

Supply chain analytics

An overview of advanced analytics solutions addressing fraud, waste, and abuse

March 6, 2019

What's driving the digital change for supply chain management?

Four big trends are driving the adoption of new approaches to supply chain analytics. Taken together, they underscore an unforgiving demand for improved performance



DATA VOLUME

Companies are drowning in data. How can they make it meaningful?

Global data volumes continue to grow exponentially. Today's analytical computing capacity and analytical tools are designed to meet the challenge.



REGULATIONS

The world isn't getting any simpler. How can analytics help navigate the complexity?

Regulators are demanding deeper insight into risk and exposure from financial, energy & resources, health care, and many other sectors requiring integrated data across the enterprise.



COST REDUCTION

You have a big, bold vision. How can analytics make it a reality?

The need to remain competitive compels investments in analytics infrastructure and tools as well as the adoption of new approaches to help solve forensic issues. The goal? More informed and responsive decisions at a fraction of the cost.



HIDDEN INSIGHT/NEW SIGNALS

Perpetrators are smart and often one step ahead of traditional fraud schemes. How can analytics help identify the unknown?

The growing complexity of global business has raised the stakes at all levels of decision-making. Facing more information than humans can possibly process, decision makers need more powerful tools for uncovering hidden patterns that may go undetected.

Sample analytics focus areas

Below is a sample listing, which just scratches the surface, of potential areas and risk scenarios where advanced analytics can be leveraged



Fraud & corruption



In an attempt to evade sanctions or expedite services, government officials can be bribed via inappropriate payments, gifts, political donations by employees leading to *bribery violations*. The bribes can be routed indirectly via third-party means such as contractors, marketing, promotions, etc.



Maintenance & health and safety



Organizations have to deal with the increasing complexity of maintenance requirements which are essential to optimize asset performance and longevity as well as keeping resources safe.



Third-party due diligence



Vendor due diligence is imperative to identify potential shell company schemes where a fake entity is established by a dishonest employee to bill goods or services that the company does not receive.



Contract bidding



Company personnel can manipulate the bidding process by providing confidential information to prospective bidders. Also, groups of bidders can secretly agree to submit complementary high bids to allow pre-selected contractors to win.

