoices for claims
 - Expenditures not easily visible
- Salary percentages

CONTRACTS

Specified deliverables
(Goods and Services)

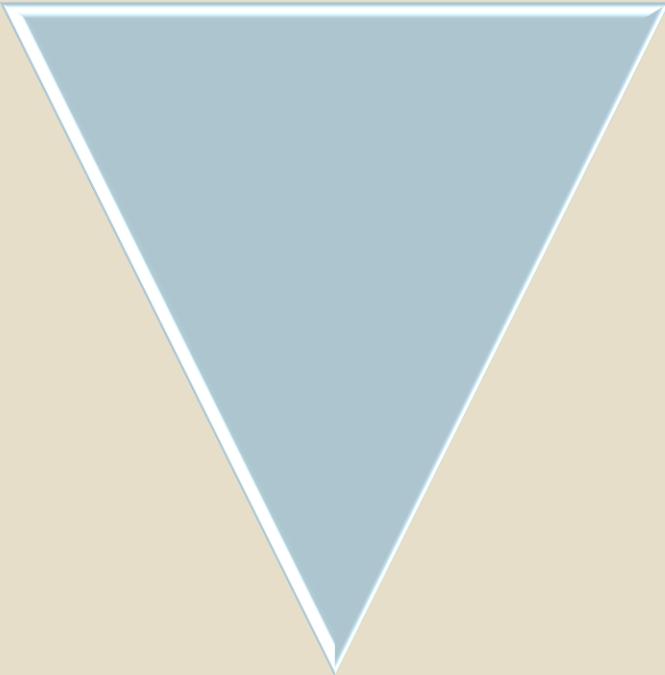
- Competitive process
- One awardee
- Contract price
- Government ownership
- Contract payments
 - Itemized payment requests
 - Invoices to support claims
 - Detailed costs
- Salary hourly rates



Focus on Risk

Many to the Few

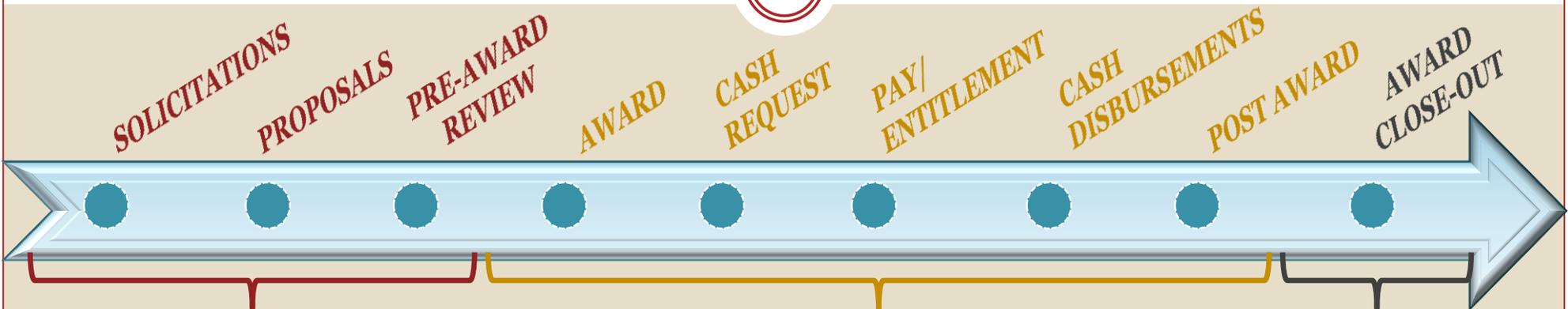
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600,000	Grant award drawdowns annually totaling \$6.3 billion Each assigned a risk score
40,000	Active awards Each assigned a risk score
2,000	Institutions Each assigned a risk score
20	Audits of higher risk institutions Each audit tests all transactions for all awards with automated risk indicators



End to End Process for Grant Oversight



PRE-AWARD RISKS	ACTIVE AWARD RISKS	AWARD END RISKS
<ul style="list-style-type: none"> •Funding Over Time •Conflict of Interest •False Statements •False Certifications •Duplicate Funding •Inflated Budgets •Candidate Suspended/Debarred 	<ul style="list-style-type: none"> •Unallowable, Unallocable, Unreasonable Costs •Inadequate Documentation •General Ledger Differs from Draw Amount •Burn Rate •No /Late/Inadequate Reports •Sub-awards, Consultants, Contracts •Duplicate Payments •Excess Cash on Hand/Cost transfers •Unreported Program Income 	<ul style="list-style-type: none"> •No /Late Final Reports •Cost Transfers •Spend-out •Financial Adjustments •Unmet Cost Share



D A T A A N A L Y S I S

Dr. Brett Baker, AIGA, NSF OIG



Common Audit Findings

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Pre-Data Analytics Audits (projections)

- Unsupported costs
- Effort reporting
- Effort reporting (subaward)
- Pre-award charges

Data Analytics Audits (actual transactions)

- Unallowable, unallocable, unreasonable costs
- Excess salary
- 2-month salary rule
- Indirect Costs
- Equipment

Look at Red Flag Areas

The more red flags, the higher the risk.

