VIS2025

Interactive Platform for the Visual Analysis of Suspicious Communication Patterns

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Fundação Getulio Vargas / Visual Data Science Lab

www.visualdslab.com

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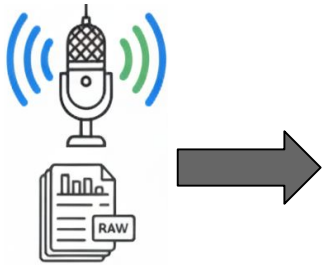
Agenda

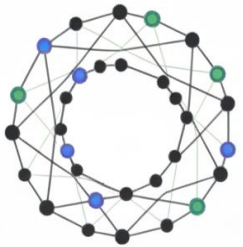
- Introduction
- Data Preparation
- System Design
- Illustrative Cases
- Contributions

Introduction

Data



Radio communications

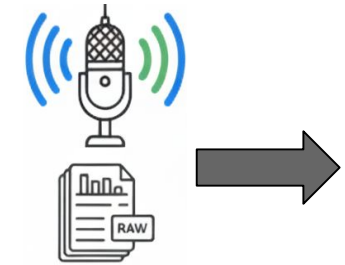


Knowledge graph (entities & events)

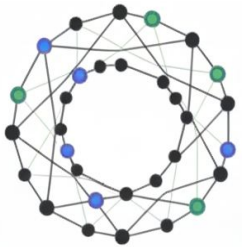
- 72 Entities nodes
- 801 Events nodes
- 285 Relationships nodes
- 586 Membership edges
- 860 Evidence edges
- 1,506 Participation edges

Two weeks of messages

Data



Radio communications



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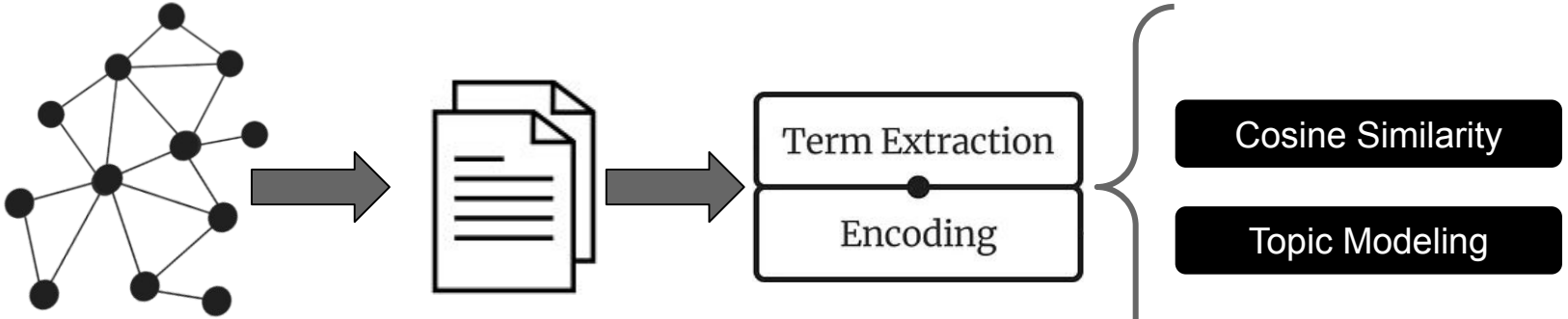
Two weeks of messages

Goals

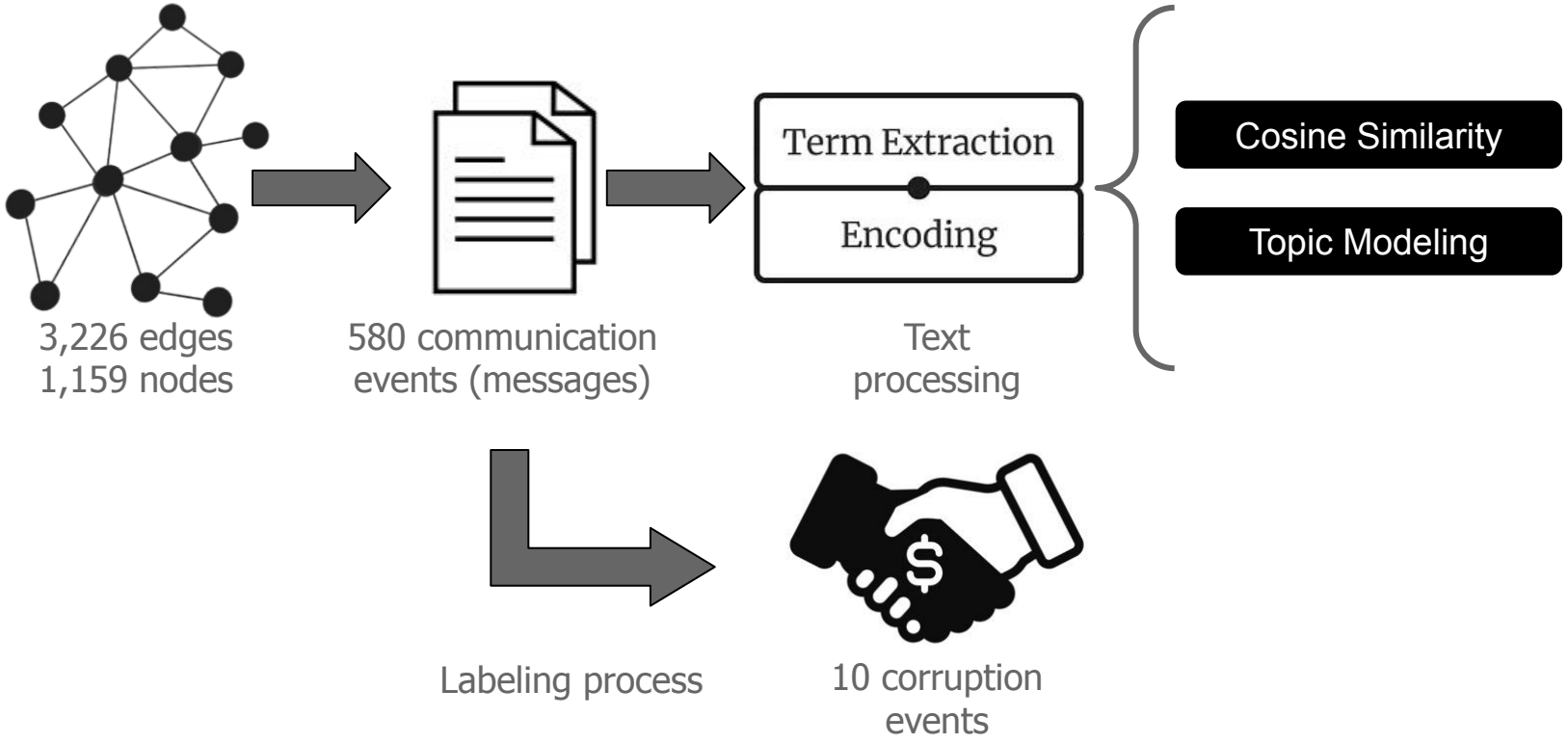
- Discover daily communication patterns
- Exploring group connections within the network
- Unmask secret identities
- Analyze Nadia Conti's suspicions