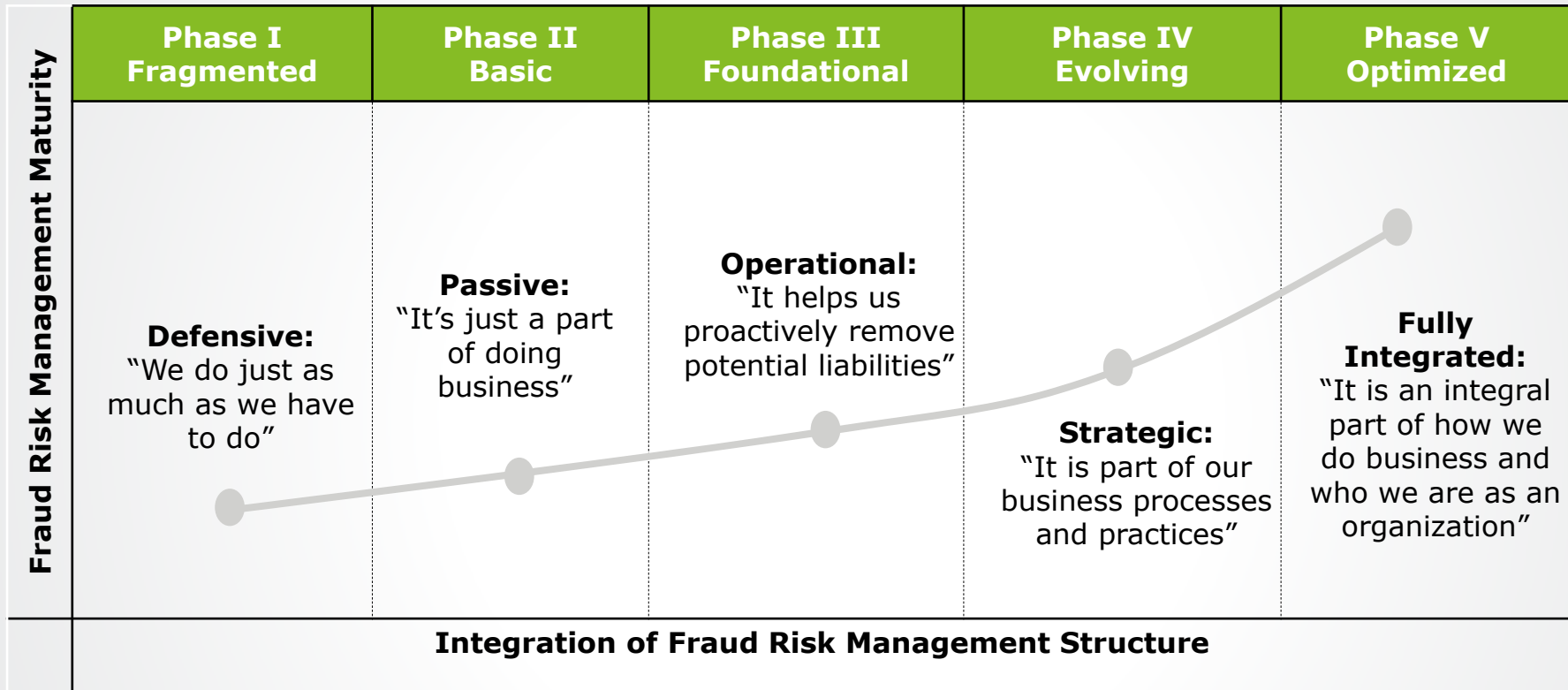


Regulatory Compliance



Compliance with an ever-changing regulatory environment creates risks of financial penalties, reputational damage, and operational stoppages. From specific industry regulation to Sarbanes-Oxley (SOX), companies need to stay ahead of the requirements.

Illustrative fraud risk management maturity model



Fraud & compliance analytics – sample areas of focus

The areas of focus below represent a sample set for fraud & compliance analytics

Areas of focus	Risk scenarios
Employees & vendors validation	<ul style="list-style-type: none">• Conflict of interests• Ghost entities
Procure to Pay – (Supply chain)	<ul style="list-style-type: none">• Collusion (Employee – Vendors)• Anomalous purchases• Unusual price increases
Accounts payables	<ul style="list-style-type: none">• Duplicate payments• Split payments• Overpayments
Time & expenses	<ul style="list-style-type: none">• Inappropriate expenses• Policy violations• High-risk spend patterns
Payroll & P-Cards	<ul style="list-style-type: none">• Excessive overtime hours• Policy violations for P-Card transactions• Duplicate transactions between P-Cards and accounts payable
Warehouse & inventory	<ul style="list-style-type: none">• Cycle count analysis• Inventory theft• Write-off trend analysis
Contract compliance	<ul style="list-style-type: none">• Overruns analysis• Labor craft code analysis• Pricing discrepancies• Budget vs. actual analysis

Supply chain analytics

*Use cases – fraud
detection/prevention*

Overview of buyer "A" fraud scenario

A company in the Energy and Resources industry was victimized by procurement fraud in its supply chain. This wasn't the first time and leadership wondered if they could be doing more.

Buyer "A" Case

A senior buyer was colluding with vendors in return for purchasing materials at extremely high prices. The buyer received a high-end luxury car, an all expense paid vacation, personal parties, etc.

An internal investigation was conducted and it was determined that the buyer was benefiting from a personal relationship with the vendor

