



Sprint Team, Purchase Order Invoice Approval Cycle Time Reduction

Process owner: Ryan Timbrook

Key Dates ---->

Team Launch 7/18

Define 7/21

Measure 7/25

Analyze 8/1

Improve 8/29

Control 9/12

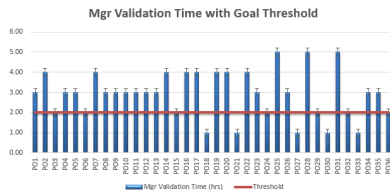
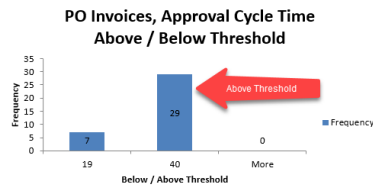
DEFINE

- Only **20%** of Vendor supplied Sprint Teams Purchase Order (PO) Invoices are being approved within the discount threshold of 19 days.
- Not achieving this discount benchmark costs the company, on average, **\$5,911 in lost revenue** on each PO invoice it processes
- Managers and Teams spend **to much time** validating Sprint PO invoices for correctness. This time not only **costs in resource dollars**, it as well has **negative impacts** to the amount of software delivery work they can complete each Sprint Cycle, leading to a **decreased 'Time to Market' performance** measure

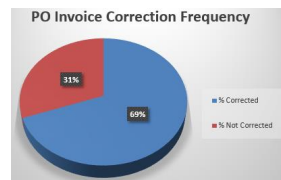


MEASURE

Managers have a low frequency rate of approving POs under threshold

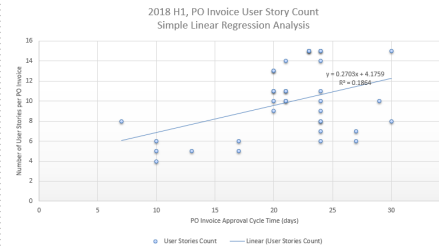


PO Invoices having to be corrected leads to longer Approval Cycle Times

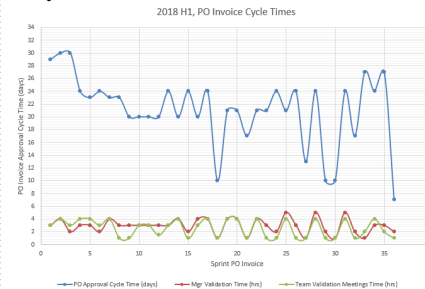


ANALYZE

PO Invoices with mid-to-high User Story Counts are increasing the likelihood a PO Invoice will need to be corrected, which leads to a longer Approval Cycle Time



The more time a Team and Mgr have to spend on Validating a PO Invoice the more likely the PO Approval Cycle Time will increase



Solution -> A New SharePoint workflow form and process.

IMPROVE

New SharePoint Workflow = Efficiency



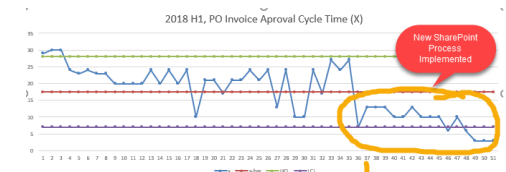
SQL 2.3



PO Invoice Accuracy Increase of **57%**

CONTROL

Control charts show a significant improvement in Approval Cycle Time starting at PO37, which was when the new SharePoint Workflow process was implemented



Ryan Timbrook

DMAIC

DEFINE



Gaps and Success

Performance Gaps



80% of PO invoices are **NOT approved** within discount threshold



69% of PO invoices **NEED correction** after submission



Managers average **3hrs to validate** a PO invoice and have reached **5hrs in some cases**

How we measure success



80% of PO invoices **ARE approved** within discount threshold



90% of PO invoices do **NOT need correction** after submission



Managers average **LESS THAN 1hr** to validate a PO invoice

******Our Customer:** Company X Procurement Intake Team

Define

Measure

Analyze

Improve

Control

Project Definitions & Terms

Defects

- A PO invoice not approved in the Ariaba procurement system within the discount threshold time
- A PO invoice needing correction after submission in Ariaba
- A Manager spending more than 2 hours validating and approving a PO invoice
- A Dev Team spending more than 3 hours validating and or correcting a PO invoice

SQL Definitions

- Unit: A Unit is a PO; 4 possible Defect Units have been identified per PO Invoice Submission
- Timeframe: Two week Sprint Cycle
- Units per Timeframe: 3 PO Invoices are created each Sprint Cycle based on the number of Sprint Teams managed by the sampled Dev Manager
- PO Approval Cycle Time: Refers to the time from when the Vendor submits a PO invoice till the time when the Manager approves the invoice in Ariaba

Corporate Measurement Goals

- PO Discount Threshold is **19 days**
- Manager PO Invoice 'Validation Time Spent' Threshold is **2 hours**
- Team PO Invoice 'Validation Time Spent' Threshold is **3 hours**
- **Less than 10%** of PO Invoices are rejected for needing corrections
- **80% or more** of PO Invoices are approved within the Discount Threshold

The **GOAL** is to **REMOVE WASTE**
This will **improve EFFICIENCY** and **PRODUCTIVITY**

Define

Measure

Analyze

Improve

Control

Data Collection Attributes

<u>Column Definitions</u>	
Sprint	Sprint squence name for the EIT department
Sprint Start Date	Sprints are in two week cycles starting wednesdays
Sprint End Date	Sprint cycle end date, every other Tuesday
Sprint Team	Name of the Sprint Team the PO is billed for
User Stories Count	Number of Rally User Stories complete for given sprint
Unique Project Count	Number of Unique Projects the User Stories align to
PO Line Item Count	Number of line items displayed on Arabia PO invoice
PO Submission Date	Date the PO was submitted by the Vendor
PO Approved Date	Date the PO was approved by Dev Manager of Sprint Team
Needed Correction	Flag specifing if the PO had errors and needed correction
PO Approval Cycle Time	Days between PO submission date and the Dev Manager approving the PO
PO Cycle Time	Total cycle time to complete the PO billing process. Starts 1 day post sprint end date
Within Disc Threshold	Flag indicator specifing if the PO cycle time was within the discount threshold of 15 biz days
Team Validation Meetings	Cumilative team time to conduct meetings to validate PO line item data
Mgr Validation Time	DevManager time to pull User Story data from Rally and validate it against PO line items
PO Est. Cost (\$)	Vendor estimated calculated cost based on Sprint Team Resources needed to deliver User Stories for Sprint
PO Act. Cost (\$)	Vendor actual calculated cost based on Sprint Team Resources needed to deliver User Stories for Sprint
PO Est. LOE (hrs)	Vendor calculated sum of estimated level of efforts to deliver each User Story for a Sprint
PO Act. LOE (hrs)	Vendor calculated sum of actual level of efforts to deliver each User Story for a Sprint

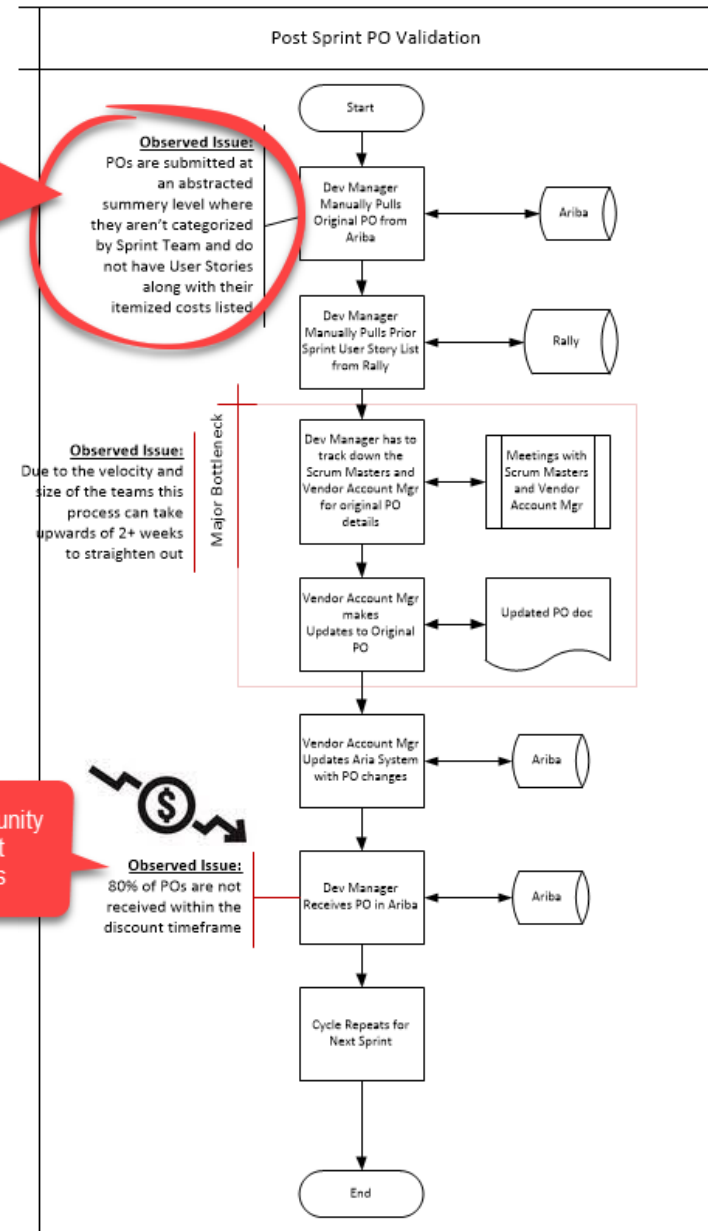


-Define-

The Business Problem:

- Only **20%** of Vendor supplied Sprint Teams Purchase Order (PO) **Invoices** are **being approved** within the discount **threshold of 19 days**.
- Not achieving this discount benchmark costs the company, on average, **\$5,911 in lost revenue** on **each PO invoice** it processes
- Managers and Teams spend **to much time** validating Sprint PO invoices for correctness. This time not only **costs in resource dollars**, it as well has **negative impacts** to the amount of software delivery work they can complete each Sprint Cycle, leading to a **decreased 'Time to Market' performance** measure

Major gap - invoices don't have details needed to validate in timely fashion



Define

Measure

Analyze

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Control

DMAIC

MEASURE



-Measure- Data Stratification Tree

Questions About Process

Does the PO invoice needing to be corrected indicate that the PO Invoice Approval Cycle time will exceed the discount threshold?