Data preparation

Data preparation & processing



Data preparation & processing



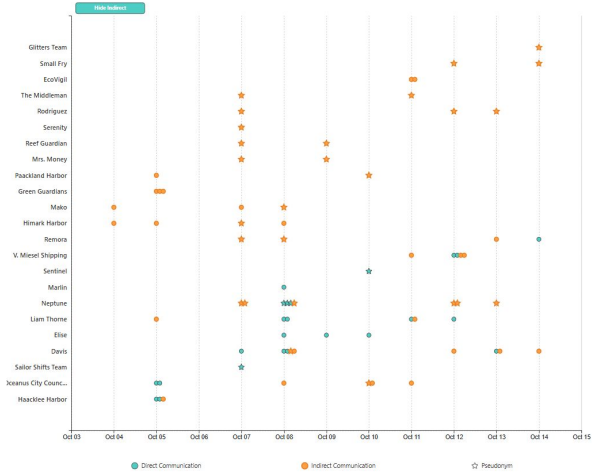
System Design

System Design

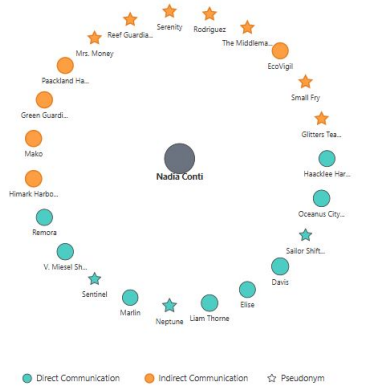
VIS2025

Daily Communication Patterns - October 2040

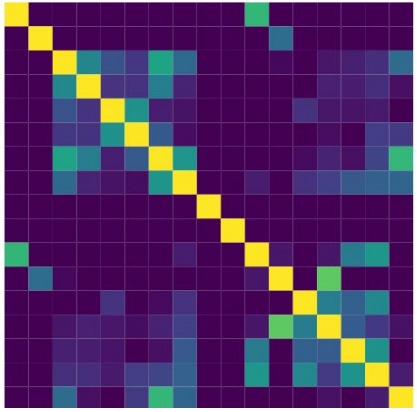
Analysis of Nadia Conti



Nadia Conti - Ego Network

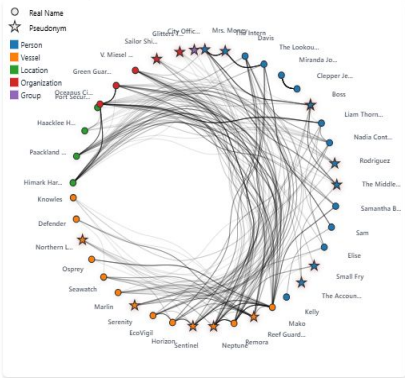


Entity Similarity Heatmap (Communication-based)

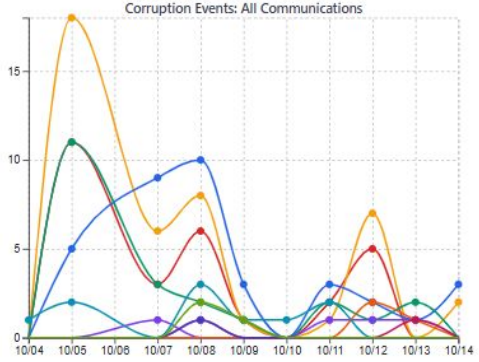


Network Exploration Dashboard

Communication Graph



Corruption Events: All Communications



Message analysis

Communications: 75 | **Corruption Events:** 10 | **Keywords Found:** 32

permission management (43 occurrences)

Keywords: cancel , permit , approval , canceled , cancellation , approved , authorization

Messages (43):

Haacklee Harbor, this is Nadia Conti. I need to cancel the special access corridor arrangements for Nemo Reef immediately. Plans have changed due to unforeseen circumstances. Destroy all related documentation. I'll contact you when we're ready to proceed with alternative locations.

direct - 2040-10-05

Ms. Conti, this is Oceanus City Council. We need clarification regarding your canceled Nemo Reef event arrangements at Haacklee Harbor. Please explain your documentation destruction request immediately. This relates to our newly expedited permit approvals.

direct - 2040-10-05

Ms. Conti, this is Oceanus City Council. We need clarification regarding your canceled Nemo Reef event arrangements at Haacklee Harbor. Please explain your documentation destruction request immediately. This relates to our newly expedited permit approvals.

direct - 2040-10-05

Ms. Conti, this is Oceanus City Council. We need clarification regarding your canceled Nemo Reef event arrangements at Haacklee Harbor. Please explain your documentation destruction request

Daily Communication Patterns View

Goal: Visualize communication patterns along these two weeks.

Daily Communication Patterns - October 2040

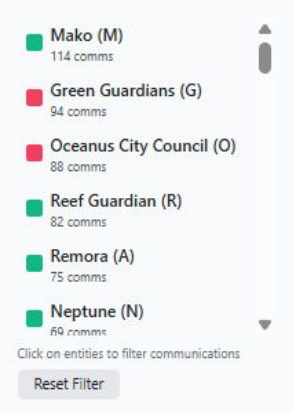
The x-axis shows hours of the day

Daily Communication Patterns - October 2040

While y-axis represents
14 consecutive days

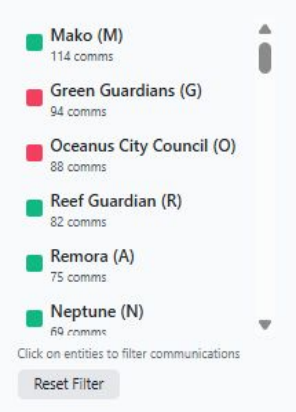
Daily Communication Patterns - October 2040

Each color determines the sender and receiver entity type



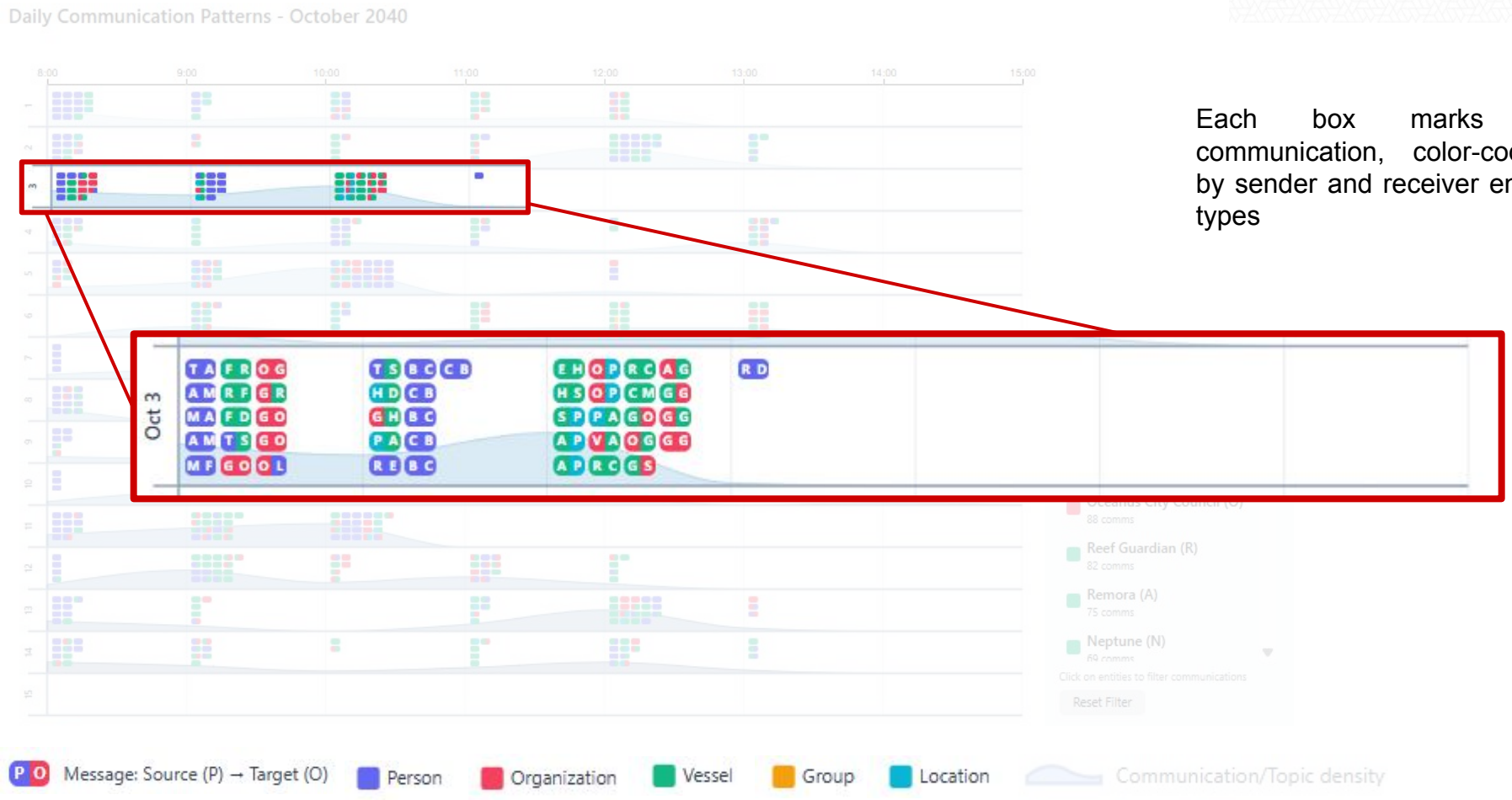
Daily Communication Patterns - October 2040