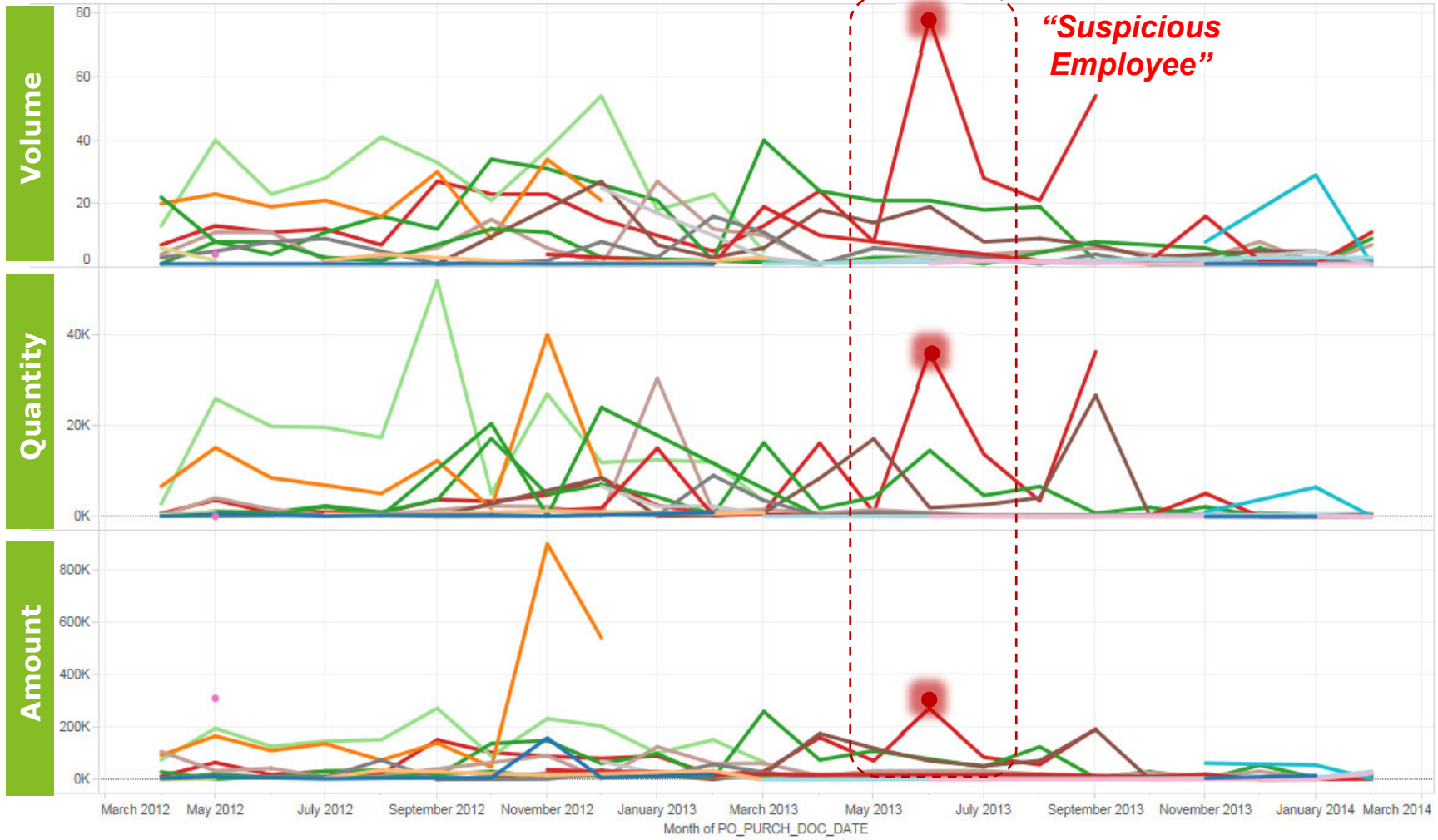
The buyer was terminated but not before defrauding the company for more than \$1.5 million

Management was concerned that this was not identified sooner and was concerned that similar type issues may still be ongoing.

Enterprise data scan and trend analysis

Initial summary analytics performed on the data population shows a particular employee stands out in the data.

Multi-dimensional Procurement Trend Analysis: Stock Material Purchases



Deciphering a fraudster's "digital fingerprint"

A number of specific features were identified related to a suspicious entity and associated transactions.