Does the number of different projects a Sprint team works on effect the approval cycle time?

Does the number of User Stories per Sprint have an effect on the correctness of the PO Invoices?

Does the number of Unique Projects per Sprint have an effect on the correctness of the PO Invoices?

Does the number of User Stories per Sprint have an effect on the time Managers spend validating a PO invoice?

Does the number of Unique Stories per Sprint have effect on the time Managers spend validating a PO invoice?

New PO Invoice
(Output Y)

Stratification factors

X Variables

PO Invoice Approval Cycle Time (days)
PO Invoice Needed Correction (Y/N)
Mgr PO Invoice Validation Time (hrs)
Team PO Invoice Validation Time (hrs)
PO Invoice User Story Count
PO Invoice Unique Project Count

Measurements

Count of Days between the 'PO Submission Date' and the 'PO Approved Date' minus 1 day
Indicator flag signifying if the PO invoice had to be sent back for correction
Hours recorded by the Manager
Hours recorded by the Team
Count of User Stories delivered for a given Sprint
Count of unique Projects that User Stories are aligned to as Project Deliverable Work

Sources of Records

PO Invoice Approval Cycle Time (days) >>> Ariaba Procurement System

PO Invoice Needed Correction (Y/N) >>> Ariaba Procurement System

Mgr PO Invoice Validation Time (hrs) >>> Clarity>Manager PO Invoice Approval & Validation Tasks

Team PO Invoice Validation Time (hrs) >>> Clarity>Team PO Invoice Validation Tasks

PO Invoice User Story Count >>> Rally>Delivery Team Sprint Project Repositories>Sprints Dashboard

PO Invoice Unique Project Count >>> Rally>Delivery Team Sprint Project Repositories>User Story>Project ID field

SQL Before

		H1-Q1 3 Sprints	H1-Q2 6 Sprints	H1-Total 12 Sprints
Defect opportunities per unit: D =	4	4	4	4
Units produced per timeframe: U =	36	9	18	36
Total possible defects per timeframe: D * U =	144			
Total actual defects in timeframe: A =	91	28	52	91
Defect-per-opportunity rate: A / DU = DPO =	0.63			
Defects per million opportunities (DPMO): DPO x 1,000,000 =	631,944			
SQL value =	1.1			

SQL Definitions

Unit: A Unit is a PO; 4 possible Defect Units have been identified per PO Invoice Submission

Timeframe: Two week Sprint Cycle

Units per timeframe: 3 PO Invoices are created each Sprint Cycle based on the number of Sprint Teams managed by one Dev Manager

Defects, H1 2018 (12 Sprints, 36 POs)	Counts
A PO Invoice needing correction after submission in Ariaba	25
A PO invoice not approved in Ariaba within discount threshold time	29
A Dev Manager spending more than 2 hours to validate and approve a PO invoice	24
A Dev Team spending more than 3 hours to validate and or correct a PO invoice	13
Total:	91

Define

Measure

Analyze

Improve

Control

-Measure- Data Collection

Existing data was manually pulled from the Ariaba Procurement System, Clarity CA PPM time tracking system and Rally and then entered into an Excel workbook for analysis

Data Collection

PRE-Process Improvement

Sample	PO ID	Sprint	Sprint Start Date	Sprint End Date	Sprint Team	PO Est. Cost (\$)	PO Est. LOE (hrs)	PO Act. Cost (\$)	PO Act. LOE (hrs)	Disc Opportunity (2%)	Disc Achieved (\$)	User Stories Count	Unique Project Count	PO Line Item Count	PO Submission Date	PO Approved Date	Needed Correction (Y/N)	PO Approval Cycle Time (days)	PO Cycle Time (days)	Within 15 biz day goal	Team Validation Meetings Time (hrs)	Mgr Validation Time (hrs)	Disc
1	PO1	EIT 1	3-Jan	23-Jan	Gamma Squad	\$43,383	292	\$44,422	299	\$8,884	\$0	10	2	2	23-Jan	28-Feb	Y	29	35	N	3.00	3.00	
2	PO2	EIT 1	3-Jan	23-Jan	Omega Squad	\$25,620	299	\$26,280	299	\$5,256	\$0	15	2	2	30-Jan	2-Mar	Y	30	37	N	4.00	4.00	
3	PO3	EIT 1	3-Jan	23-Jan	Theta Squad	\$41,418	333	\$42,735	406	\$8,547	\$0	8	2	2	30-Jan	2-Mar	Y	30	37	N	3.00	2.00	
4	PO4	EIT 2	24-Jan	6-Feb	Gamma Squad	\$53,522	385	\$50,307	353	\$10,061	\$0	14	3	3	12-Feb	3-Mar	Y	24	30	N	4.00	3.00	
5	PO5	EIT 2	24-Jan	6-Feb	Omega Squad	\$28,196	319	\$26,825	304	\$5,365	\$0	15	2	2	13-Feb	3-Mar	Y	23	30	N	4.00	3.00	
6	PO6	EIT 2	24-Jan	6-Feb	Theta Squad	\$45,320	400	\$45,887	405	\$3,177	\$0	6	4	4	9-Feb	6-Mar	Y	24	27	N	3.00	2.00	
7	PO7	EIT 3	7-Feb	20-Feb	Gamma Squad	\$55,285	426	\$45,452	346	\$9,090	\$0	15	3	3	27-Feb	23-Mar	Y	23	30	N	4.00	4.00	
8	PO8	EIT 3	7-Feb	20-Feb	Omega Squad	\$26,377	322	\$26,825	327	\$5,365	\$0	15	2	2	27-Feb	23-Mar	N	23	30	N	1.00	3.00	
9	PO9	EIT 3	7-Feb	20-Feb	Theta Squad	\$47,486	490	\$45,887	474	\$3,177	\$0	10	4	4	23-Feb	16-Mar	Y	20	23	N	1.00	3.00	
10	PO10	EIT 4	21-Feb	6-Mar	Gamma Squad	\$48,706	361	\$42,636	316	\$8,527	\$0	11	3	3	12-Mar	2-Apr	Y	20	26	N	3.00	3.00	
11	PO11	EIT 4	21-Feb	6-Mar	Omega Squad	\$36,480	397	\$30,185	329	\$6,037	\$0	11	2	2	12-Mar	2-Apr	Y	20	26	N	3.00	3.00	
12	PO12	EIT 4	21-Feb	6-Mar	Theta Squad	\$47,885	429	\$42,185	378	\$8,437	\$0	13	1	1	9-Mar	30-Mar	N	20	23	N	1.50	3.00	
13	PO13	EIT 5	7-Mar	20-Mar	Gamma Squad	\$46,004	317	\$48,017	331	\$9,603	\$0	8	2	2	23-Mar	17-Apr	Y	24	27	N	3.00	3.00	
14	PO14	EIT 5	7-Mar	20-Mar	Omega Squad	\$34,223	390	\$29,835	340	\$5,967	\$0	13	2	2	27-Mar	17-Apr	Y	20	27	N	4.00	4.00	
15	PO15	EIT 5	7-Mar	20-Mar	Theta Squad	\$42,389	407	\$38,745	372	\$7,749	\$0	8	1	1	23-Mar	17-Apr	Y	24	27	N	1.00	2.00	
16	PO16	EIT 6	21-Mar	3-Apr	Gamma Squad	\$52,955	306	\$45,631	281	\$9,126	\$0	9	4	4	6-Apr	27-Apr	Y	20	23	N	3.00	4.00	
17	PO17	EIT 6	21-Mar	3-Apr	Omega Squad	\$34,312	482	\$29,360	412	\$5,872	\$0	11	2	2	9-Apr	4-May	Y	24	30	N	4.00	4.00	
18	PO18	EIT 6	21-Mar	3-Apr	Theta Squad	\$40,790	263	\$37,915	244	\$7,583	\$7,583	6	1	1	6-Apr	17-Apr	N	10	13	Y	1.00	1.00	
19	PO19	EIT 7	4-Apr	17-Apr	Gamma Squad	\$48,697	294	\$46,973	256	\$9,395	\$0	10	5	5	23-Apr	15-May	Y	21	27	N	4.00	4.00	
20	PO20	EIT 7	4-Apr	17-Apr	Omega Squad	\$21,644	282	\$24,905	325	\$4,981	\$0	11	2	2	23-Apr	15-May	Y	21	27	N	4.00	4.00	
21	PO21	EIT 7	4-Apr	17-Apr	Theta Squad	\$36,031	297	\$34,272	283	\$6,854	\$6,854	5	1	1	20-Apr	8-May	N	17	20	Y	1.00	1.00	
22	PO22	EIT 8	18-Apr	1-May	Gamma Squad	\$49,496	304	\$49,220	302	\$9,844	\$0	10	3	3	7-May	29-May	Y	21	27	N	4.00	4.00	
23	PO23	EIT 8	18-Apr	1-May	Omega Squad	\$20,605	251	\$20,933	255	\$4,187	\$0	11	1	1	7-May	29-May	N	21	27	N	1.00	3.00	
24	PO24	EIT 8	18-Apr	1-May	Theta Squad	\$37,517	379	\$35,685	361	\$7,137	\$0	7	2	2	4-May	29-May	Y	24	27	N	1.00	2.00	
25	PO25	EIT 9	2-May	15-May	Gamma Squad	\$56,375	387	\$48,260	330	\$9,652	\$0	14	4	4	21-May	12-Jun	Y	21	27	N	4.00	5.00	
26	PO26	EIT 9	2-May	15-May	Omega Squad	\$24,739	286	\$19,150	221	\$3,830	\$0	10	1	1	18-May	12-Jun	N	24	27	N	1.00	3.00	
27	PO27	EIT 9	2-May	15-May	Theta Squad	\$28,811	177	\$30,439	187	\$6,088	\$6,088	5	2	2	18-May	1-Jun	N	13	16	Y	1.00	1.00	
28	PO28	EIT 10	16-May	29-May	Gamma Squad	\$54,053	445	\$48,260	402	\$9,852	\$0	15	4	4	4-Jun	29-Jun	Y	24	30	N	4.00	5.00	
29	PO29	EIT 10	16-May	29-May	Omega Squad	\$27,743	313	\$23,095	261	\$4,619	\$4,619	4	1	1	1-Jun	12-Jun	N	10	13	Y	1.00	2.00	
30	PO30	EIT 10	16-May	29-May	Theta Squad	\$51,507	305	\$32,002	190	\$6,400	\$6,400	5	2	2	1-Jun	12-Jun	N	10	13	Y	1.00	1.00	
31	PO31	EIT 11	30-May	12-Jun	Gamma Squad	\$44,116	326	\$43,956	324	\$8,791	\$0	15	4	4	18-Jun	13-Jul	Y	24	30	N	4.00	5.00	
32	PO32	EIT 11	30-May	12-Jun	Omega Squad	\$33,364	318	\$21,960	207	\$4,392	\$4,392	6	1	1	15-Jun	3-Jul	N	17	20	Y	1.00	2.00	
33	PO33	EIT 11	30-May	12-Jun	Theta Squad	\$37,863	264	\$34,995	244	\$6,999	\$0	6	2	2	15-Jun	13-Jul	Y	27	30	N	2.00	1.00	
34	PO34	EIT 11	30-May	12-Jun	Gamma Squad	\$49,583	345	\$42,597	297	\$8,519	\$0	9	3	3	2-Jul	27-Jul	Y	24	30	N	4.00	3.00	
35	PO35	EIT 11	30-May	12-Jun	Omega Squad	\$27,483	196	\$23,350	166	\$4,670	\$0	7	1	1	29-Jun	27-Jul	Y	27	30	N	2.00	3.00	
36	PO36	EIT 11	30-May	12-Jun	Theta Squad	\$37,263	366	\$37,779	371	\$7,556	\$7,556	8	1	1	29-Jun	7-Jul	N	7	10	Y	1.00	2.00	
Totals:						\$1,500,783	13185	\$1,370,138	12002	\$274,028	\$43,492						27			8	98.50	113.00	sum or count
						\$38,482	338	\$35,132	308	\$7,026	\$1,115	9.8	2.3	2.3			69.23%	21.0	25.7	20.5%	2.5	2.9	avg
						\$12,707	72	\$11,547	70		\$2,469	3.35	1.16	1.16				5.46	6.40		1.30	1.12	std dev
						\$56,375	313.00	\$50,307	307.40		\$7,583	11.00	4.00	4.00				23.00	27.00		3.00	4.00	range