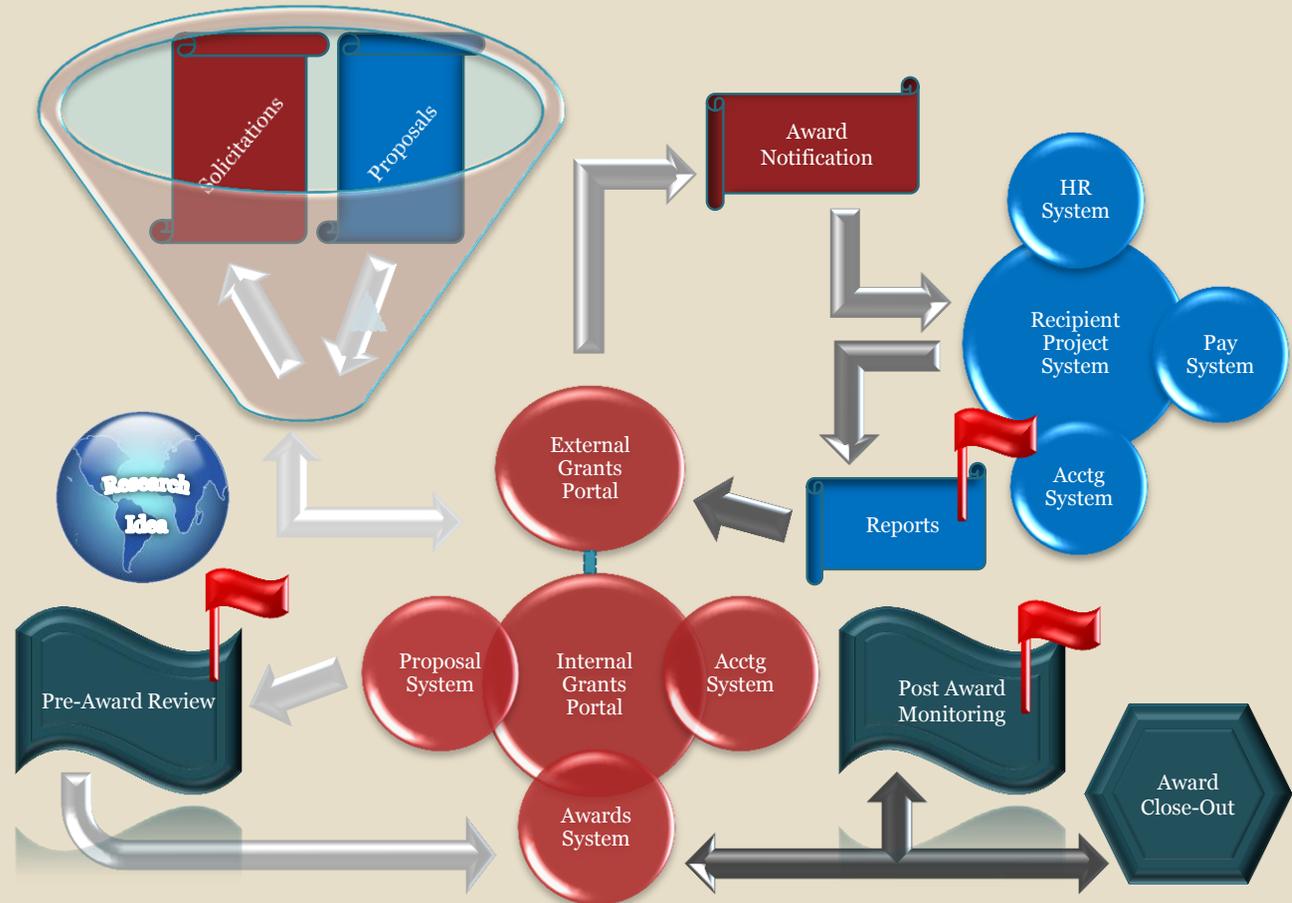


The less red flags, the lower the risk.



Use Data Analytics to identify anomalies that are potential fraud indicators, such as:

- breaks in trends, outliers...





Risk Assessment and Identification of Questionable Transactions

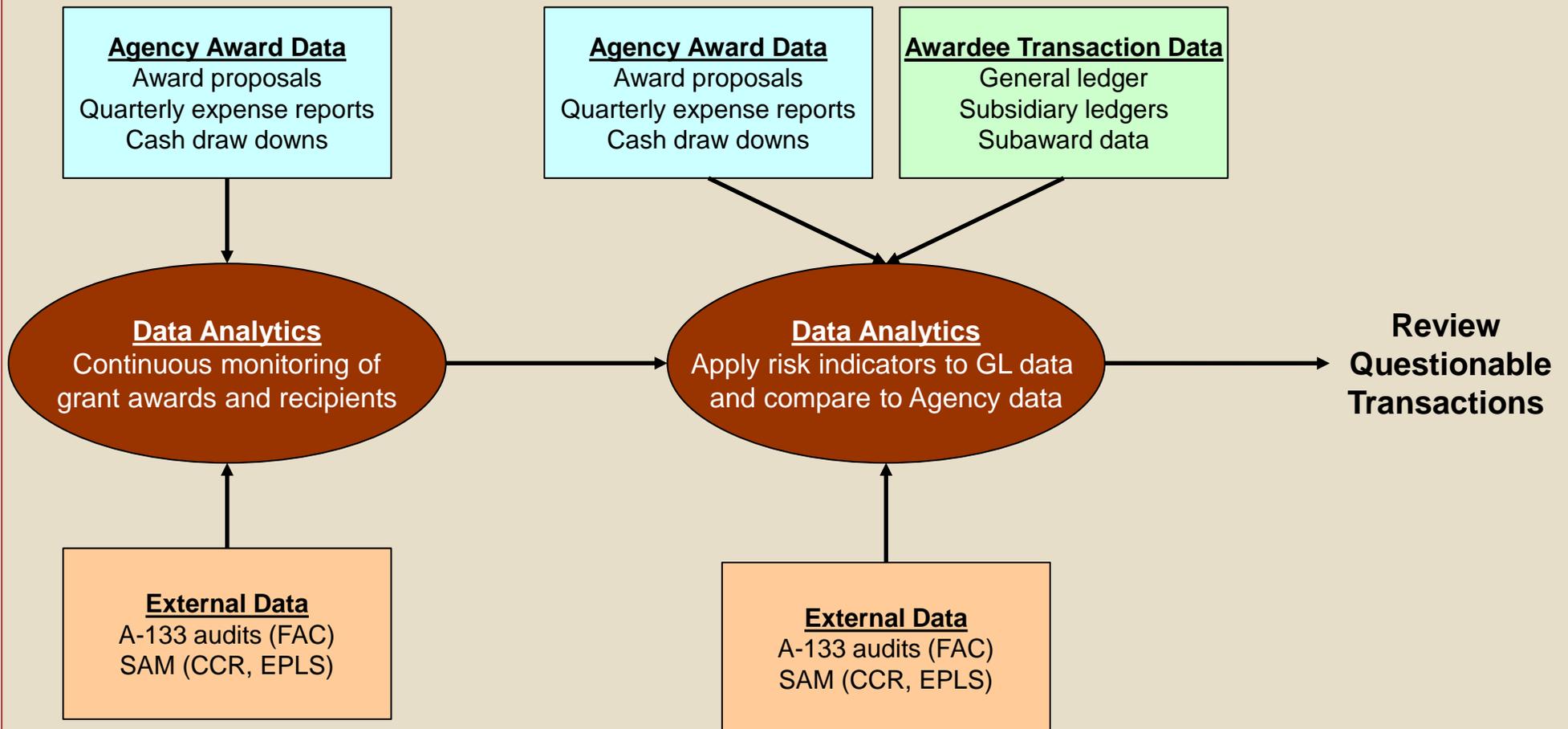
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Phase I