Each message is sorted by source-target



Daily Communication Patterns - October 2040

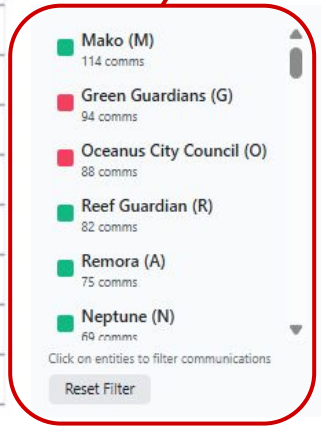
A density curve in the background illustrates hourly message volume



Each box marks a communication, color-coded by sender and receiver entity types

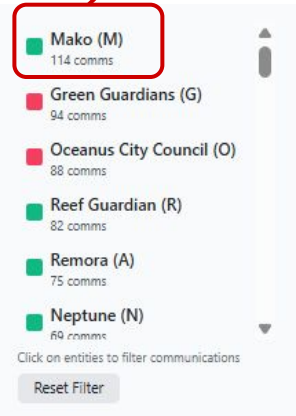
Daily Communication Patterns - October 2040

We list all entities



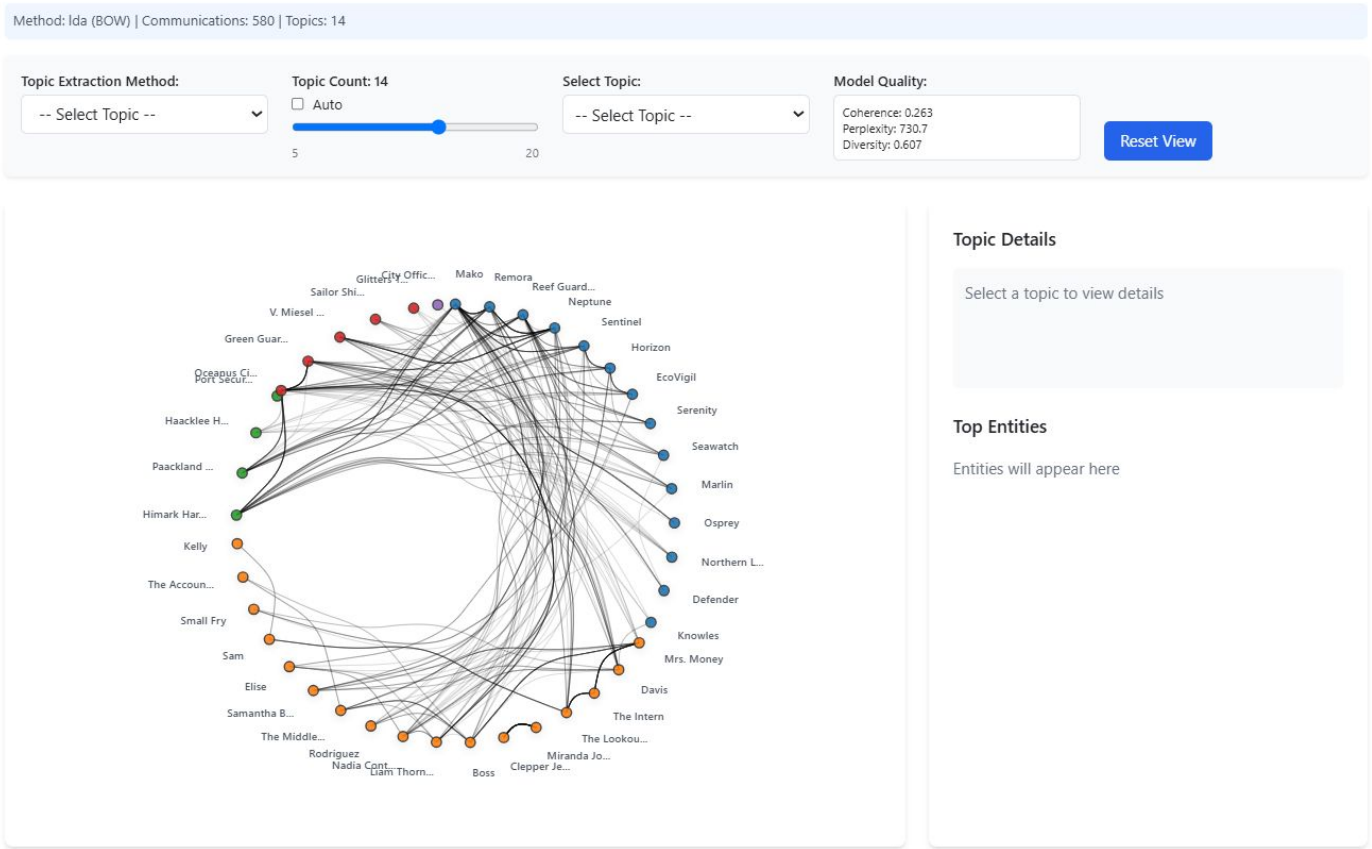
Daily Communication Patterns - October 2040

We can select an entity to filter communications from that entity.



P O Message: Source (P) → Target (O) Person Organization Vessel Group Location Communication/Topic density

Topic Modeling Explorer View



Goal: Analyze entities interactions and message topics

Method: lda (BOW) | Communications: 580 | Topics: 14

Topic Extraction Method:

-- Select Topic --

Topic Count: 14

Auto

5 20

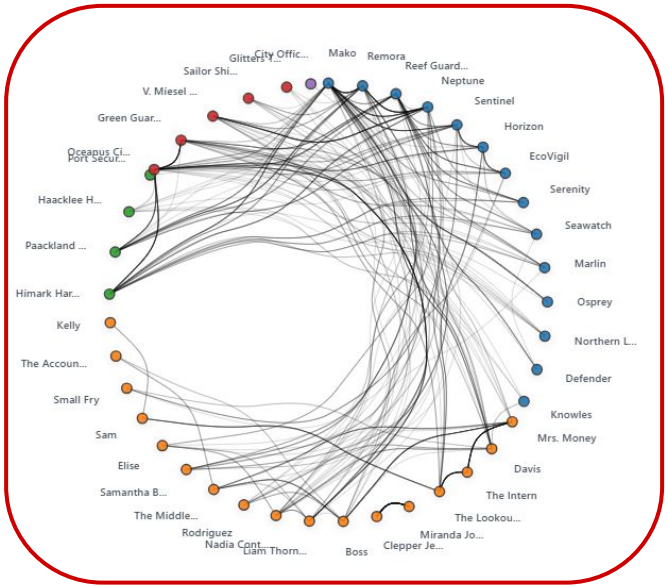
Select Topic:

-- Select Topic --

Model Quality:

Coherence: 0.263
Perplexity: 730.7
Diversity: 0.607

Reset View



Topic Details

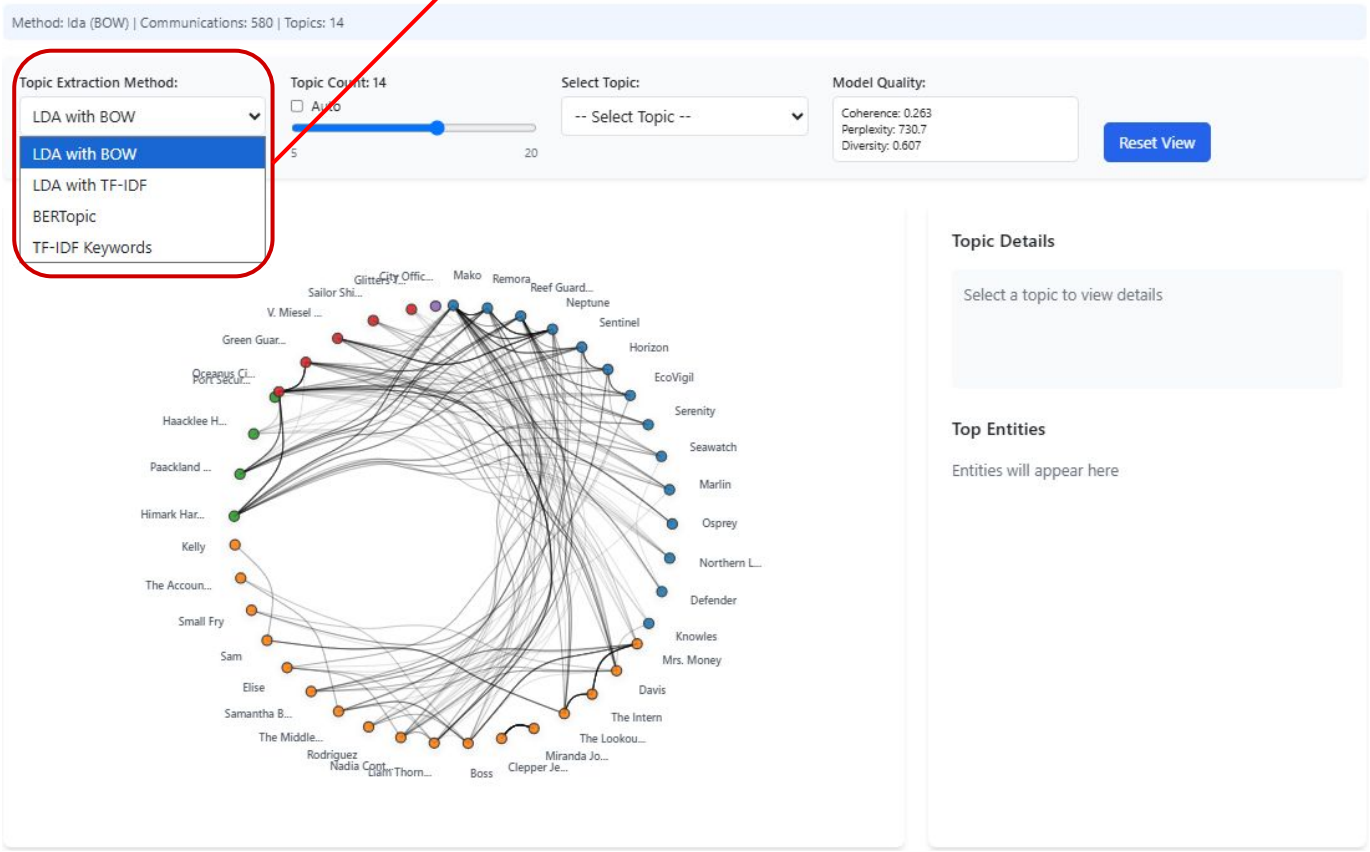
Select a topic to view details

Top Entities

Entities will appear here

All interactions between all entities graph

We can select the desired topic modeling method



Besides, select the number of topics

Method: lda (BOW) | Communications: 580 | Topics: 14

Topic Extraction Method:

LDA with BOW

Topic Count: 14

Auto

5 20

Select Topic:

-- Select Topic --

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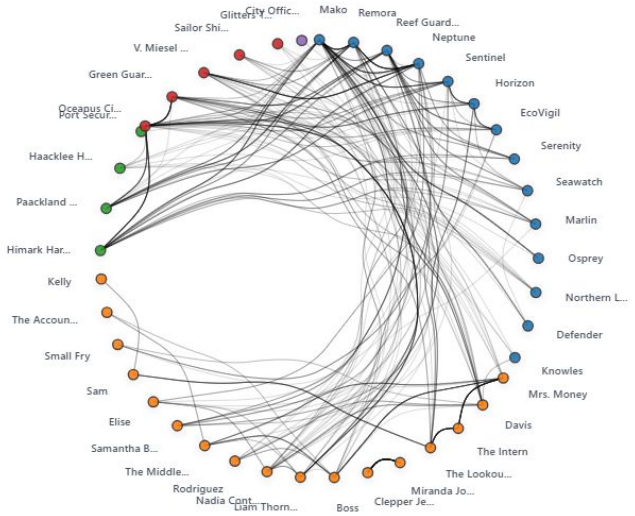

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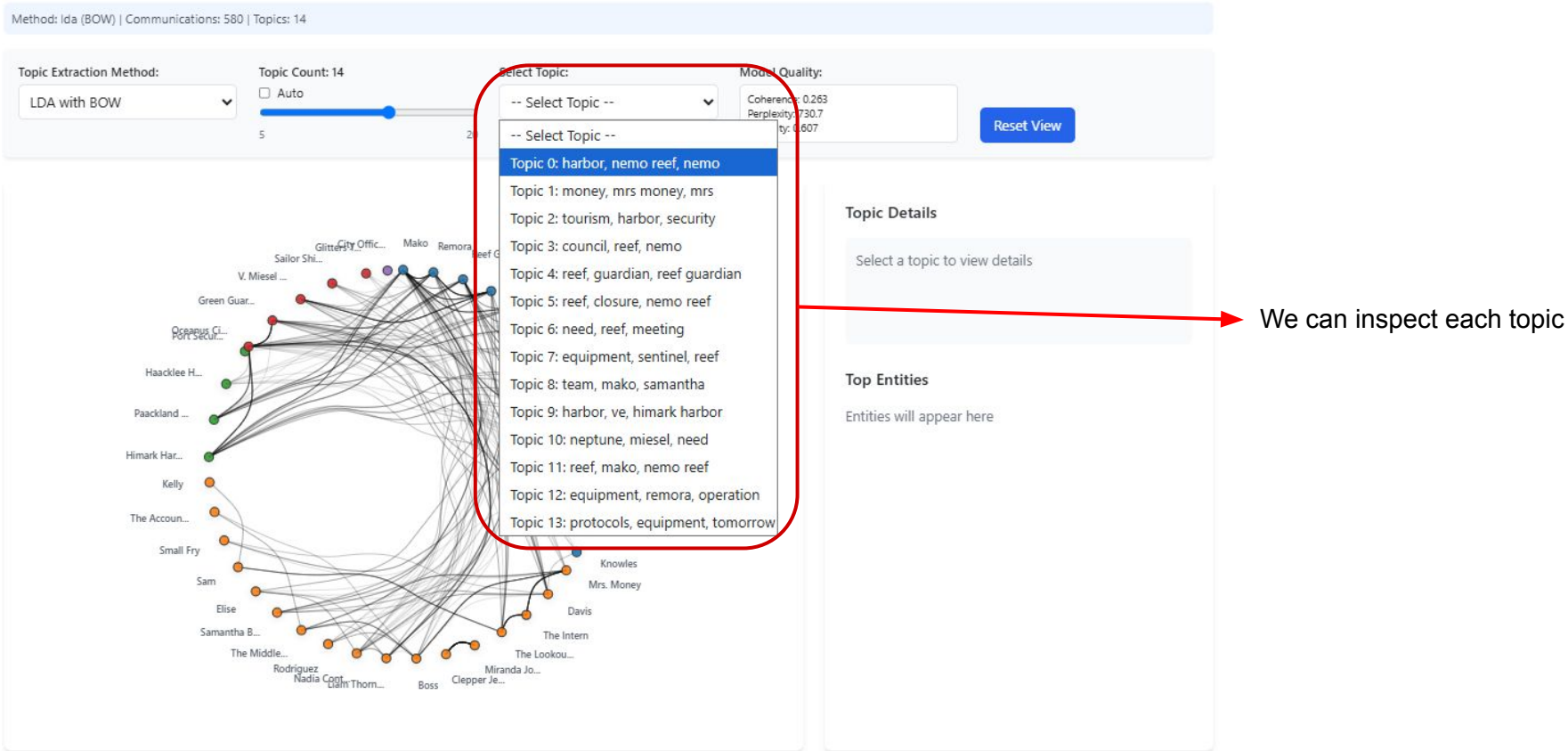