36 samples were collected. The new PO process started the first of the year where prior data isn't comparable

Define

Measure

Analyze

Improve

Control

-Measure- Process Map

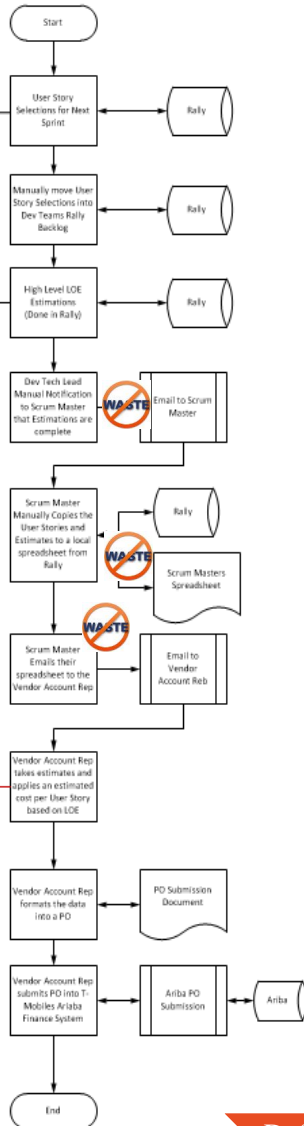
Sprint n-1

Start Process

Roles/People:
Product Owners
Scrum Masters
Dev Tech Lead

Roles/People:
Dev Tech Lead
Sprint Dev/Team
Scrum Masters

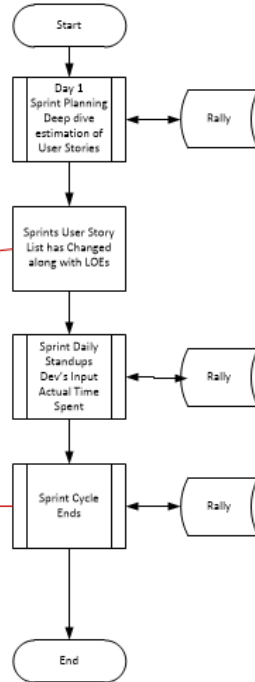
Observed Issues:
Due to the nature of Agile and User Stories high level detail along with the 3-day before Sprint Start submission deadline, this PO is typically inaccurate



Sprint n

Observed Issue:
PO submission is now out of sync with User Story list for this sprint along with estimates

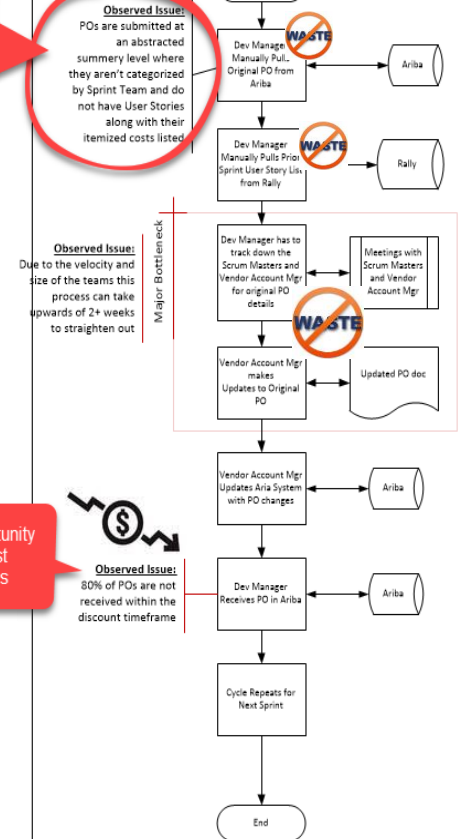
Observed Issue:
Final User Story List along with Actuals are recorded in Rally



Major gap - invoices don't have details needed to validate in timely fashion

Lost opportunity for cost savings

Post Sprint PO Validation



Observed Issue:
Due to the velocity and size of the teams this process can take upwards of 2+ weeks to straighten out