Identify High Risk Institutions

Phase II

Identify Questionable Expenditures



Identification of Higher Risk Institutions and Transactions

Agency Award Data

(Grant Level)

Institution ID	Award ID	Proposal Score	Award Amount	Grant Expiration Date	Expenses To Date	Grant Extensions
XXXX01	X11	51	535,000	12/31/11	325,000	Y
XXXX01	X12	82	875,000	03/31/12	915,658	N
XXXX01	X12	76	1,465,000	06/28/12	998,254	N

Risk Flags

(Grant Level)

PI S&D Flag	Burn Rate Flag	Spend Out Flag	Extension Request Flag	Special Payment Flag	Risk Score
		1	1	1	3
		1			1
1	1				2

Compare grant level risks to GL analysis



Agency Institution Data

(Summarized Award Data at Institution Level)

Institution ID	Active Awards	Dollars	Number Of Draws	Special Payment Status
XXXX01	20	15,120,963	72	Yes
XXXX02	37	34,361,394	10	No
XXXX03	45	66,452,125	27	Yes

External Data

(Institution Level)

ELPS	D&B	ROC	FAC	990

Risk Flags

(Institution Level)

Draw Spike Flag	Spend Out Flag	ELPS Match Flag	FAC Findings Flag	Special Payment Flag	Risk Score
	1	1	1	1	4
1		1			2
1	1	1	1	1	5

PHASE I

Review Institutions with higher risk scores

Web-accessible Sources

Institution's General Ledger Data

(Transaction Level)

Award ID	Source Code	Award Expiration Date	Transaction Date	Dollars	Data Entry Staff Code	Comment Field
X11	PAY	12/31/11	2/15/11	84,456		
X11	AP	12/31/11	9/13/11	31,742		Equip
X11	AP	12/31/11	9/16/11	22,541		Trav

Risk Flags

(General Ledger Transaction Level)

Draw Spike Flag	Burn Rate Flag	Spend Out Flag	Travel Expenses Flag	Cost Transfer Flag	Risk Score
1		1		1	3
1		1			2
			1		1

PHASE II

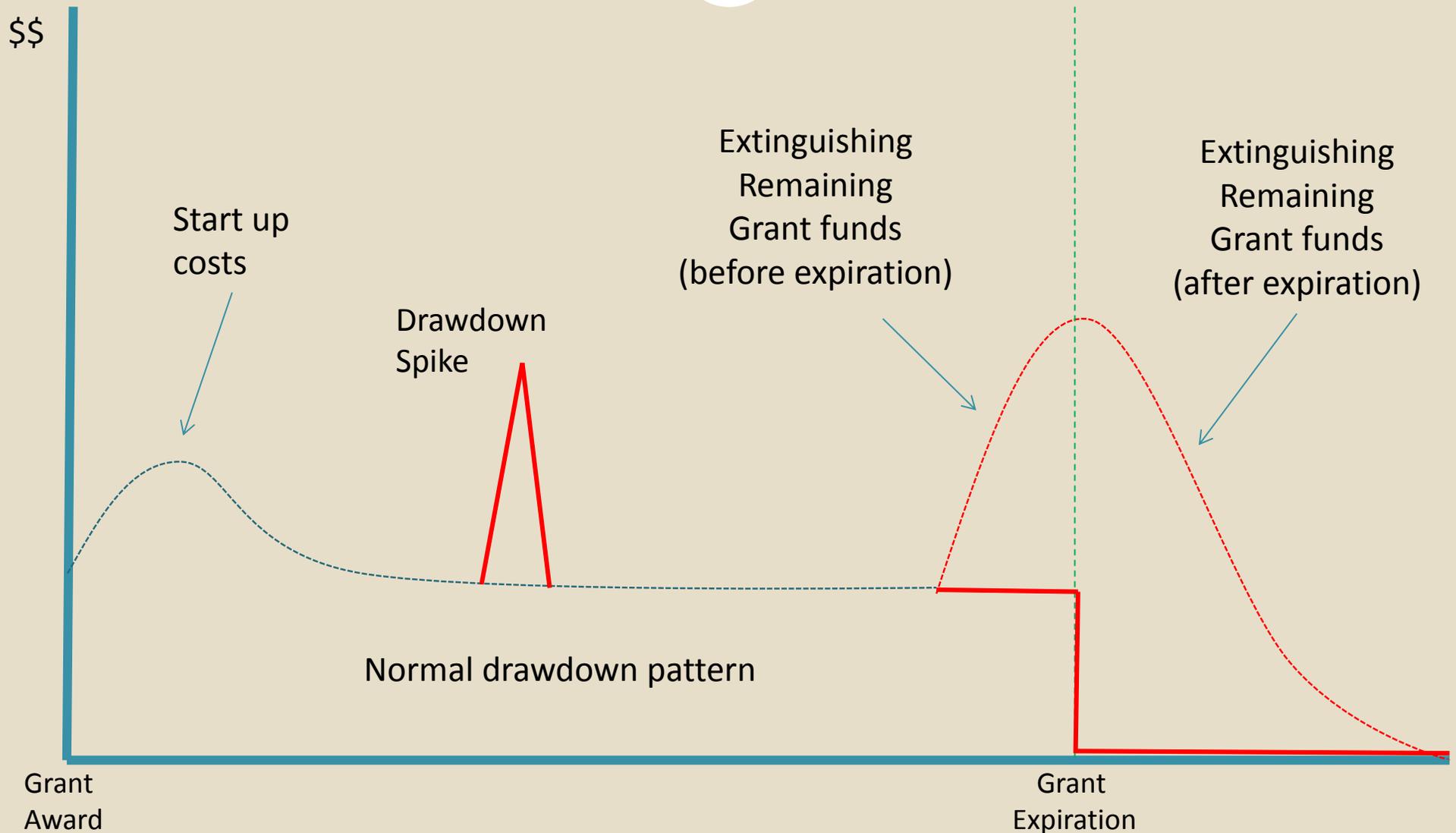
Review transactions and groups with higher risk scores