We can inspect each topic

Method: lda (BOW) | Communications: 580 | Topics: 14

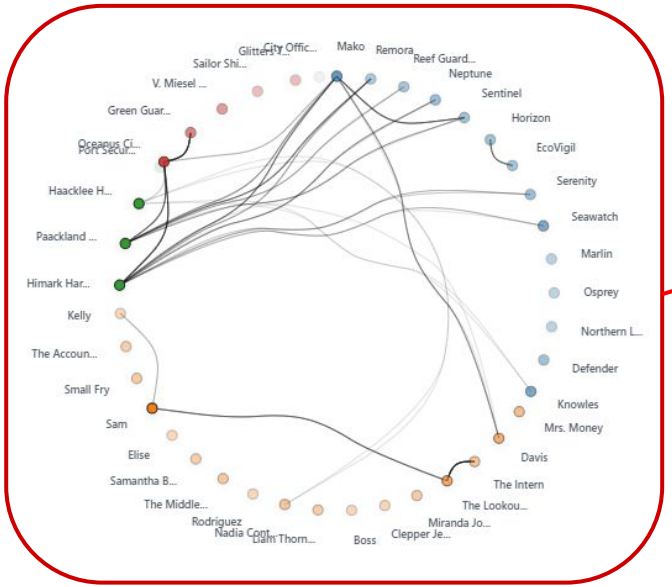
Topic Extraction Method: LDA with BOW

Topic Count: 14 — Auto — 5 — 20

Select Topic: Topic 0: harbor, nemo reef, ne

Model Quality: Coherence: 0.263 Perplexity: 730.7 Diversity: 0.607

Reset View



Topic Details

Topic 0

Method: lda (BOW)

MESSAGES	AVG. LENGTH	AVG. SCORE
43	34.7	0.629

harbor · nemo reef · nemo · reef · special · himark harbor · permit · clearance · operations · himark

Top Entities

Sam	0.632
Himark Harbor	0.298
Haacklee Harbor	0.273
Paackland Harbor	0.267
Oceanus City Council	0.169
Mako	0.120

Interaction of entities according to the selected topic

Method: lda (BOW) | Communications: 580 | Topics: 14

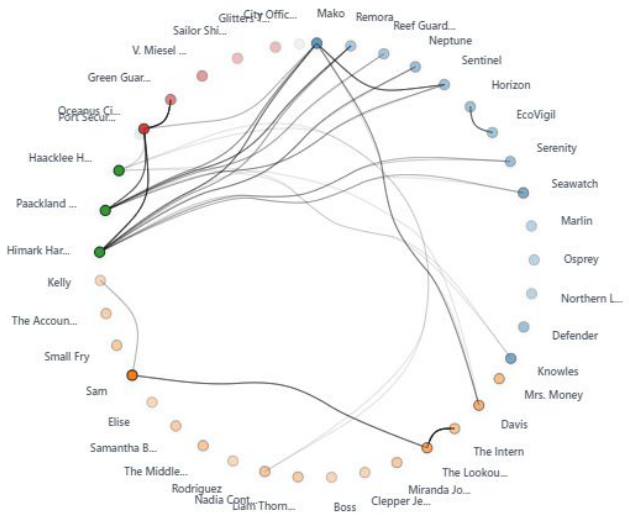
Topic Extraction Method: LDA with BOW

Topic Count: 14 — Auto — 5 — 20

Select Topic: Topic 0: harbor, nemo reef, ne

Model Quality: Coherence: 0.263 Perplexity: 730.7 Diversity: 0.607

Reset View



Topic Details

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harbor · nemo reef · nemo · reef · special · himark harbor · permit · clearance · operations · himark

Top Entities

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Oceanus City Council	0.169
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Topic details, showing number of messages and most used words

Method: lda (BOW) | Communications: 580 | Topics: 14

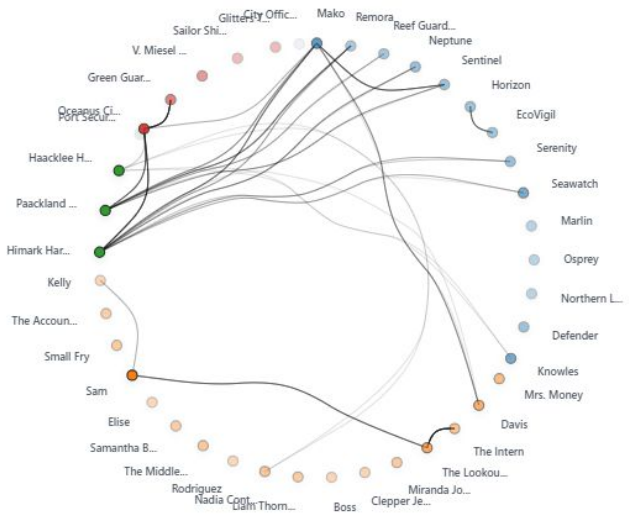
Topic Extraction Method: LDA with BOW

Topic Count: 14 — Auto — 5 — 20

Select Topic: Topic 0: harbor, nemo reef, ne

Model Quality: Coherence: 0.263 Perplexity: 730.7 Diversity: 0.607

Reset View



Topic Details

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harbor | nemo reef | nemo | reef | special | himark harbor | permit | clearance | operations | himark