Major Bottleneck



Observed Issue:
80% of POs are not received within the discount timeframe

End Process

Define

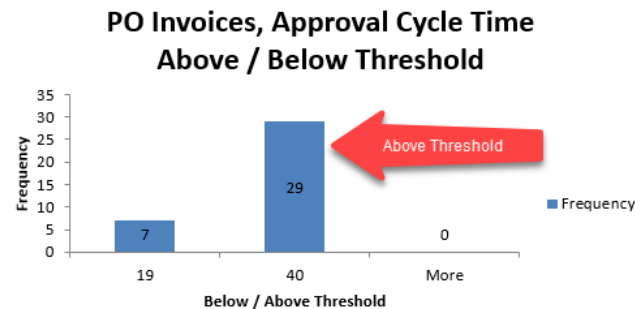
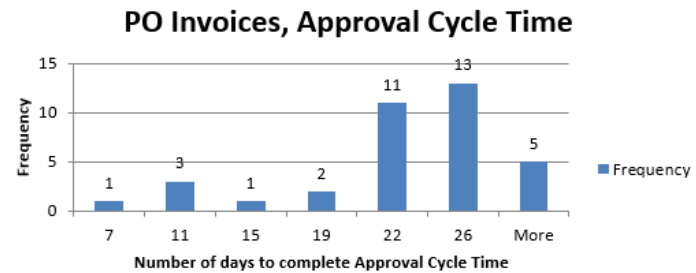
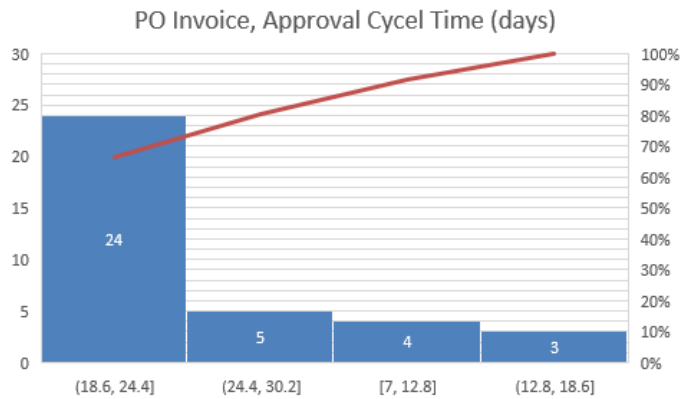
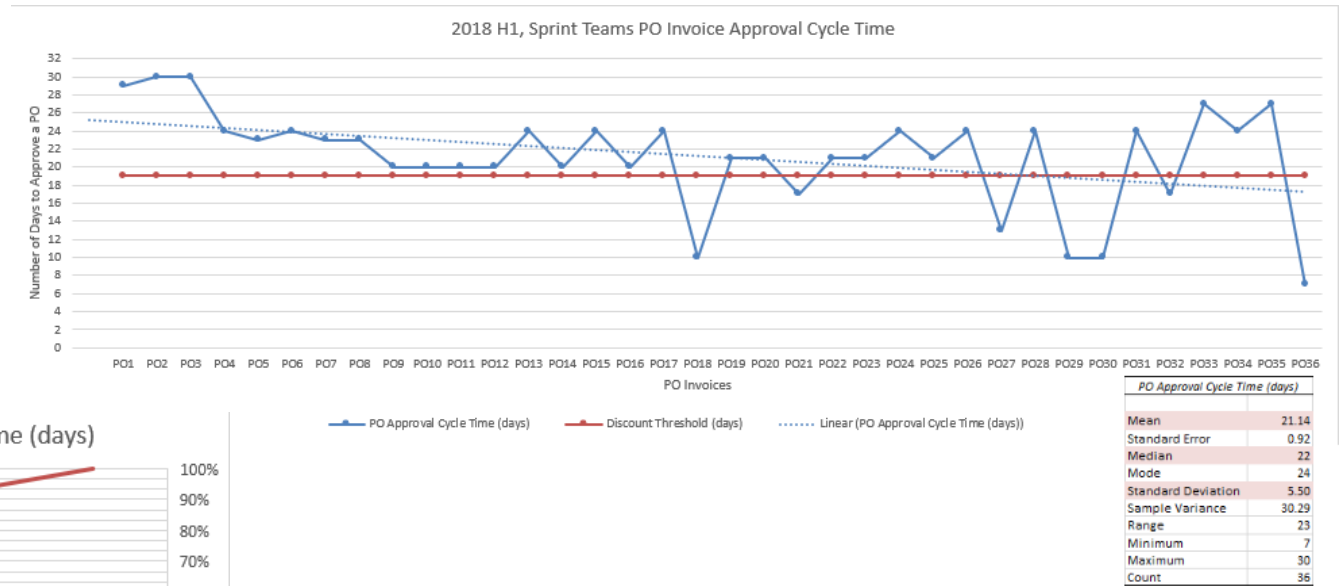
Measure

Analyze

Improve

Control

-Measure- PO Invoice Approval Cycle Time



Define

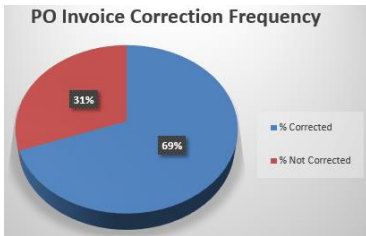
Measure

Analyze

Improve

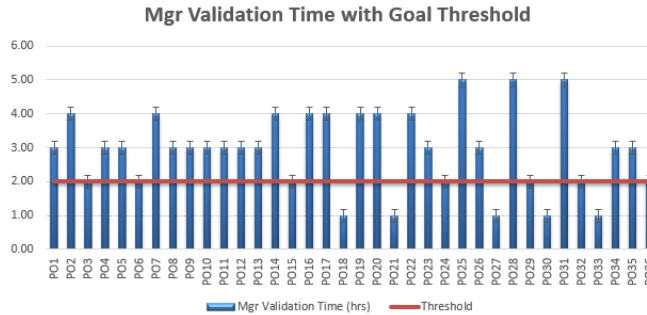
Control

PO Invoice Correction



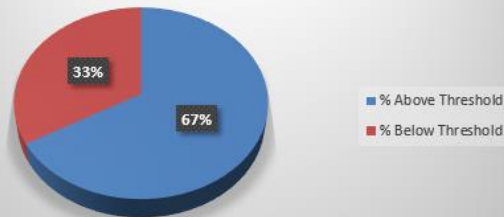
Yes Correction	No Correction	% Corrected	% Not Corrected
25	11	69.44%	30.56%

Mgr Validation Time

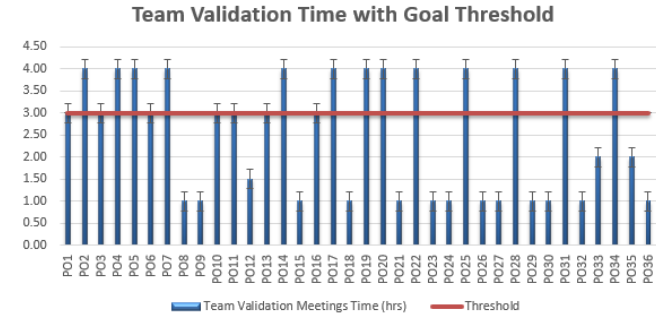


Mgr Validation Cycle Time	
Mean	2.9166667
Standard Error	0.1926218
Median	3
Standard Deviation	1.1557311
Sample Variance	1.3357143
Range	4
Minimum	1
Maximum	5
Count	36

Frequency that Managers are Validating PO Invoices within the 2hr Goal

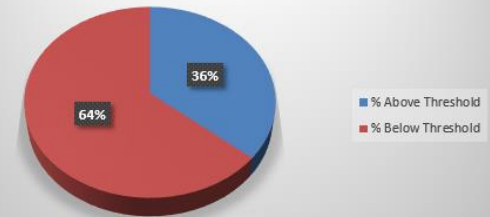


Team Validation Time



Team Validation Cycle Time	
Mean	2.5416667
Standard Error	0.2212653
Median	3
Mode	4
Standard Deviation	1.3275918
Sample Variance	1.7625
Range	3
Minimum	1
Maximum	4
Count	36

Frequency that Teams are Validating PO Invoices within 3hr Goal



Define

Measure

Analyze

Improve

Control

DMAIC

ANALYZE



-Analyze- PO Invoice Approval Cycle Time

Hypothesis Statements

PO Invoices not approved within discount threshold:

Is my average PO Approval process cycle time (avg = 21 days , std dev = 5.5) performing well versus goal (avg less than 19 days)?

Type of Data: Continuous

Sample Size: n = 36

Ho = PO Approval Process Cycle Time Avg is greater than 19 days = $\mu \geq 19$ days

Ha = PO Approval Process Cycle Time Avg is greater than 19 days = $\mu < 19$ days

We do not reject the null hypothesis, our PO Approval Process Cycle Time Avg is greater than the given threshold of 19 days

Test Statistic

One-Tail Test

Lower/left-tail

Sample Size = 36

Test Statistic:

$$Z = \frac{\bar{x} - \mu}{(s/\sqrt{n})} = \frac{(21-19)}{(5.5/6)} = 2 / .92 = \mathbf{2.17 = .9850}$$

$$p = \mathbf{0.838}$$

-Analyze-

Simple Linear Regression on PO Approval Cycle time output compared to User Stories Count

Hypothesis Statements

Number of User Stories vs. PO Invoice Approval Within Threshold:

-Is the number of User Stories for a given Sprint PO associated with PO invoices not being approved within our threshold time?

Sample Size: n = 36

Ho = PO Approval Cycle Time is not effected by the number of User Stories in the given PO Invoice

Ha = PO Approval Cycle Time is effected by the number of User Stories in the given PO Invoice

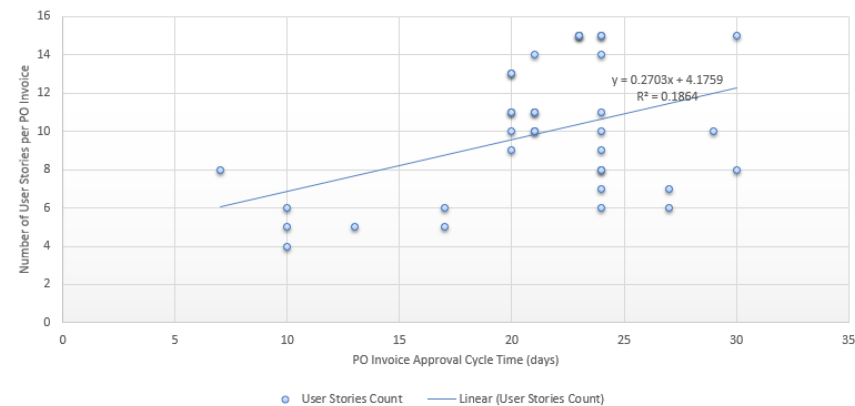
>>> p-value is lower than our confidence alpha of .05, we reject the Null Hypothesis

>>> PO Approval Cycle Time is effected by the number of Users Stories in the given PO Invoice. The linear trend line shows a positive increase.

Regression Statistics	
Multiple R	0.431696739
R Square	0.186362074
Adjusted R Square	0.162431547
Standard Error	5.0372285
Observations	36

	Coefficients	Standard Error	t Stat	P-value
Intercept	14.3197861	2.583767315	5.54221195	3.39047E-06
User Stories Count	0.689572193	0.247102481	2.79063241	0.008563959

2018 H1, PO Invoice User Story Count
Simple Linear Regression Analysis



Define

Measure

Analyze

Improve

Control

-Analyze-

Simple Linear Regression on PO Approval Cycle time output compared to Unique Project Count

Hypothesis Statements

Number of Unique Projects vs. PO Invoices Approval Within Threshold:

-Is the number of unique projects for a given Sprint PO Invoice associated with a higher than average PO Approval Cycle time?