Buyer "A" Case

Anomalous activity pattern recognition

Price increases

Significant increases in material unit price

Same-day orders

Multiple orders for a material on the same day

Buyer "A" Digital Fingerprint



Suspicious Activity Found

Split requisitions

Splitting purchase requisitions into multiple orders

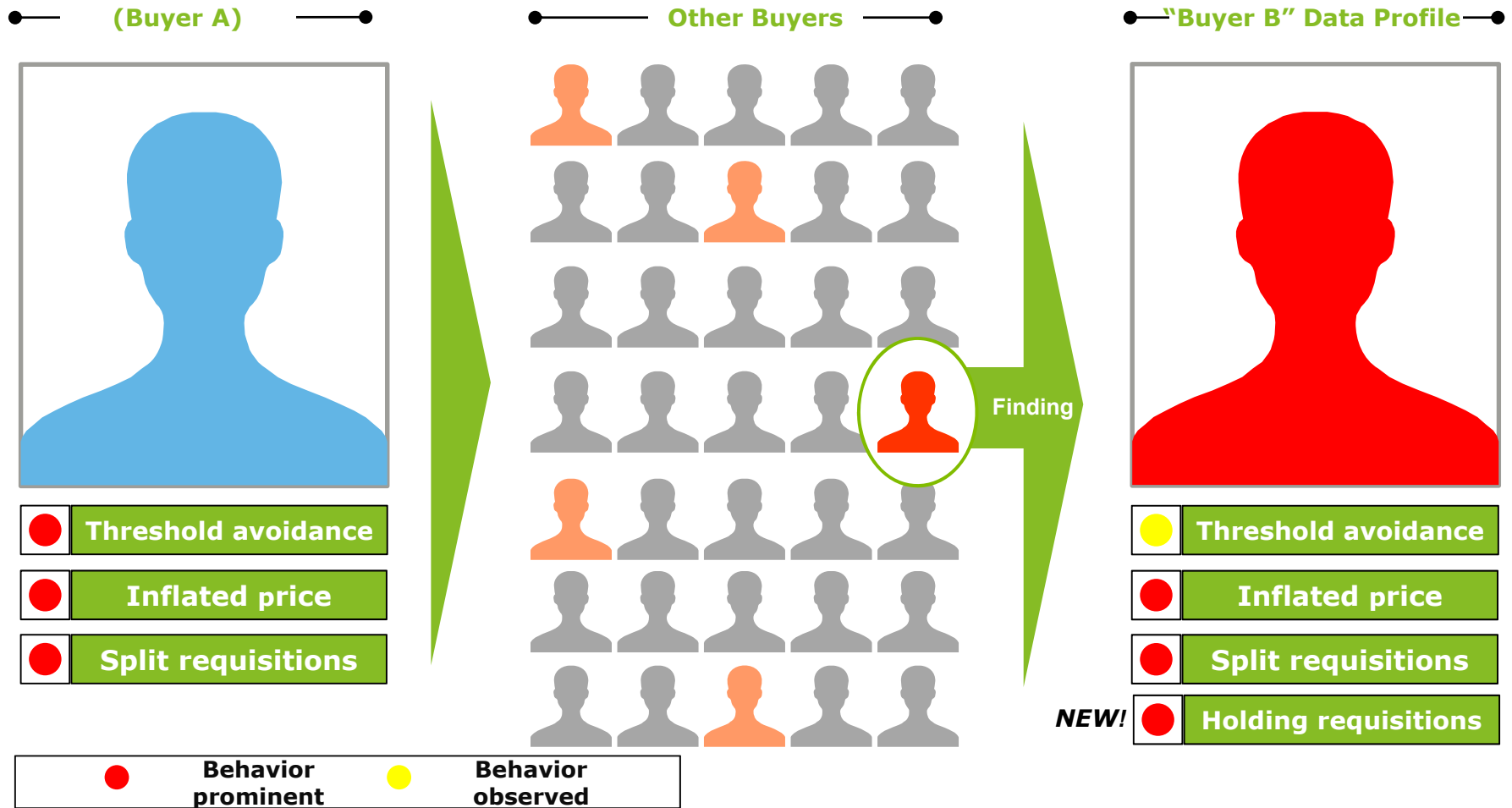
Skirting approval

Purchase order amounts just below approval thresholds

Using this learning, these patterns can be applied to find the buyer and others that are similar

Use digital fingerprint to identify fraud

Using the digital fingerprint and additional predictor variables, similar entities were identified.



Text analytics - natural language processing (NLP)

Natural language/semantic text analytics applied to non-stock material descriptions identified several suspicious purchases by comparing them to material groups

Approach

Technique and tools

NLP/Semantic Text Analysis

- **Process:** take any two phrases and compare how close the concepts in the two phrases are to each other
- **Result:** Finds the average semantic distance between two phrases and assigns a numeric value

NLP Algorithm

```

all_avg_score = []
for word in key.split():
    word = word.strip(string.punctuation)
    word = Word(word)
    print word

    wordsyns = wn.synsets(word, pos=wn.NOUN)

    if len(wordsyns) > 0 :
        synsets = wordsyns[0]

        arrayList = []

        for word2 in val.split():

            word2 = word2.strip(string.punctuation)
            word2 = Word(word2)
            print word2

            wordsyns2 = wn.synsets(word2, pos=wn.NOUN)

            if len(wordsyns2) > 0 :
                synsets2 = wordsyns2[0]
                print synsets2

                score = synsets.path_similarity(synsets2)

                arrayList.append(score)

        if len(arrayList) > 0 and len(wordsyns) > 0:
            print arrayList
            avg_score = sum(arrayList)/len(arrayList)
            all_avg_score.append(avg_score)

if len(all_avg_score) > 0:
    avg_avg_score = sum(all_avg_score)/len(all_avg_score)
    print "\n" + str(all_avg_score) + "all avg"
    print avg_avg_score
    
```

Model Outputs

Dissimilar Phrases

(Phrase 1) Material Group	(Phrase 2) Material Text	Closeness Score
Office Supplies/FFE	Cigarette	7.0620
Misc. Maintenance Supplies	DVD Movie	7.0982
Engineering and Industrial Supplies	Guitar, Electric	7.5228
Misc. Maintenance Supplies	Blu-ray Movie	7.6751
Misc. Operation Supplies	Cigarette	7.7152
Office Supplies/FFE	HD TV 32	8.2251

Similar Phrases

(Phrase 1) Material Group	(Phrase 2) Material Text	Closeness Score
Food/Beverages	Water Melon, Large Seedless	91.7649
Engines	GASKET	92.5000
Wheels/Brakes/Axles	SPRING BRAKE SHOE	94.1545

Illustrative Examples



Shipping analytics

Issue

An international Energy and Resources company engaged with a third-party shipping and logistics supplier to manage its midstream operations. Management observed an increase in overall spend and raised concerns regarding potential fraud, waste, and abuse related to the third party