Top Entities

Sam	0.632
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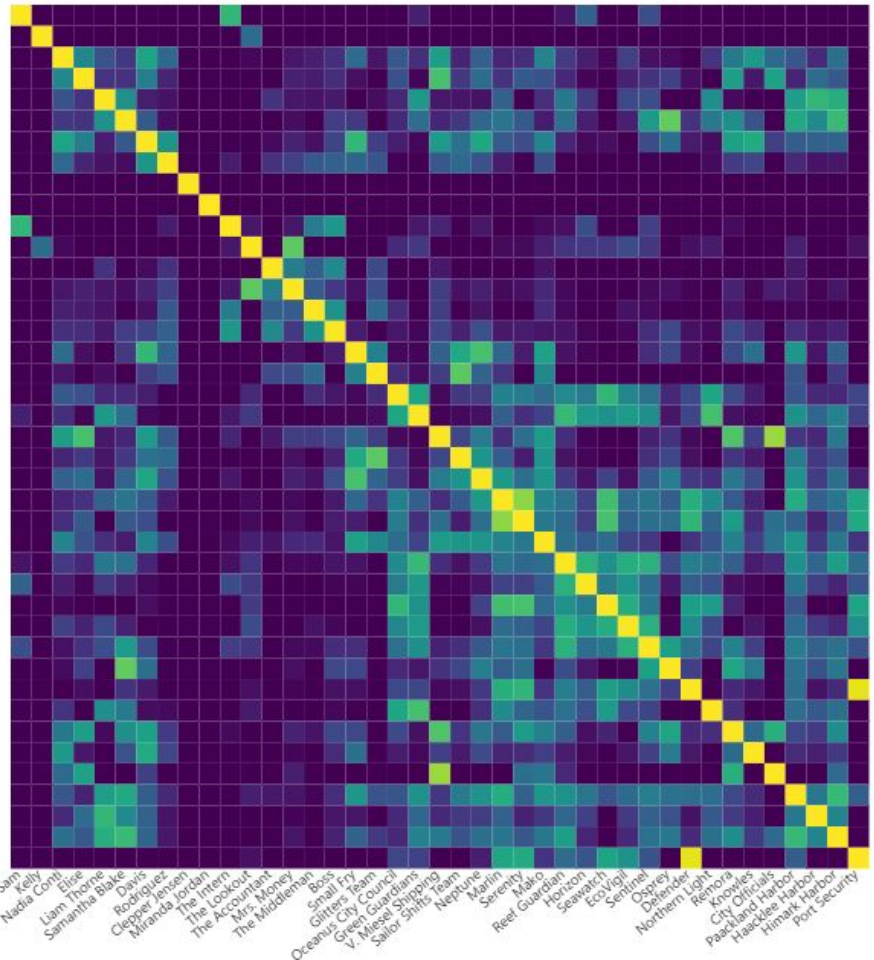
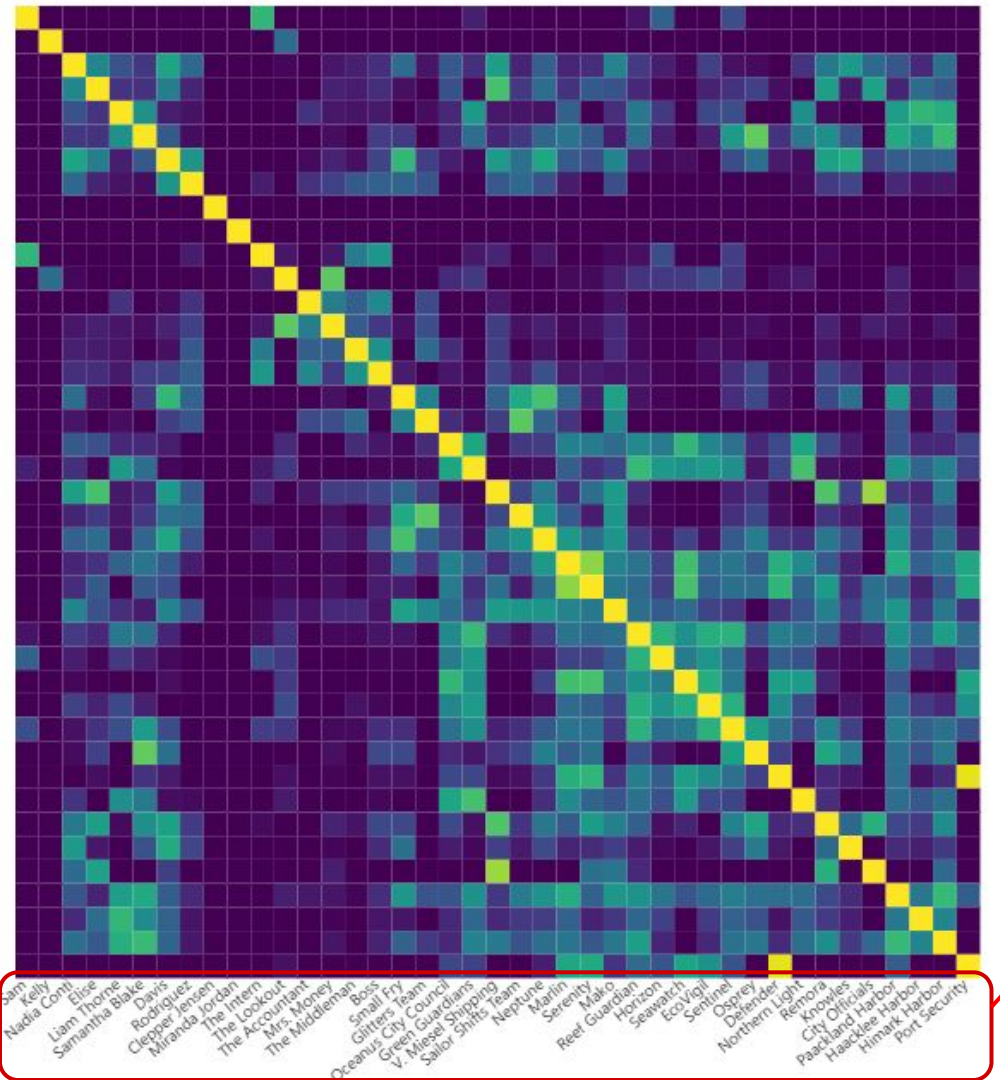
Paackland Harbor	0.267
Oceanus City Council	0.169
Mako	0.120