Sample Size: n = 36

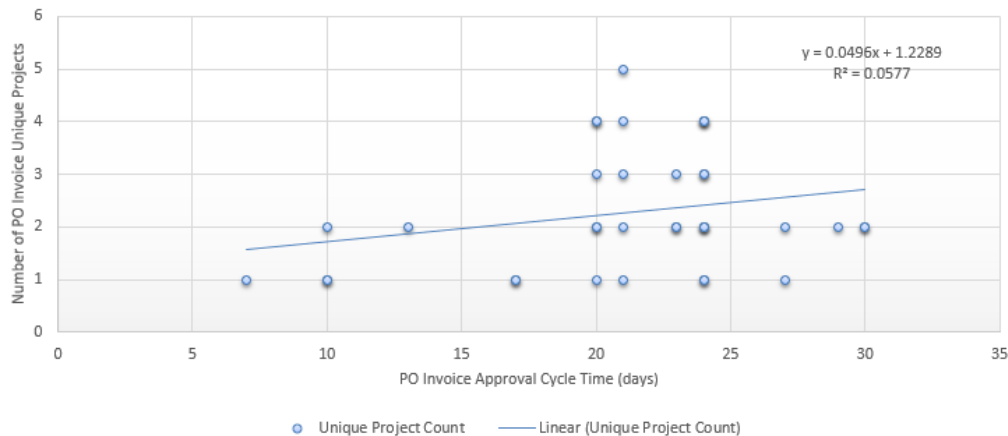
Ho = The number of Unique Projects for a given PO Invoice has no impact on the PO Approval Cycle Time

Ha = The number of Unique Projects for a given PO Invoice has an impact on the PO Approval Cycle Time

>>> p-value of 0.1581 is higher than our alpha of .05, we do not reject the Null Hypothesis

>>> Though the Linear Regression shows a slight increase trend our R squared, Coefficient of Determination is low representing a poor fit of our data to the regression line

2018 H1, PO Invoice Unique Project Count
Simple Linear Regression Analysis



Regression Statistics	
Multiple R	0.24026251
R Square	0.05772607
Adjusted R Square	0.03001213
Standard Error	5.42081576
Observations	36

	Coefficients	Standard Error	t Stat	P-value
Intercept	18.4889435	2.04635718	9.03505199	1.46732E-10
Unique Project Count	1.16339066	0.80609958	1.44323442	0.158105407

Define

Measure

Analyze

Improve

Control

-Analyze- PO Invoice Approval Cycle Time

Hypothesis Statements

PO Invoices not approved within discount threshold:

Is my average PO Approval process cycle time (avg = 21 days , std dev = 5.5) performing well versus goal (avg less than 19 days)?

Type of Data: Continuous

Sample Size: n = 36

Ho = PO Approval Process Cycle Time Avg is greater than 19 days = $\mu >= 19$ days

Ha = PO Approval Process Cycle Time Avg is greater than 19 days = $\mu < 19$ days

We do not reject the null hypothesis, our PO Approval Process Cycle Time Avg is greater than the given threshold of 19 days

Test Statistic

One-Tail Test

Lower/left-tail

Sample Size = 36

Test Statistic:

$$Z = \frac{\bar{x} - \mu}{(s/\sqrt{n})} = \frac{(21-19)}{(5.5/6)} = 2 / .92 = 2.17 = .9850$$

$$p = 0.838$$

Data Characteristics

>>> Is a Discrete Categorical attribute

>>> If group data into categories, can use chi-squared test for independence

>>> Calculate degrees of freedom (df)

$$df = (r-1) * (c-1) = (2-1) * (3-1) = 1 * 2 = 2$$

$$df = 2$$

Actual (observed) Frequencies					Expected Frequencies				
PO Invoice User Story Count Groupings					PO Invoice User Story Count Groupings				
Needed Correction (Y/N)	Low 1-5	Med 6-10	High 11-15	Total	Needed Correction (Y/N)	Low 1-5	Med 6-10	High 11-15	Total
No	4	4	3	11	No	1.22	4.89	4.89	11.00
Yes	0	12	13	25	Yes	2.78	11.11	11.11	25.00
Total	4	16	16	36	Total	4.00	16.00	16.00	36.00
					p-value: 0.005587				

-Analyze- User Story Count on PO Invoice Correction

Hypothesis Statements

Number of User Stories vs. PO Invoice Needing Correction:

-Is the number of Users Stories for a given Sprint PO Invoice associated with PO Invoices needing correction?

Type of Data: Categorical

Sample Size: n = 36

Ho = PO Invoice User Story Count and PO Invoices needing correction are independent (no relationship)

Ha = PO Invoice User Story Count and PO Invoices needing correction are not independent (is a relationship)

>>> p-value = 0.005587

>>> p is low, Ho must go. Reject Null Hypothesis

>>> There is a relationship between the Number of User Stories and PO Invoice needing correction

Data Characteristics

>>> Is a Discrete Categorical attribute

>>> If group data into categories, can use chi-squared test for independence

>>> Calculate degrees of freedom (df)

$$df = (r-1) * (c-1) = (2-1) * (3-1) = 1 * 2 = 2$$

$$df = 2$$

Actual (observed) Frequencies					Expected Frequencies				
PO Invoice Unique Pri Count Groupings					PO Invoice Unique Pri Count Groupings				
Needed Correction (Y/N)	Low 1-2	Med 3-4	High 5-6	Total	Needed Correction (Y/N)	Low 1-2	Med 3-4	High 5-6	Total
No	11	0	0	11	No	7.33	3.36	0.31	11.00
Yes	13	11	1	25	Yes	16.67	7.64	0.69	25.00
Total	24	11	1	36	Total	24.00	11.00	1.00	36.00
					p-value: 0.019063				

-Analyze- Unique Project Count on PO Invoice Correction

Hypothesis Statements

Number of Unique Projects vs. PO Invoices Needing Correction:

-Is the number or unique projects for a given Sprint PO Invoice associated with PO Invoices needing to be corrected?

Type of Data: Categorical

Sample Size: n = 36

Ho = PO Invoice Unique Project Count and PO Invoices needing correction are independent (no relationship)

Ha = PO Invoice Unique Project Count and PO Invoices needing correction are not independent (is a relationship)

>>> p-value = 0.019063

>>> alpha (confidence level) = .05

>>> p-value (0.019063) is less than alpha (0.05), we reject the Null Hypothesis that these factors are independent.

>>> PO Invoice Unique Project Count and PO Invoices needing correction are NOT independent

Define

Measure

Analyze

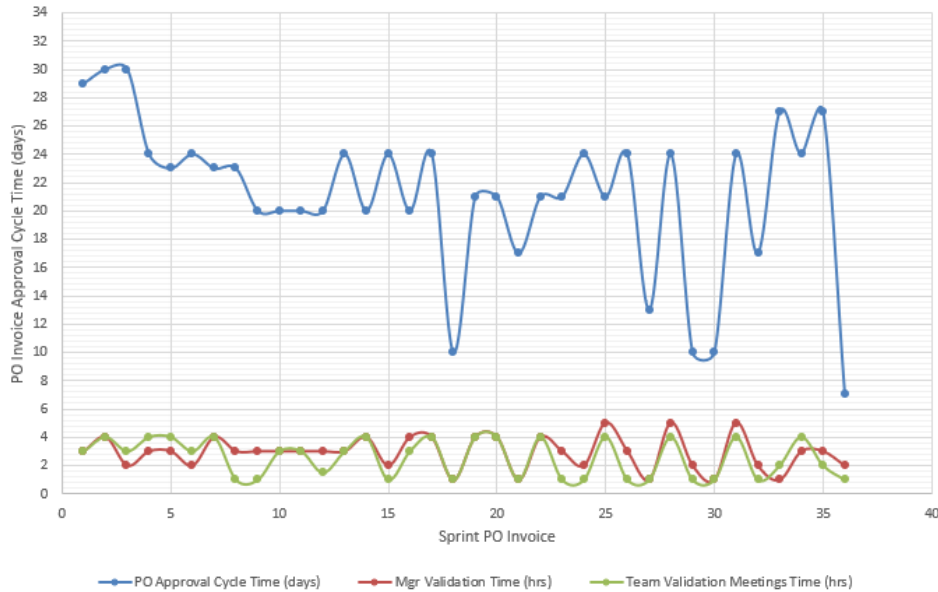
Improve

Control

-Analyze-

Correlation Analysis of PO Approval Cycle Time with Mgr Validation Time and Team Validation Time

2018 H1, PO Invoice Cycle Times



Correlation Analysis

	PO Approval Cycle Time (days)	Mgr Validation Time (hrs)	Team Validation Meetings Time (hrs)
PO Approval Cycle Time (days)	1		
Mgr Validation Time (hrs)	0.410600104	1	
Team Validation Meetings Time (hrs)	0.487945685	0.73787005	1

PO Approval Cycle Time (Y) / Mgr Validation Cycle Time (X)

SUMMARY OUTPUT

Regression Statistics

Multiple R	0.410600104
R Square	0.168592446 <<
Adjusted R Square	0.144139282
Standard Error	5.09193725
Observations	36

	Coefficients
Intercept	15.43553179
slope>> X Variable 1	1.95543672

PO Approval Cycle Time (Y) / Team Validation Cycle Time (X)

SUMMARY OUTPUT

Regression Statistics

Multiple R	0.487945685
R Square	0.238090991
Adjusted R Square	0.215681903
Standard Error	4.874472384
Observations	36

	Coefficients
Intercept	15.99718564
slope>> X Variable 1	2.022965214

Define

Measure

Analyze

Improve

Control

DMAIC

IMPROVE



-Improve-

New SharePoint Workflow and Data Input Form

This form represents all of the attributes and data elements which need to be collected for a timely validation of Purchase Orders submitted by the Vendor.