Approach

The company decided to perform a data-driven approach using advanced analytic tools and techniques to identify potential fraud, waste, and abuse. The company leveraged invoices received directly from the third party and developed rules to identify contract compliance issues. In addition, the company leveraged anomaly detection and clustering algorithms to identify entities (vessels, ports) that exhibited anomalous behavior when compared to the rest of the population

Impact

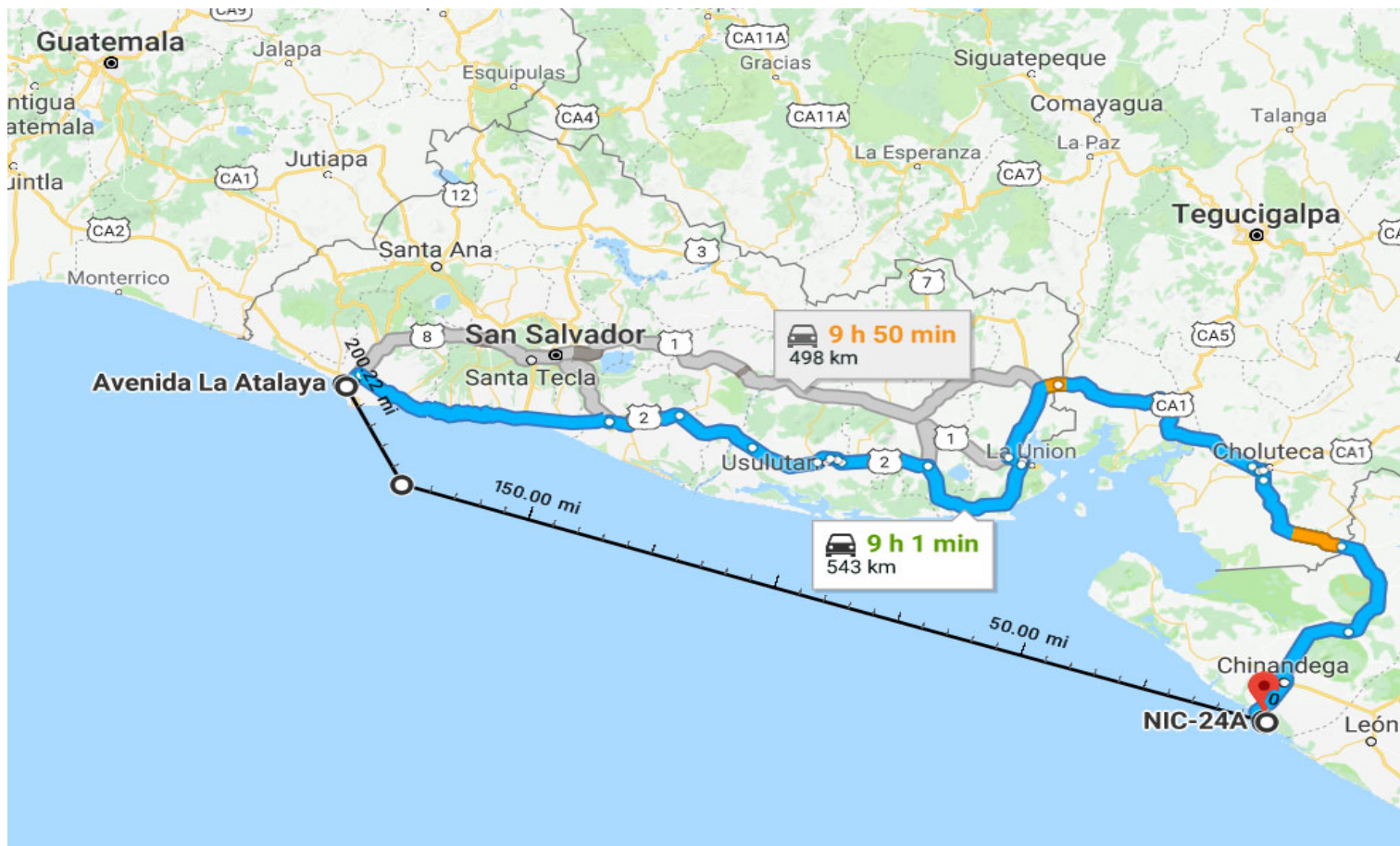
The analysis identified numerous issues that pointed to fraud, waste, and abuse. The company identified several different scenarios which led to potential overpayments amounting to more than \$6.5 million over the course of three months' time.