The entities that interacted the most according to the selected topic

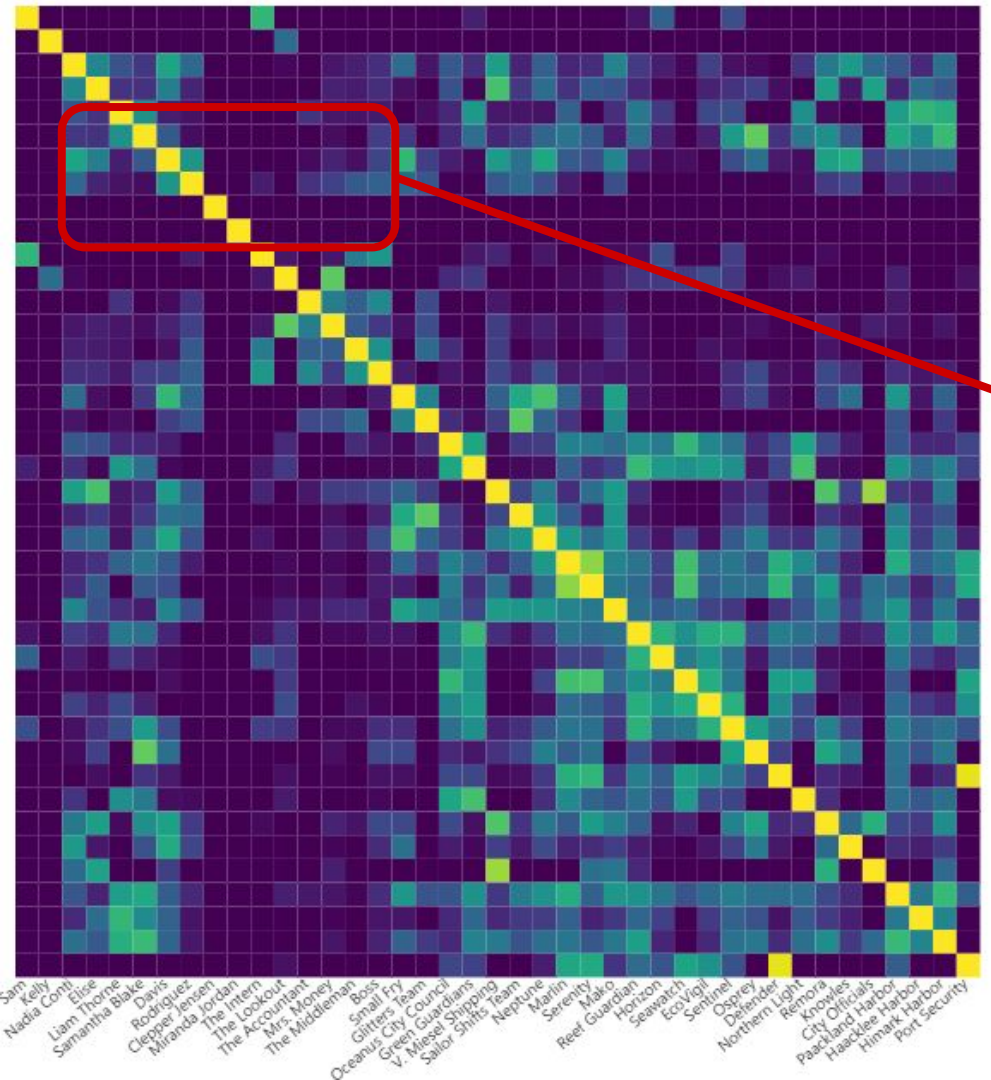
Communication Patterns View

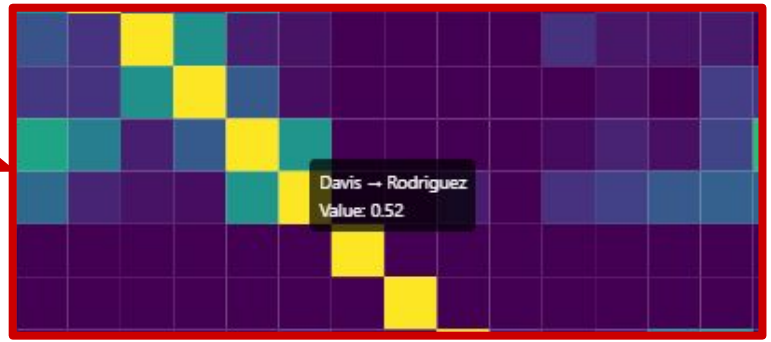


Goal: Find and pair pseudonyms – entities



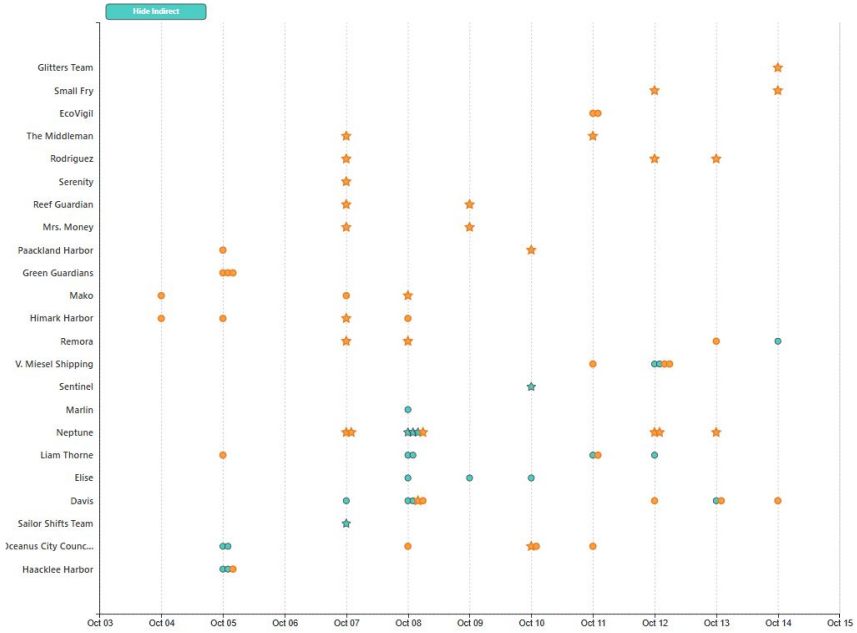
The entities (includes names and pseudonyms)