Prior to this new process, all of this data had to be manually tracked down by the Dev Manager before approving a PO in the Ariba Procurement System.

Title <input type="text" value="Prokarma-EIT Sprint 15-Voice Portal_Gamma Squad"/>				Vendor Name <input type="text" value="Prokarma"/>				
*This field is auto populated as follows: {VendorName} {BillingSprint} {DeliveryTeam} {SprintTeam}								
Billing Year	<input type="text" value="2018"/>	Billing Quarter	<input type="text" value="Q3"/>	Billing Date	<input type="text" value="8/6/2018"/>	Requester Email	<input type="text"/>	
				*Add email addresses for those who need to be notified of workflow progress. Semicolon delimited.				
Billing Sprint	<input type="text" value="EIT Sprint 15"/>							
	<input type="text" value="07-25"/>	<input type="text" value="08-07"/>						
Org	<input type="text" value="Frontline Care"/>	Delivery Team	<input type="text" value="Voice Portal"/>	Sprint Team	<input type="text" value="Gamma Squad"/>			
Project Cost Code	Project Ref Id	Billing Code (SAP or GL)	Rally User Story ID	Rally User Story Name	Est LOE (Hrs.)	Act LOE (Hrs.)	Est Cost (\$)	Act Cost (\$)
		*N Codes List						
CapEx	PR208850	N-002554-01	US375849	[Dev][Build][Execute][ConvoUX] Bug Fix, Integration Testing ...	45	45	\$15,778.07	\$15,778.06
CapEx	PR209708	N-002768-01	US376372	[TA][ADD][PLAN][Design]: Digital Payments Enhancement - ...	59	8	\$19,738.81	\$2,676.45
CapEx	PR208850	N-002554-01	US374566	[Dev][Build][Execute]VUI: API: Automate checkDMAndNDNT...	21	21	\$7,363.1	\$7,363.1
CapEx	PR209708	N-002768-01	US374571	[Dev][RDB][Execute] Deployment support for U2 prepaid app...	11	7.5	\$3,680.12	\$2,509.17
CapEx	PR209708	N-002768-01	US374575	[Dev][RDB][Execute] Deployment support for Postpaid applic...	4	4	\$1,338.22	\$1,338.22
CapEx	PR209708	N-002768-01	US374565	[SDET] [TEST][EXECUTE] U2 Prepaid: Pending Feature issue	0	27	\$0	\$9,033.02
CapEx	PR209708	N-002768-01	US375940	[DEV] [BUILD][EXECUTE] PDP Simplification	53	35.5	\$17,731.48	\$11,876.76
CapEx	PR209708	N-002768-01	US376366	[TA & SME][TEST & PM][EXECUTE] U2 Prepaid Ph. 2 CR726.1 ...	3	4	\$1,003.67	\$1,338.22
					0	0	\$0	\$0
					0	0	\$0	\$0
					0	0	\$0	\$0
					0	0	\$0	\$0
					0	0	\$0	\$0
					0	0	\$0	\$0
					0	0	\$0	\$0
					0	0	\$0	\$0
Comments:								
Est PO Cost (\$)		<input type="text" value="\$66,633.47"/>			Total Est LOE (Hrs.)		<input type="text" value="196"/>	
		*Add total estimated cost of PO						
Act PO Cost (\$)		<input type="text" value="\$51,913"/>			Total Act LOE (Hrs.)		<input type="text" value="152"/>	
		*Add total actual cost of PO						
Total Adjusted Cost (\$)		<input type="text" value="-14720"/>			Total Adjusted LOE (Hrs.)		<input type="text" value="-44"/>	

Define

Measure

Analyze

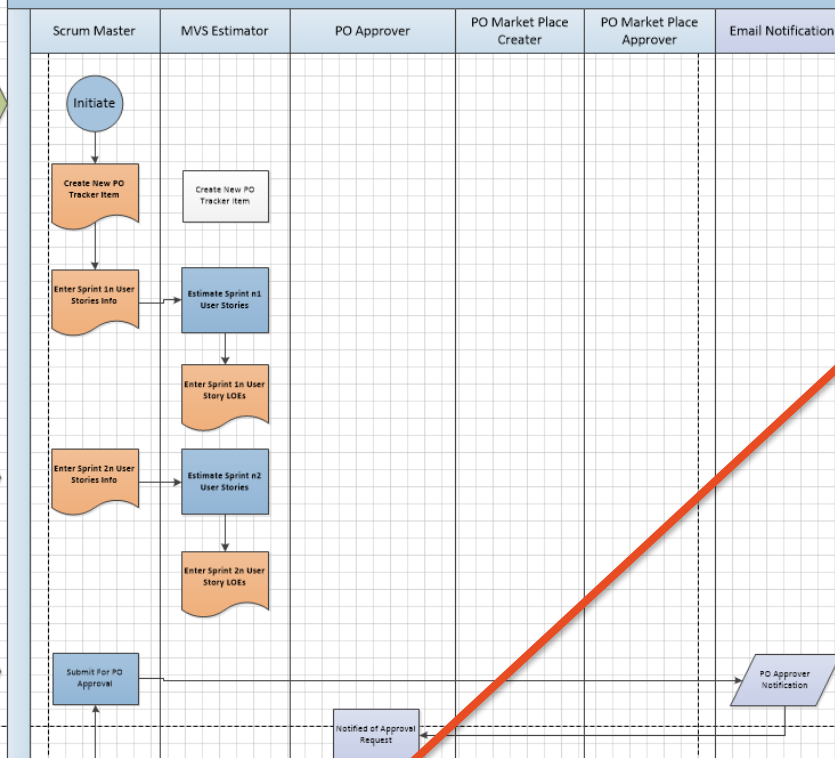
Improve

Control

-Improve- New Process Flow

PO Tracker - MVS

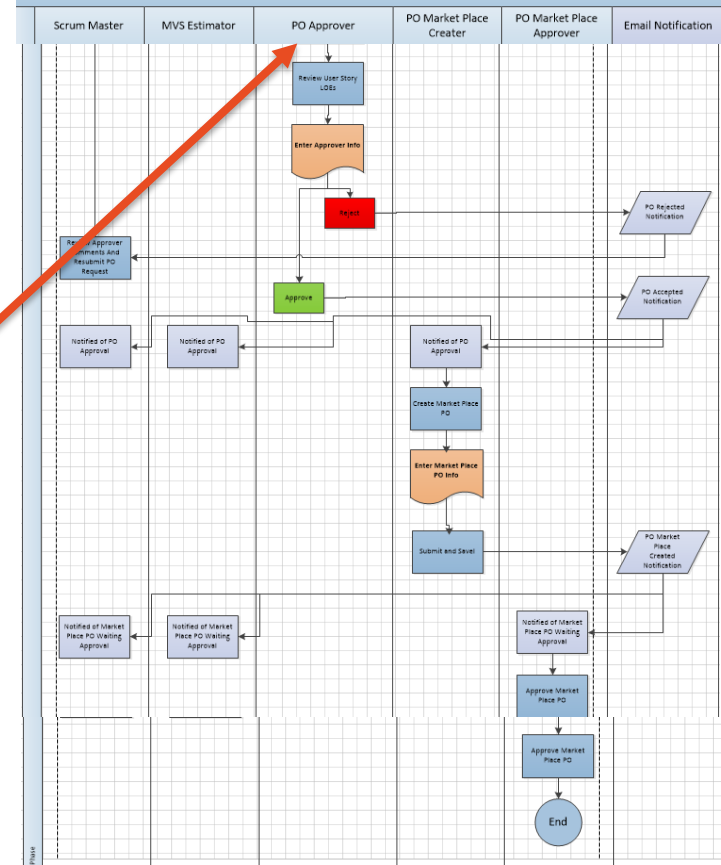
Role / Actor Actions



Flow continues with the PO Approver in the next image

PO Tracker - MVS

Role / Actor Actions



Define

Measure

Analyze

Improve

Control

-Improve- New SharePoint Workflow Pilot

After completing the new SharePoint workflow form and process map a pilot was ran for **5 Sprint Cycles** which yielded the collection of **15 sample PO Invoices** to be processed through the new SharePoint workflow process.