Shipping analytics

Identification of unusual vessel activity – A ship in 2 ports at the same time

The two ports of El Salvador and Corinto are the western coast of South America
The distance between the two ports by sea is approximately 200 miles





Vendor invoice analytics

Issue

A large international organization was seeking to improve invoicing accuracy by performing analytics and identifying potential discrepancies including:

- Non-compliance with contractual terms
- Fraud, waste, and abuse
- Duplicate billings
- Billing errors and anomalies

Approach

The organization decided to conduct a pilot project leveraging advanced data analytics to analyze and quantify potential invoice variances. Specific features of the organization's future vision included:

- Expanding analytics across the supply chain
- Exercising contractual audit rights
- Updating the vendor billing process

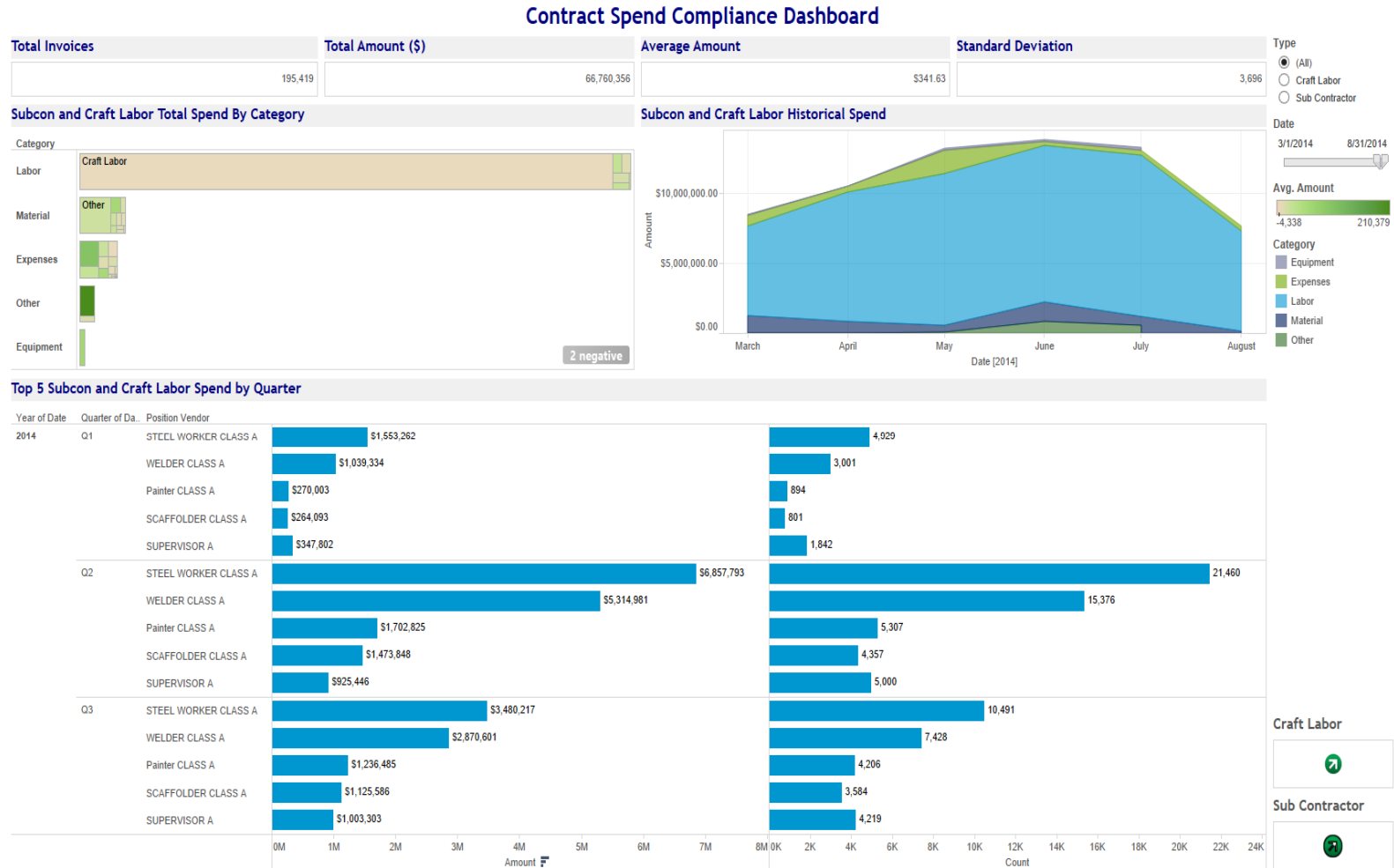
Impact

The company identified numerous vendor invoicing issues including incorrect labor charges, inflated labor hours, invoice duplicates, unqualified laborers, subcontractor expense anomalies, and invalid OT charges which amounted to more than \$1.5 million in potential issues.