Anomalous Drawdown Patterns

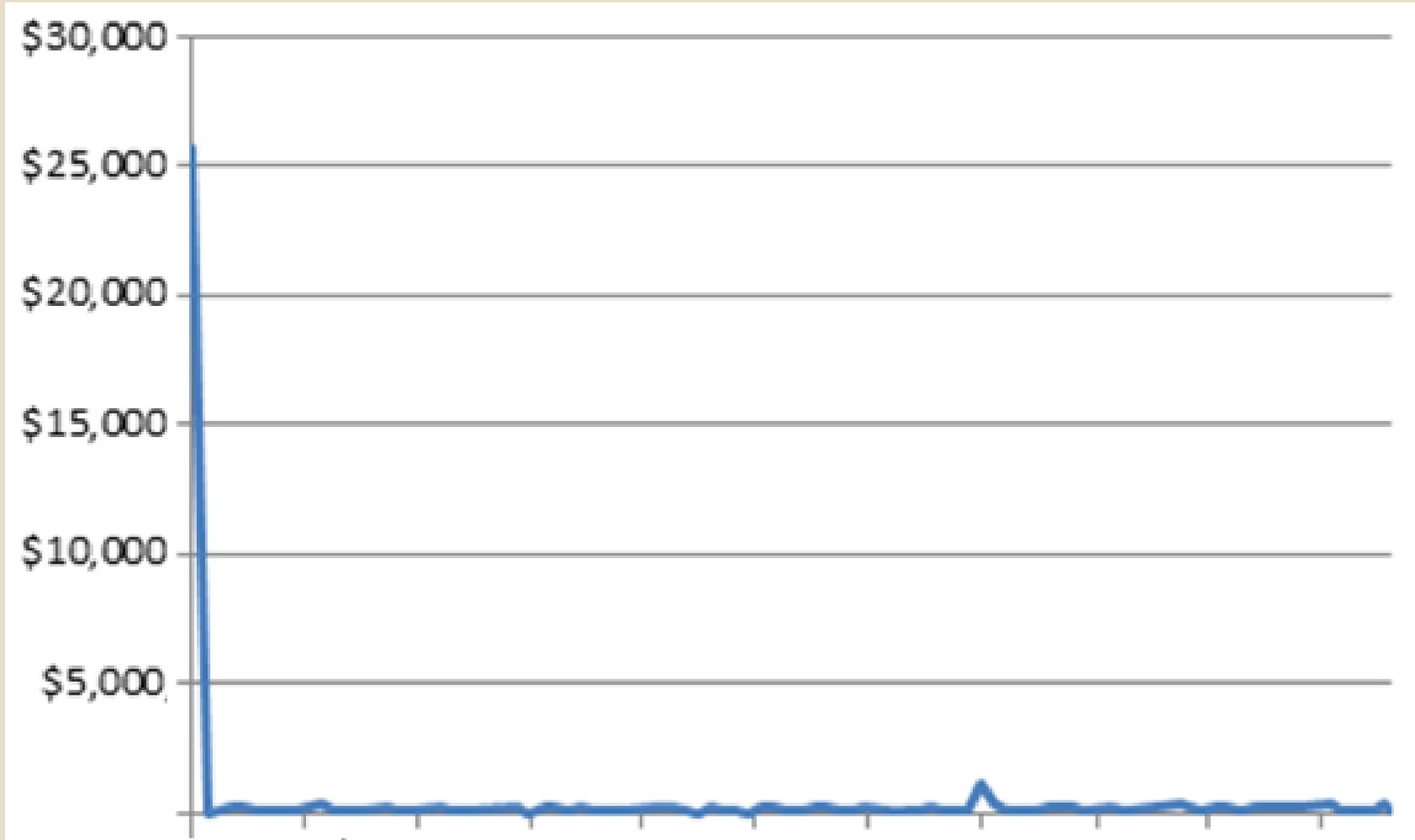
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Early Drawdown