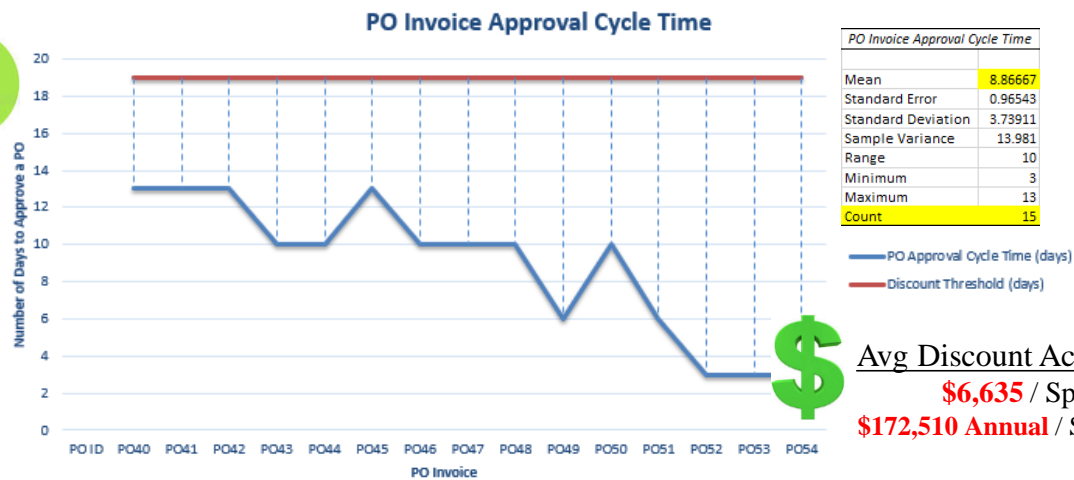
Discount Achieved Opportunity

Before: Discount Achieved = \$43,492 (avg, \$1,115) -> \$28,990 Annual per Sprint Team

After: Discount Achieved = \$89,203 (avg, **\$6,635**) -> **\$172,510 Annual** per Sprint Team

A **5.95x** increase in potential discount savings

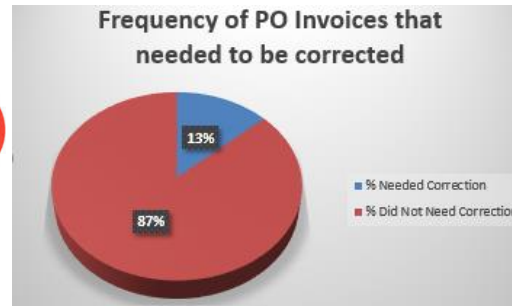
- Observed decrease in Mgr Validation Time of 2.05 hrs
- Increase of 70% cycle time efficiency
- \$7,540 Annual Mgr Resource Cost Savings



Avg Discount Achieved

\$6,635 / Sprint

\$172,510 Annual / Sprint Team

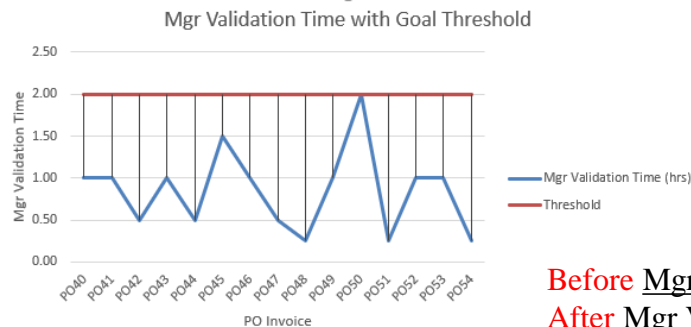


Goal was 90% accuracy on PO Invoice Correctness

Before Accuracy Rate: 30%

After Accuracy Rate: 87%

Increase of 57%



Mgr Validation Time (hrs)	
Mean	0.85
Standard Error	0.126302735
Standard Deviation	0.489168391
Sample Variance	0.239285714
Range	1.75
Minimum	0.25
Maximum	2
Count	15

Before Mgr Validation Time Avg: 2.9 hrs

After Mgr Validation Time Avg : 0.85 hrs

Define

Measure

Analyze

Improve

Control

-Improve- Data Collection

POST-Process Improvement																				*Within 15 biz day goal	*3 Resources	*1 Resources	
Sample		Sprint	Sprint Start Date	Sprint End Date	Sprint Team Count	PO Est. Cost (\$)	PO Est. LOE (hrs)	PO Act. Cost (\$)	PO Act. LOE (hrs)	Disc Opportunity (2%)	Disc Achieved (\$)	User Stories Count	Unique Project Count	PO Line Item Count	PO Submission Date	PO Approved Date	Needed Correction (Y/N)	PO Approval Cycle Time (days)	PO Cycle Time (days)	Within Disc Threshold (Y/N)	Team Validation Meetings Time (hrs)	Mgr Validation Time (hrs)	
1	PO40	EIT 14	11-Jul	24-Jul	Gamma Squad	\$41,685	164	\$39,038	153	\$7,808	\$7,808	11	2	2	27-Jul	10-Aug	N	13	16	Y	2.00	1.00	
2	PO41	EIT 14	11-Jul	24-Jul	Omega Squad	\$16,596	294	\$12,560	223	\$2,512	\$2,512	10	1	1	27-Jul	10-Aug	N	13	16	Y	0.00	1.00	
3	PO42	EIT 14	11-Jul	24-Jul	Theta Squad	\$41,195	347	\$35,022	295	\$7,004	\$7,004	8	1	1	27-Jul	10-Aug	N	13	16	Y	0.00	0.50	
4	PO43	EIT 15	25-Jul	7-Aug	Gamma Squad	\$66,633	196	\$51,913	152	\$10,383	\$10,383	8	2	2	10-Aug	21-Aug	N	10	13	Y	2.00	1.00	
5	PO44	EIT 15	25-Jul	7-Aug	Omega Squad	\$15,387	361	\$15,430	362	\$3,086	\$3,086	6	1	1	10-Aug	21-Aug	N	10	13	Y	0.00	0.50	
6	PO45	EIT 15	25-Jul	7-Aug	Theta Squad	\$35,834	310	\$30,680	268	\$6,136	\$6,136	8	2	2	10-Aug	24-Aug	Y	13	16	Y	2.00	1.50	
7	PO46	EIT 16	8-Aug	21-Aug	Gamma Squad	\$27,689	156	\$27,423	151	\$5,485	\$5,485	7	3	3	24-Aug	4-Sep	N	10	13	Y	1.00	1.00	
8	PO47	EIT 16	8-Aug	21-Aug	Omega Squad	\$27,749	341	\$36,287	411	\$7,257	\$7,257	8	1	1	24-Aug	4-Sep	N	10	13	Y	0.00	0.50	
9	PO48	EIT 16	8-Aug	21-Aug	Theta Squad	\$32,598	201	\$26,823	159	\$5,365	\$5,365	4	1	1	24-Aug	4-Sep	N	10	13	Y	0.00	0.25	
10	PO49	EIT 17	22-Aug	4-Sep	Gamma Squad	\$49,598	169	\$49,220	182	\$9,844	\$9,844	9	2	2	7-Sep	14-Sep	N	6	9	Y	2.00	1.00	
11	PO50	EIT 17	22-Aug	4-Sep	Omega Squad	\$13,268	341	\$20,933	411	\$4,187	\$4,187	10	1	1	7-Sep	18-Sep	Y	10	13	Y	3.00	2.00	
12	PO51	EIT17	22-Aug	4-Sep	Theta Squad	\$32,598	201	\$35,685	159	\$7,137	\$7,137	4	1	1	7-Sep	14-Sep	N	6	9	Y	0.00	0.25	
13	PO52	EIT 18	5-Sep	18-Sep	Gamma Squad	\$46,004	250	\$48,017	257	\$9,603	\$9,603	10	3	3	21-Sep	25-Sep	N	3	6	Y	1.00	1.00	
14	PO53	EIT 18	5-Sep	18-Sep	Omega Squad	\$34,223	617	\$29,835	352	\$5,967	\$5,967	15	1	1	21-Sep	25-Sep	N	3	6	Y	1.00	1.00	
15	PO54	EIT18	5-Sep	18-Sep	Theta Squad	\$42,389	476	\$38,745	178	\$7,749	\$7,749	4	1	1	21-Sep	25-Sep	N	3	6	Y	0.00	0.25	
Totals:						\$523,447	4422	\$497,611	3712	\$99,522	\$89,203	122	8	2			2			15		0.85	total or count
avg						\$34,896	295	\$33,174	247	\$6,635	\$6,635	8	2	2			13.33%	8.9	11.9	100.00%	0.93	0.84	avg
std dev						\$14,109	128.17	\$11,632	97.52	\$2,326	\$2,326	2.97	0.74	0.74				3.74	3.74		1.03	0.49	std dev
range						\$53,366	461.50	\$39,353	260.00	\$7,871	\$7,871	11.00	2.00	2.00				10.00	10.00		3.00	1.75	range
Accuracy Rate:																		86.67%					

SQL After

Defect opportunities per unit: D =	4
Units produced per timeframe: U =	5
Total possible defects per timeframe: D * U =	20
Total actual defects in timeframe: A =	4
Defect-per-opportunity rate: A / DU = DPO =	0.2
Defects per million opportunities (DPMO): DPO x 1,000,000 =	200,000.00
SQL value =	2.3

H2-Q1

SQL Definitions

Unit: A Unit is a PO; 4 possible Defect Units have been identified per PO Invoice Submission

Timeframe: Two week Sprint Cycle

Units per timeframe: 3 PO Invoices are created each Sprint Cycle based on the number of Sprint Teams managed by one Dev Manager

Defects, H2:Q2 2018 (5 Sprints, 15 POs)

Defects, H2:Q2 2018 (5 Sprints, 15 POs)	Counts
A PO invoice needing correction after submission in Ariaba	2
A PO invoice not approved in Ariaba within discount threshold time	0
A Dev Manager spending more than 1 hours to validate and approve a PO invoice	2
A Dev Team spending more than 3 hours to validate and or correct a PO invoice	0
Total:	4