Vendor Invoice Analytics

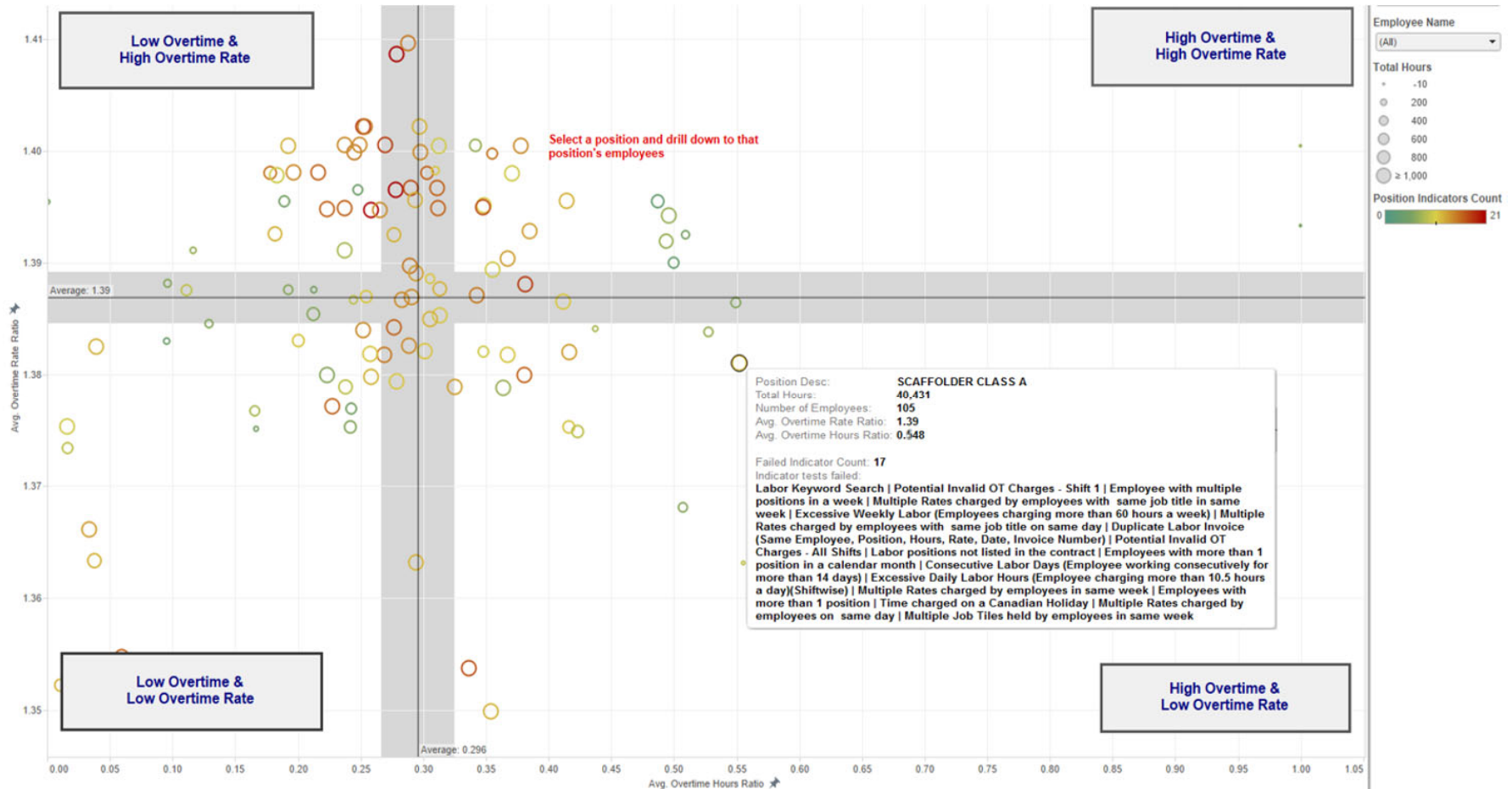
The dashboard provides insight into historical trends, spend patterns, and vendor utility with easy-to-use filtering and navigation capabilities.



Vendor Invoice Analytics

Combining systematic processes with statistics, advanced analytics technologies, and pattern testing enables a review team to find anomalies and potential recoveries from contract compliance issues.

Labor compliance analysis – Overtime outliers by position



In this example "Scaffolder Class A" is considered an outlier because these employees are billing unusually high amounts of overtime hours compared to their regular hours for this position. Employees within this position also failed an unusually high number of risk indicators.



Cycle count analysis

Issue

A global Energy and Resources company was concerned that a low volume of adjustments were being processed for certain international locations / warehouses in contrast to other locations and/or general industry trends (i.e., site's performance was "too good to be true").

Approach

Derived specific risk factors, which when applied to materials / count events, created a sub-population with a higher potential for false counts, manual counts, improper segregation of duties, material stock outages, and improper inventory processing

Impact

The company was able to confirm their hypothesis utilizing a data-driven approach and was also able to identify instances of material theft, inventory compliance violations, training opportunities, and materials that were improperly written off as obsolete.