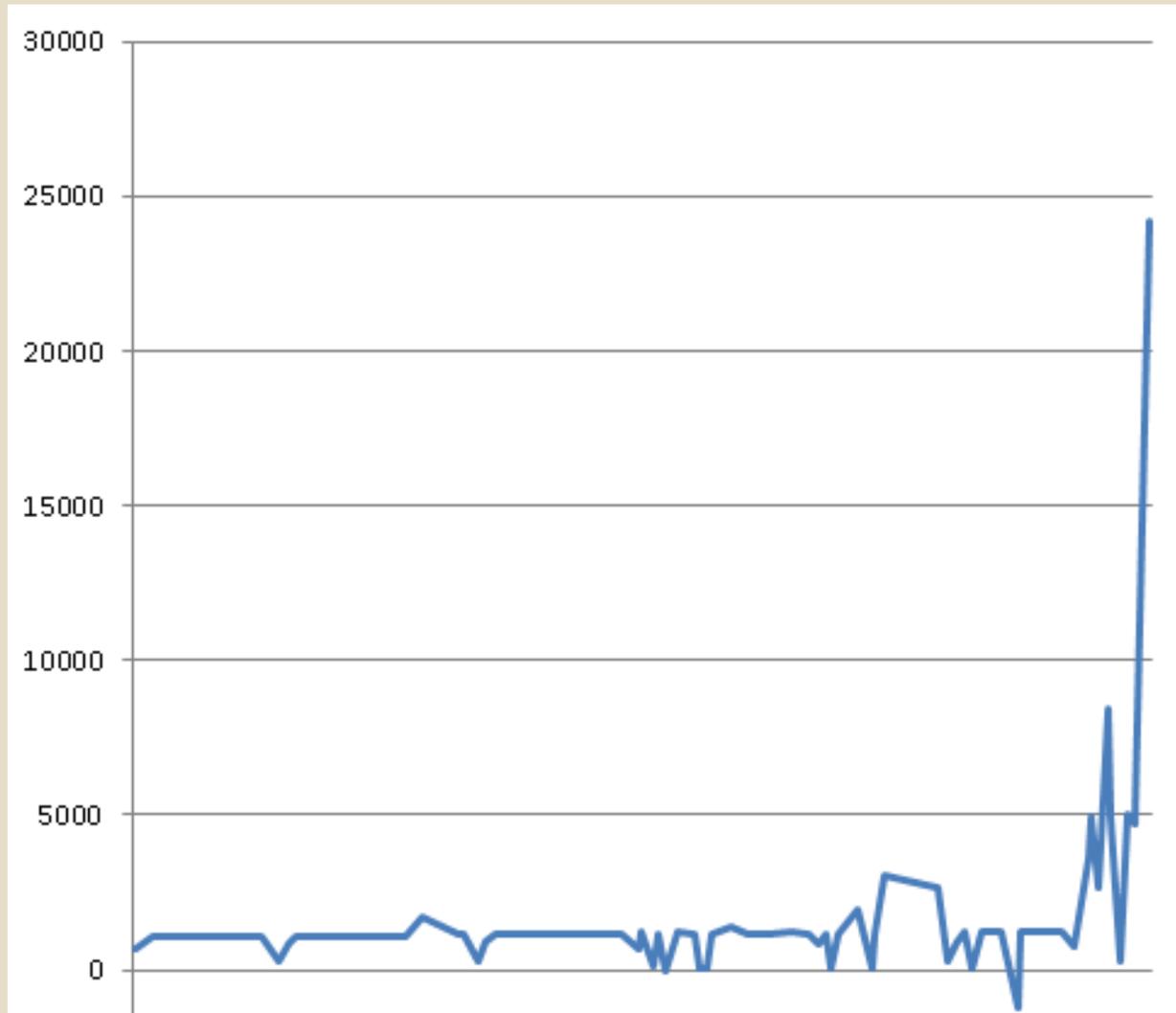
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Spend out Pattern