SQL
2.3

Define

Measure

Analyze

Improve

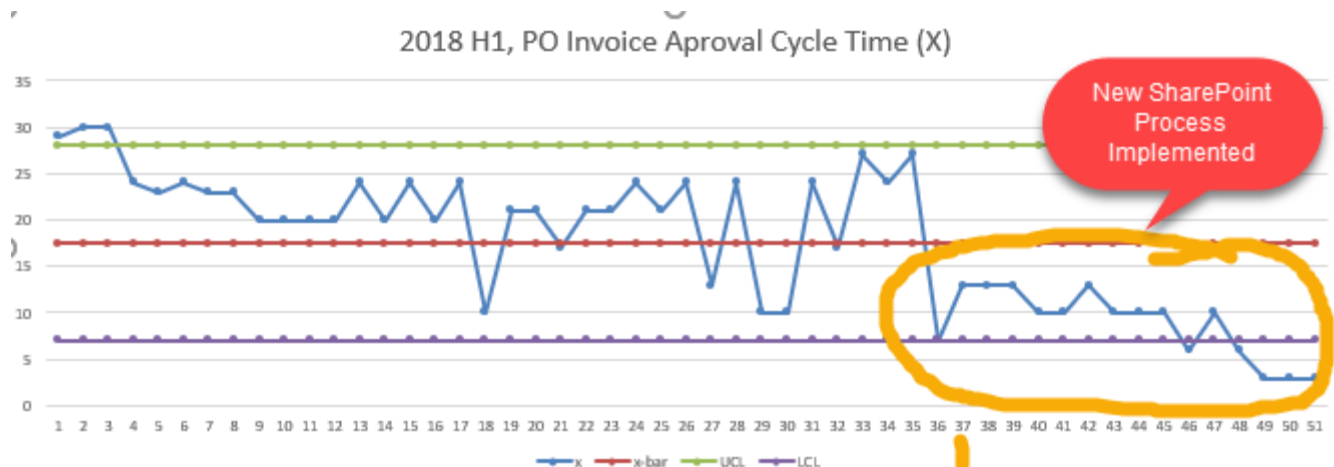
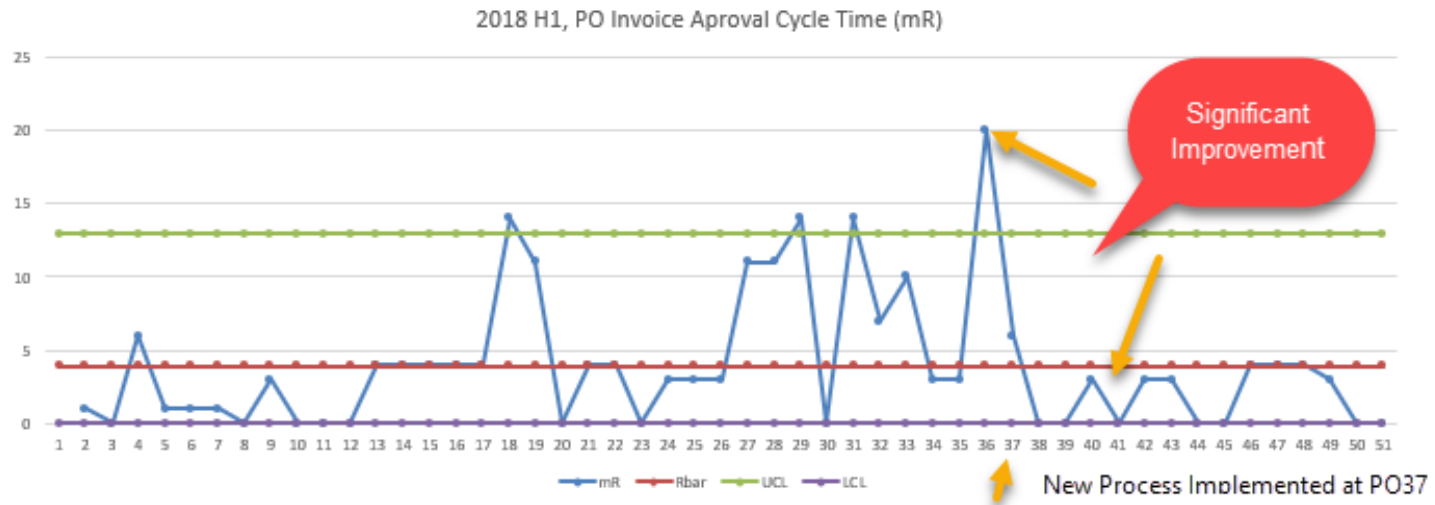
Control

DMAIC

CONTROL



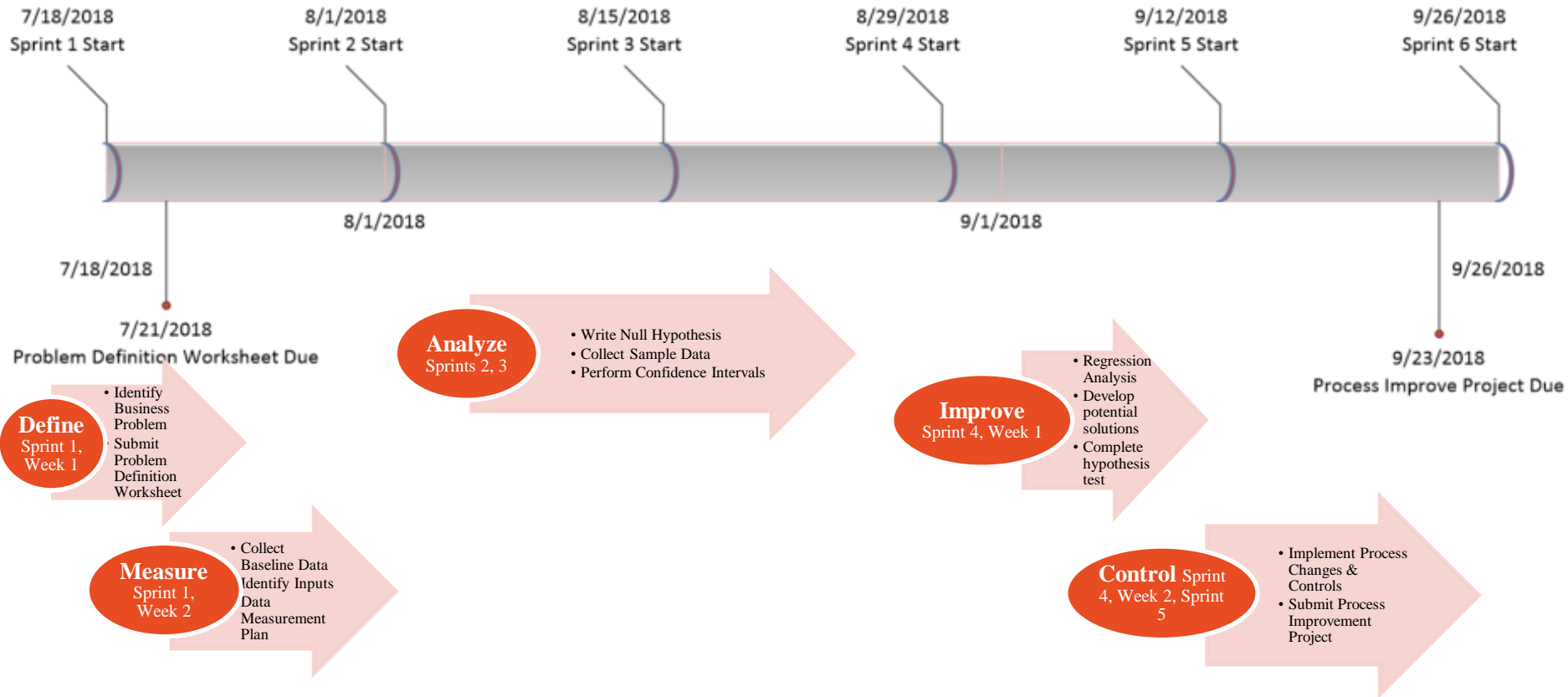
-Control- PO Invoice Approval Cycle Time



Delivery Timeline; Example Ariaba PO Invoice

APPENDIX

Delivery Timeline



Sprint 1:

- Week 1: 7/18 – 7/24
- Week 2: 7/25 – 7/31

Sprint 2:

- Week 3: 8/1 – 8/7
- Week 4: 8/8 – 8/14

Sprint 3:

- Week 5: 8/15 – 8/21
- Week 6: 8/22 – 8/28

Sprint 4:

- Week 7: 8/29 – 9/4
- Week 8: 9/5 – 9/11

Sprint 5:

- Week 9: 9/12 – 9/18
- Week 10: 9/19 – 9/25

Sprint 6:

- Week 11: 9/26 – 10/2

7/18

Sprint 1 Start

7/21

Problem Definition Worksheet Due

Identify Inputs

Data measurement/collection Plan

Collect baseline data

Calculate SQL

8/1

Sprint 2 Start

Write Null Hypothesis

Conduct Hypothesis Testing

8/15

Sprint 3 Start

Collect Sample Data

Perform confidence Interval Analysis

8/29

Sprint 4 Start

Regression Analysis

Develop potential solutions

Complete hypothesis test

9/12

Sprint 5 Start

Implement Process Changes & Controls

9/26

Project Due Date

Example Ariaba PO Invoice

This example of a PO submitted by the Vendor is intended to highlight the limited data available to the Dev Manager to be able to accurately validate if the quantity and amount being billed is representative of the work delivered by this Vendor.

Prior to our new SharePoint input form and workflow process the validation of these material line items was very timely and often times incomplete due to work demands.

PO invoice must reference the PO# and line item number						
Item	Material	Del. Date	Quantity	UM	Unit Price (in USD)	Amount (in USD)
1	Gamma - PR208850 - U2 Postpaid - Rebelli	06/30/2018	16,440.80	EA	1.00	16,440.80
2	Gamma - PR208850 - U2 Prepaid Ph 2 - Re	06/30/2018	20,418.98	EA	1.00	20,418.98
3	Gamma - Opex - 1003440 - PR207136 - Ope	06/30/2018	1,182.70	EA	1.00	1,182.70
4	Gamma - PR209788 - Haw	06/30/2018	3,548.11	EA	1.00	3,548.11
5	Gamma - PR209078- Cob	06/30/2018	2,365.41	EA	1.00	2,365.41
6	Omega - PR208850- U2 Postpaid - Rebellio	06/30/2018	21,960.00	EA	1.00	21,960.00
7		06/30/2018	28,971.27	EA	1.00	28,971.27