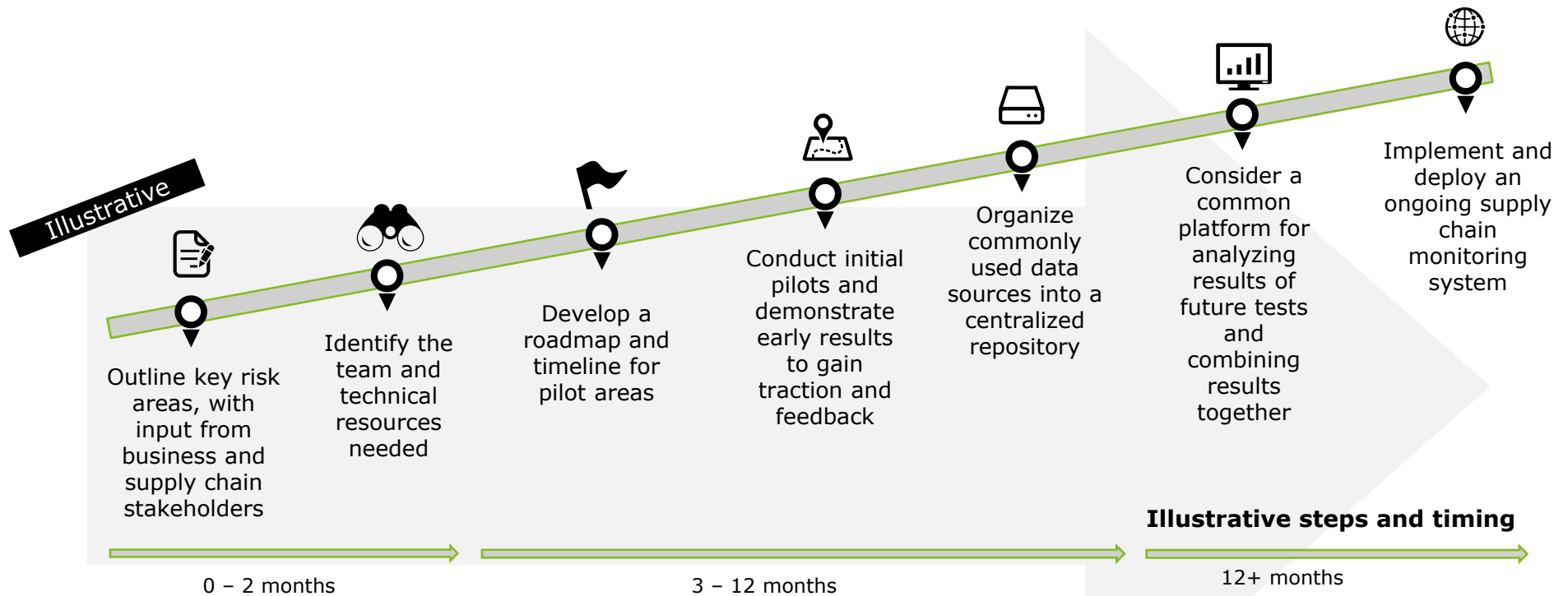
Return on investment (ROI) – supply chain continuous monitoring solution

The results of supply chain monitoring solution can potentially bring about significant savings, recoveries, and business process improvements.

ROI category	ROI description
Fraud, waste, & abuse identification and deterrence	Identified fraudulent and other undesirable behaviors across business processes that led to corrective actions. Such actions may have led to a behavior change within the organization confirmed by a sharp decline in the fraudulent/undesirable behaviors observed
Cost recovery	Identified unsupported price increases where there was no adequate justification to describe the price increase between purchase orders resulting in credits or funds being recovered from the vendor.
Cost savings & strategic sourcing	Strategic sourcing opportunities were identified where a number of high volume, uncontracted materials were identified as being sourced from multiple suppliers at significantly different prices
Continuous monitoring	Established greater visibility for Global Supply Chain (“GSC”) department to monitor for anomalous trends on a continuous basis which allowed the GSC department to rectify unwanted activity before money was paid
Process enhancements	Identified and implemented numerous business processes enhancements designed to improve compliance with desired process (emergency purchases, cores, outline agreements, etc.).
System enhancements	Enhanced usage of system to include additional flags and notes to capture business scenario that warrants a deviation from defined process
Training opportunities	Conducted location specific training sessions to implement corrective actions specific to the behaviors identified at the individual locations
Internal Audit and compliance	Technology-enabled Internal Audit capabilities, SOX control validation and testing

Taking action

An illustrative timeline to develop a supply chain analytics program





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