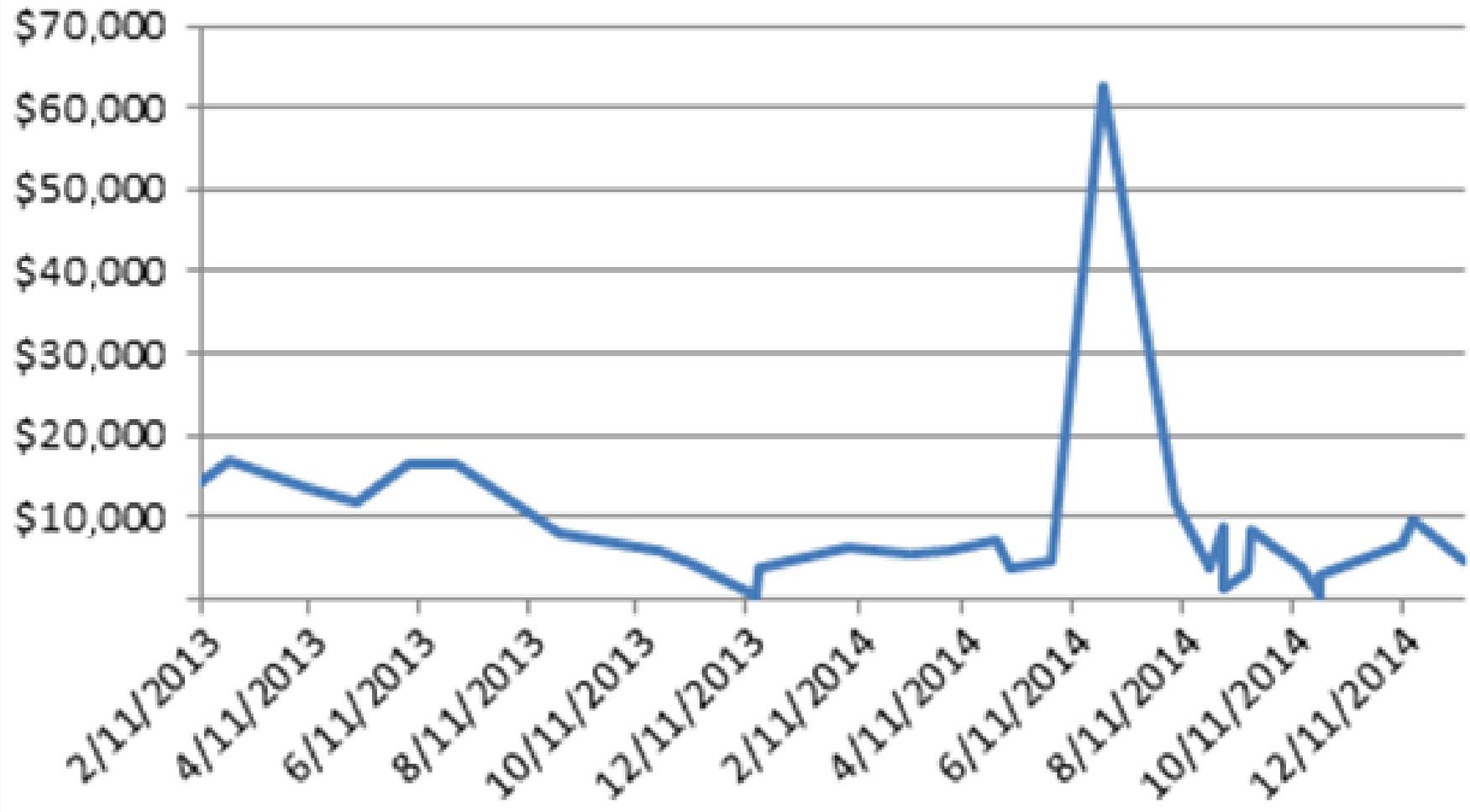
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Draw Spike

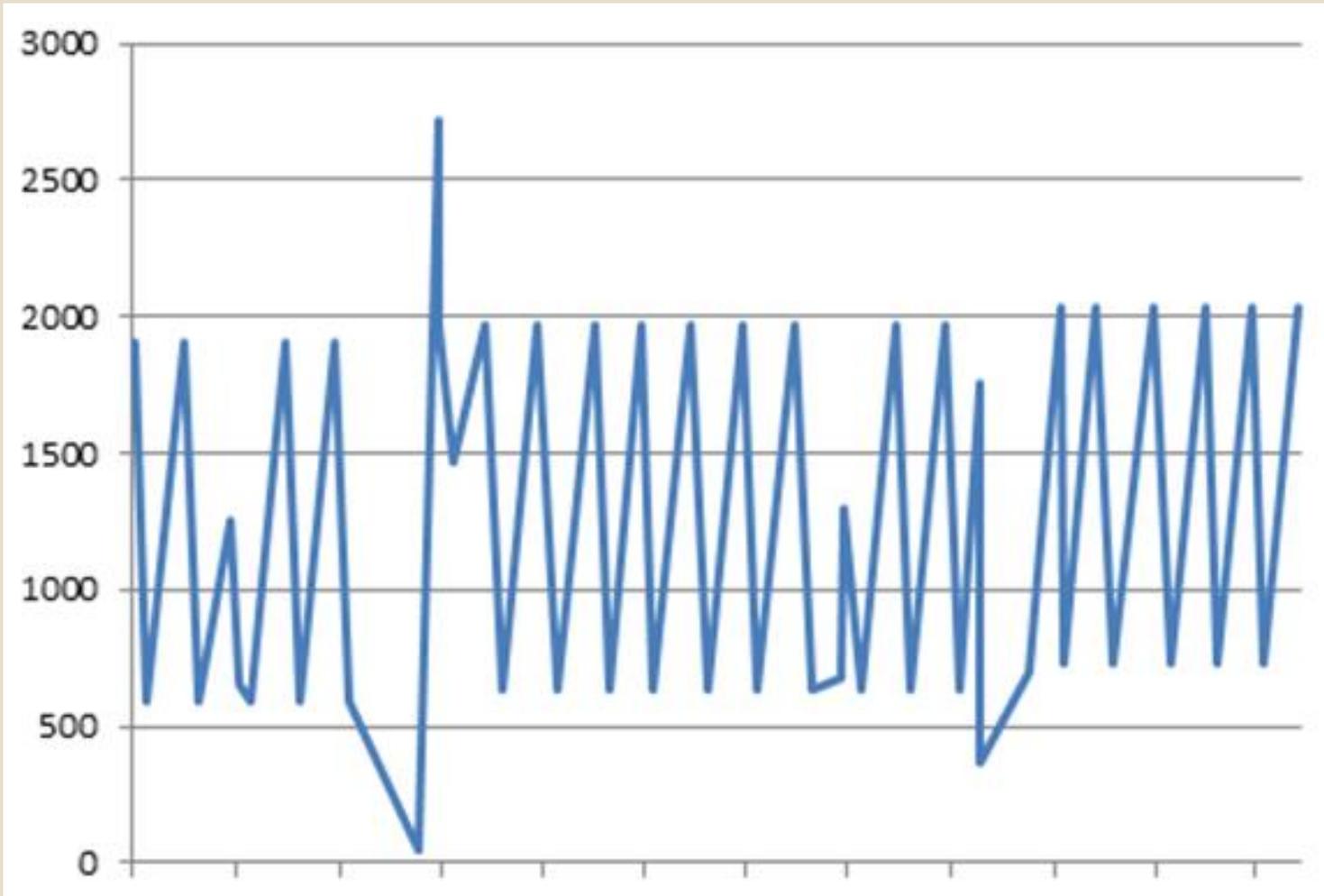
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Does this drawdown pattern look okay?

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Burn Rate – Actual vs Expected

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Actual				Expected			
Award	Amount (\$K)	Expended (\$K)	% Expend	Award Days	Days Active	% Total Days	Delta
1	10,000	9,000	90%	1095	769	70%	1.29
2	5,000	4,000	80%	1095	524	48%	1.67
3	2,000	1,500	75%	1095	404	37%	2.03
4	1,000	995	99%	365	200	55%	1.81
5	20,000	12,000	60%	1826	500	27%	2.22
6	10,000	5,000	50%	1826	1600	88%	0.57
Awarde e Totals	48,000	32,495	68%	7,302	3,997	55%	1.24

1.00 would be normal



Equipment Charges Incurred Immediately Before Grant Expiration

GRANT ID	OBJECT DESCRIPTION	GRANT EXPIRATION DATE	TRANSACTION DATE	LEDGER POST DATE	FINANCIAL AMOUNT
XXXXX42	CONSTRUCTION AND ACQUISITION	09/30/2009	09/30/2009	10/06/2009	51,851.22
Same day as expiration					
GRANT ID	OBJECT DESCRIPTION	GRANT EXPIRATION DATE	TRANSACTION DATE	LEDGER POST DATE	FINANCIAL AMOUNT
XXXXX27	INVENTORIAL EQUIPMENT	07/31/2010	06/04/2010	08/11/2010	31,621.56
57 days before expiration					
GRANT ID	OBJECT DESCRIPTION	GRANT EXPIRATION DATE	TRANSACTION DATE	LEDGER POST DATE	FINANCIAL AMOUNT
XXXXX77	INVENTORIAL EQUIPMENT	08/31/2009	07/16/2009	09/10/2009	23,163.75
46 days before expiration					
TOTAL					106,636.53



Travel Related to Award?

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Just before award expiration

NSF_OIG_Transaction	Expiration Date	Transaction Date	Expense Type	Amount
GL Trans-030745	09/25/2007	08/31/2007	TRAVEL-IN-STATE	73,519
GL Trans-099671	06/11/2010	06/01/2010	TRAVEL - FOREIGN	41,474
GL Trans-084844	11/02/2010	10/31/2010	TRAVEL - OUT-OF-STATE	37,516
GL Trans-045792	02/09/2010	02/01/2010	TRAVEL-IN-STATE	28,905
GL Trans-117607	06/11/2010	07/15/2010	TRAVEL - FOREIGN	27,262
GL Trans-126299	08/19/2010	09/30/2010	TRAVEL-IN-STATE	20,975

Just after award expiration



Purchase Card Oversight using Data Analytics

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- Government purchase card overview
 - Simplified acquisition
 - Still high risk for abuse without strong oversight
 - Government Credit Card Fraud Prevention Act 2013
- DoD Joint Purchase Card Review
- Current work at NSF



DoD Joint Purchase Card Review

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- Review objective
 - Identify purchase card abuses and recommend process improvement
- Universe under review
 - 15 million purchase card transactions (\$9 billion)
 - 200,000 cardholders (CH) and 40,000 authorizing officials (AO)
- 300 DoDIG and Defense agency auditors/investigators
- Subject Matter Expert conferences
 - Structured brainstorming with auditors, investigators, GSA officials
 - Developed 115 indicators of potential fraud → 46 codable
- Build targeted business rules and run against data
- Field research, reporting, and process improvements
- \$122M in recoveries, 100 prosecutions, 275 adverse actions
- **Most important outcome: indicators built into bank systems**

File Edit View Insert Format Records Tools Window Help

DoDIG Control Number: [redacted]

PHONE SOURCE TRANS LIMIT CRATE COMPANY SERVICE
 () - 0 U 0000190728816 58004 21

Totals Below Are for All Cardholders Associated with this AO
 Avg Trans Per Month AO Reviews: 71.47 AO CH Count: 27
 Avg Tot Trans Amount Per Month: \$37,849.58

PHONE: SOURCE TRANS LIMIT CRATE COMPANY SERVICE
 U 0000190728116 58004 21

CHTransactions: 11 Reviewer Name: [redacted]
 Totaling: (\$1.03) Reviewer Phone: [redacted]

Referred to Investigator? [checkbox]

Reason Flagged for Review [checkbox]

Amount Invalid? [checkbox]

Explanation of Findings

TDATE	PDATE	TRANS AMT	MERCHANT	MERCHANT ADDRESS	MCC	REF NUMBER	AUTH	VTCOD	Flagged to Review	Reason Flagged for Review	Referred to Investigator?	Amount Invalid?	Explanation of Findings
5/1/2001	5/4/2001	(\$39.95)	BILL *WWW.IBILLCS.COM	800-307-3558, FL 033321	5967	74401401123061025539853	0	11	<input checked="" type="checkbox"/>	-32MERDS-3	<input type="checkbox"/>	<input type="checkbox"/>	
3/27/2001	5/17/2001	(\$39.95)	BILL *WWW.IBILLCS.COM	800-307-3558, FL 000000	5967	74798261137061025112928	0	11	<input checked="" type="checkbox"/>	-32MERDS-3	<input type="checkbox"/>	<input type="checkbox"/>	
2/25/2001	4/27/2001	(\$39.95)	BILL *WWW.IBILLCS.COM	800-307-3558, FL 000000	5967	74798261117061025228827	0	11	<input checked="" type="checkbox"/>	-33,28-17,28-3 2MERDS-3	<input type="checkbox"/>	<input type="checkbox"/>	
11/25/2000	1/10/2001	(\$15.10)	NET	MOSCOW, 000000	4816	74798261010014124420116	0	11	<input checked="" type="checkbox"/>	-17,28-1- 110MOSCOW	<input type="checkbox"/>	<input type="checkbox"/>	
10/19/2000	10/19/2000	(\$0.48)	MPAC REBATE - THANK YOU	11111, 000000	0000	74798260293000000063054	0	65	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
4/13/2001	4/13/2001	(\$0.47)	MPAC REBATE-THANK YOU	58125, D 00000	0000	74798261103000000030440	0	65	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
1/17/2001	1/17/2001	(\$0.08)	MPAC REBATE - THANK YOU	00001, D 00000	0000	74798261017000000000372	0	65	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
11/25/2000	11/27/2000	\$15.10	NET	MOSCOW, 000000	4816	74908520331014124420114	863530	10	<input checked="" type="checkbox"/>	-1-110MOSCOW	<input type="checkbox"/>	<input type="checkbox"/>	
4/26/2001	4/30/2001	\$39.95	BILL *WWW.IBILLCS.COM	800-307-3558, FL 033321	5967	24401401117061025096246	476930	10	<input checked="" type="checkbox"/>	-32MERDS-3	<input type="checkbox"/>	<input type="checkbox"/>	
3/27/2001	3/29/2001	\$39.95	BILL *WWW.IBILLCS.COM	800-307-3558, FL 033321	5967	24401401087061025112924	867470	10	<input checked="" type="checkbox"/>	-32MERDS-3	<input type="checkbox"/>	<input type="checkbox"/>	
2/25/2001	2/27/2001	\$39.95	BILL *WWW.IBILLCS.COM	800-307-3558, FL 033321	5967	24401401057061025228825	987040	10	<input checked="" type="checkbox"/>	-33,28-32MERDS-3	<input type="checkbox"/>	<input type="checkbox"/>	

Record: 1 of 11

27 CHs

Reason Flagged

Many credits

Merchant is "I-Bill"

Merchant address = "Moscow"

8 of 11 transactions were flagged



Top Indicator Combinations

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- 97% Adult websites, Weekend/Holidays
- 67% Purchases from 1 vendor, CH=AO
- 57% Adult websites
- 57% Internet transactions, 3rd party billing
- 53% Interesting vendors, many transactions
- 43% Even dollars, near limit, same vendor,
vendor business w/few CHs



NSF Purchase Card Work

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- Similar approach as DoD Joint Purchase Card Review
- Universe
 - 3 years of purchase card activity
 - 230 card holders
 - 34,000 transactions
 - \$17 million
- Purchase card transaction data from the bank's website
- Worked closely with Investigations
- Developed risk indicators at transaction level
- Risk-based approach to testing



Risk Factor Examples

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- **AO Span Of Control >4** – Flags transactions for Cardholders (CH) whose Approving official has a span of control of 5 or more CHs. (Risk value = 1)
- **Suspect MCC Codes** – Flags transactions with MCC codes we deemed suspect. (Risk value = 2)
- **Blocked MCC Codes** – Flags transactions with Blocked MCC codes. (Risk value = 3)
- **Holiday Purchases** – Flags transactions that occurred on holidays. (Risk value = 3)
- **Weekend Purchases** – Flags transactions that occurred on the weekends (i.e., Saturday or Sunday). (Risk value = 3)



Risk Factor Examples (continued)

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- **Suspect Level 3 Data** – Flags transactions with Level 3 data we deemed suspect based on manual review. For example, possible personal purchase, possible split transaction, questionable legitimate business need. (Risk value = 3)
- **One to One Card Holder to Merchant** – Flags transactions in which the merchant only did business with that particular NSF card holder. (Risk value = 2)
- **Possible Split Purchase** – Flags transactions by a card holder in which more than 1 purchase to the same merchant totaling more than \$3,000 occurred on the same day, or within a few days. (Risk value = 3)



Example of Level 3 Data

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Transaction Detail With Purchase Addendum

NSFSMP2

Tran Date	Post Date	Tran Id	Purchase Method	Merchant Name	City	State	MCC Code	Debit Amount	Credit Amount	Tax
HOLDER, PURCHASE CARD *****1234										

08/08/2013	08/09/2013	12345678	In Person	BEST BUY	00008433	OTTUMWA	IA	5732	\$1,604.94	\$0.00	\$0.00
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QTY	Description	Unit Cost	Line Item Total	Product Code	Unit of Measure
1	\$50 APPLE ITUNES ICO	\$50.00	\$50.00	4056111	EACH
1	CLEAR CHARCOAL IWATC	\$24.99	\$24.99	2074092	EACH
1	\$50 ITUNES CHILD	\$0.00	\$0.00	7256916	EACH
1	NEW RZ CARD FY12	\$0.00	\$0.00	2490532	EACH
1	OFFICE MAC HOME STUD	\$69.98	\$69.98	1303083	EACH
1	AO756-2623 - CELERON	\$279.99	\$279.99	5688602	EACH
1	OFFICE MAC HOME STUD	\$0.01	\$0.01	1308816	EACH
1	RZ CERTIFICATE EMAIL	\$0.00	\$0.00	6072313	EACH
1	APPLE 100.00 CHILD S	\$0.00	\$0.00	9603002	EACH
1	SVE15115FXS - 15.5/I	\$629.99	\$629.99	5570073	EACH
1	16GB NANO 6TH GEN GR	\$149.99	\$149.99	1161934	EACH
1	SOUNDLINK WIRELESS M	\$299.99	\$299.99	2989098	EACH
1	\$100 APPLE ITUNES IC	\$100.00	\$100.00	4056157	EACH



Questions?

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