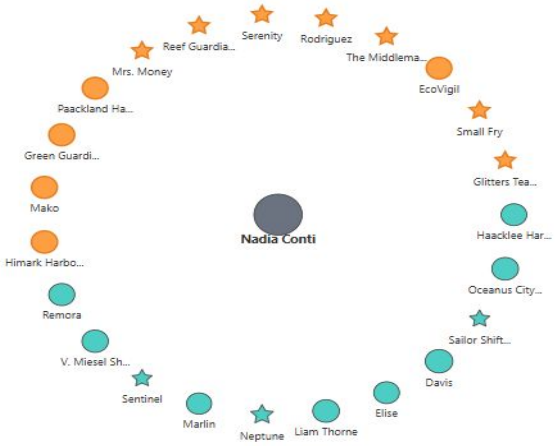


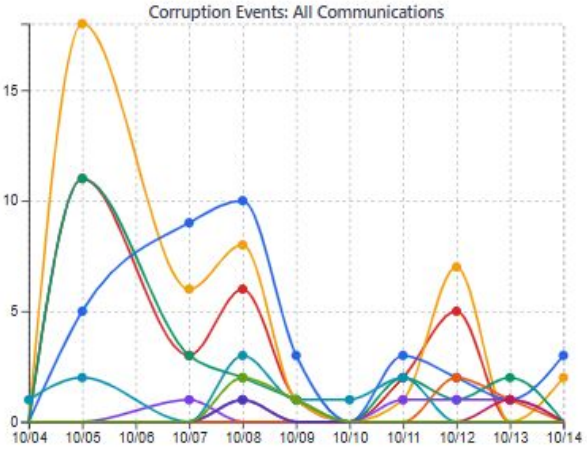


Analyze the similarity of messages written by different entities

Nadia Conti Analysis View

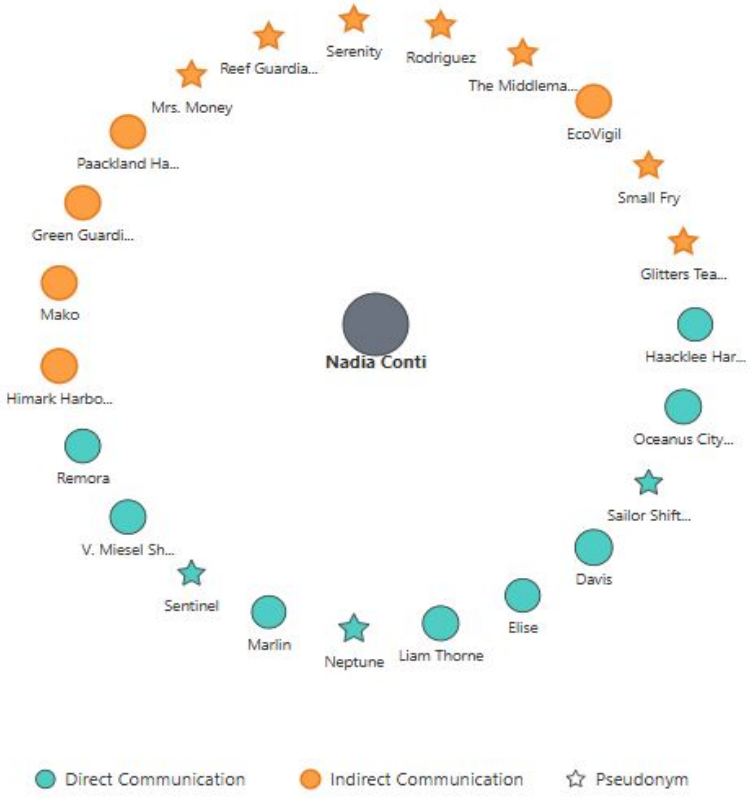




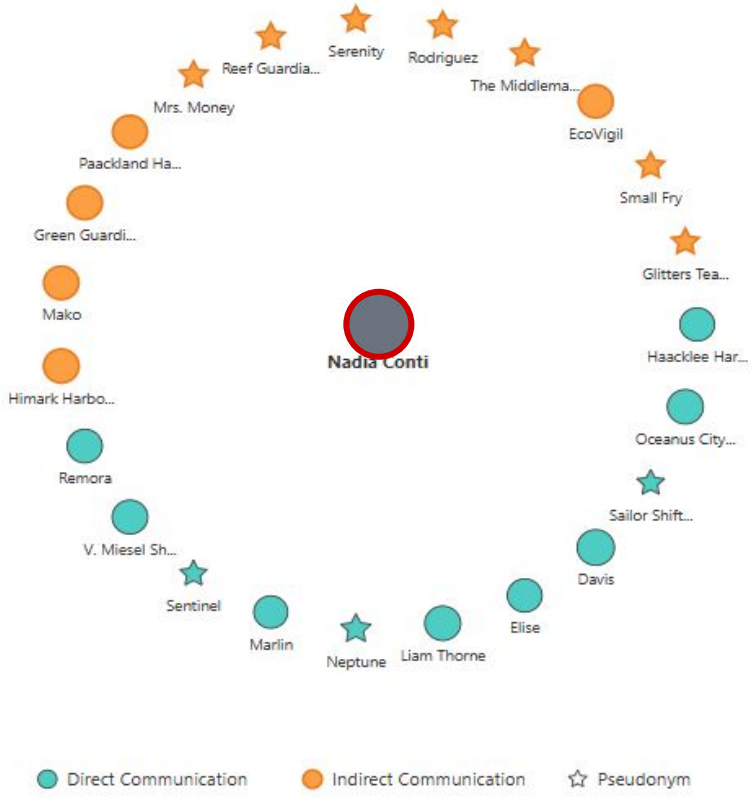


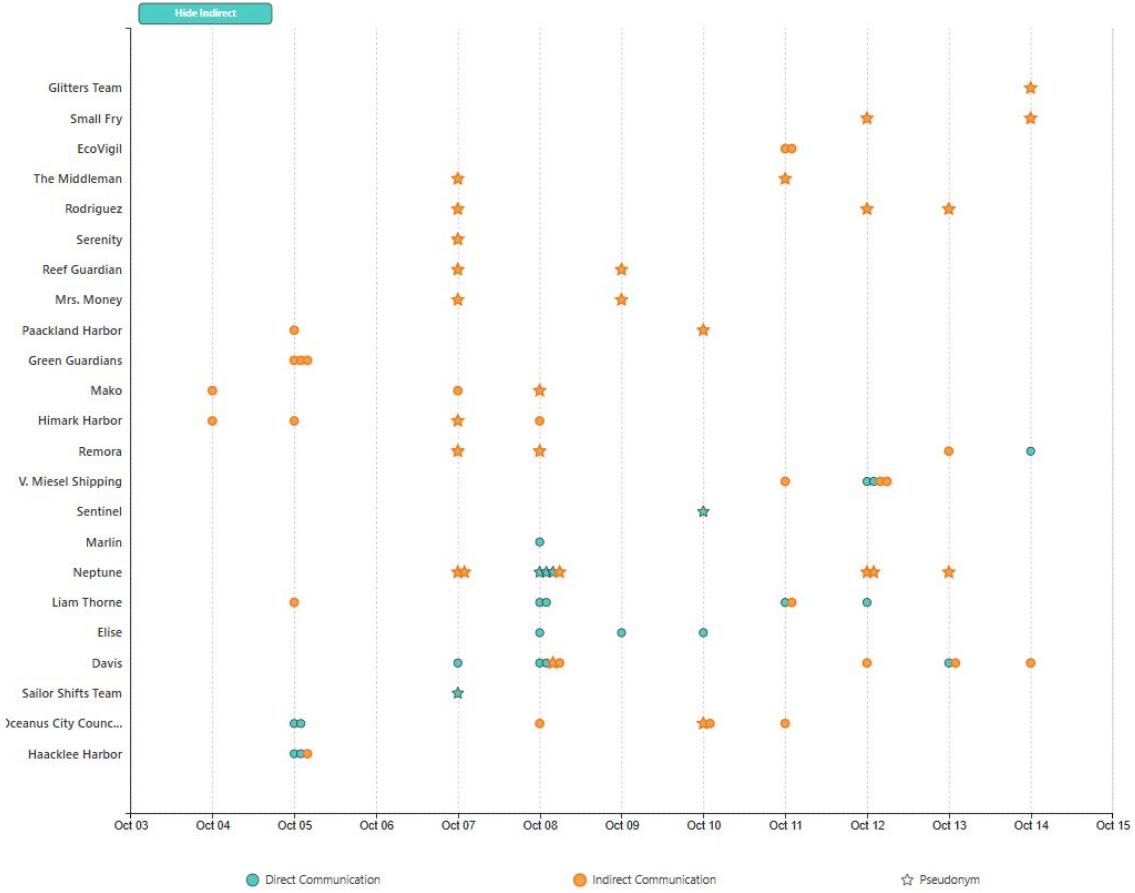
Goal: We created a diagram to analyze Nadia Conti's communications in detail.

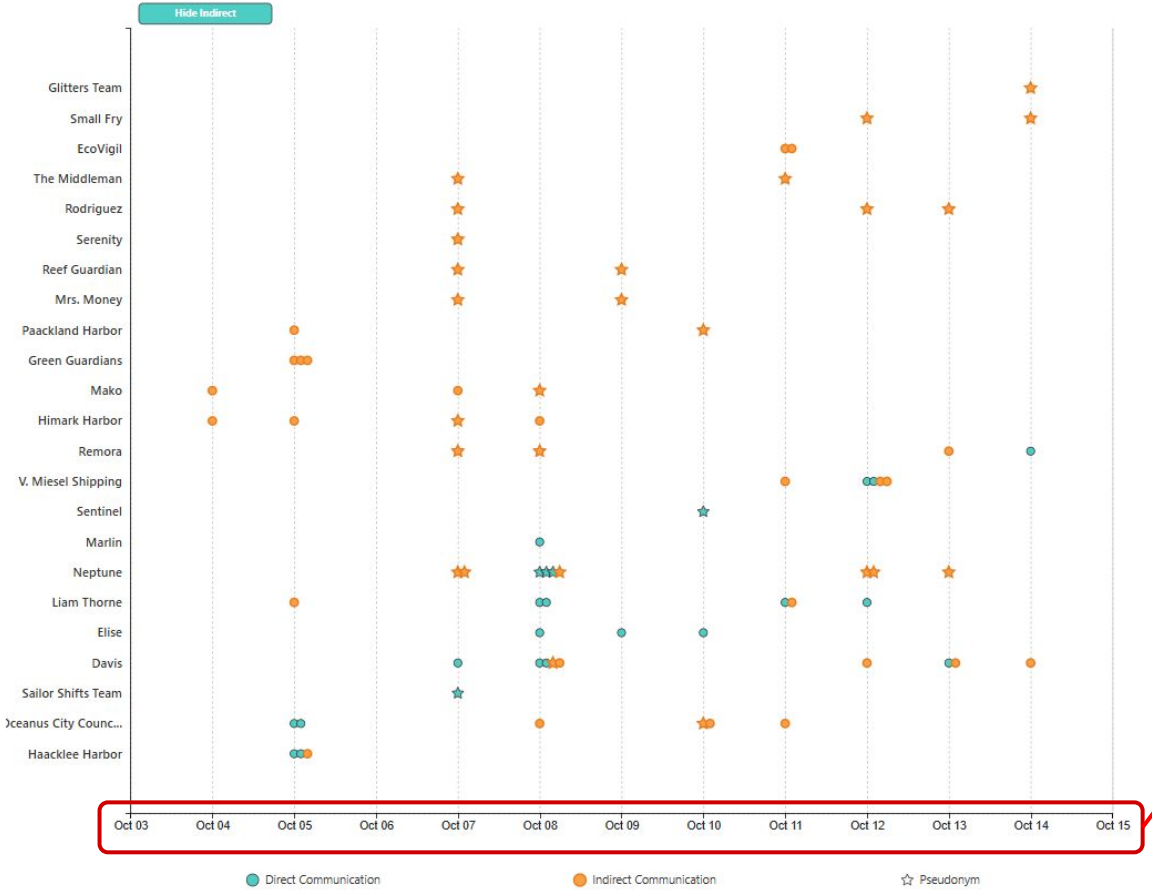
Nadia Conti - Ego Network



Nadia Conti - Ego Network

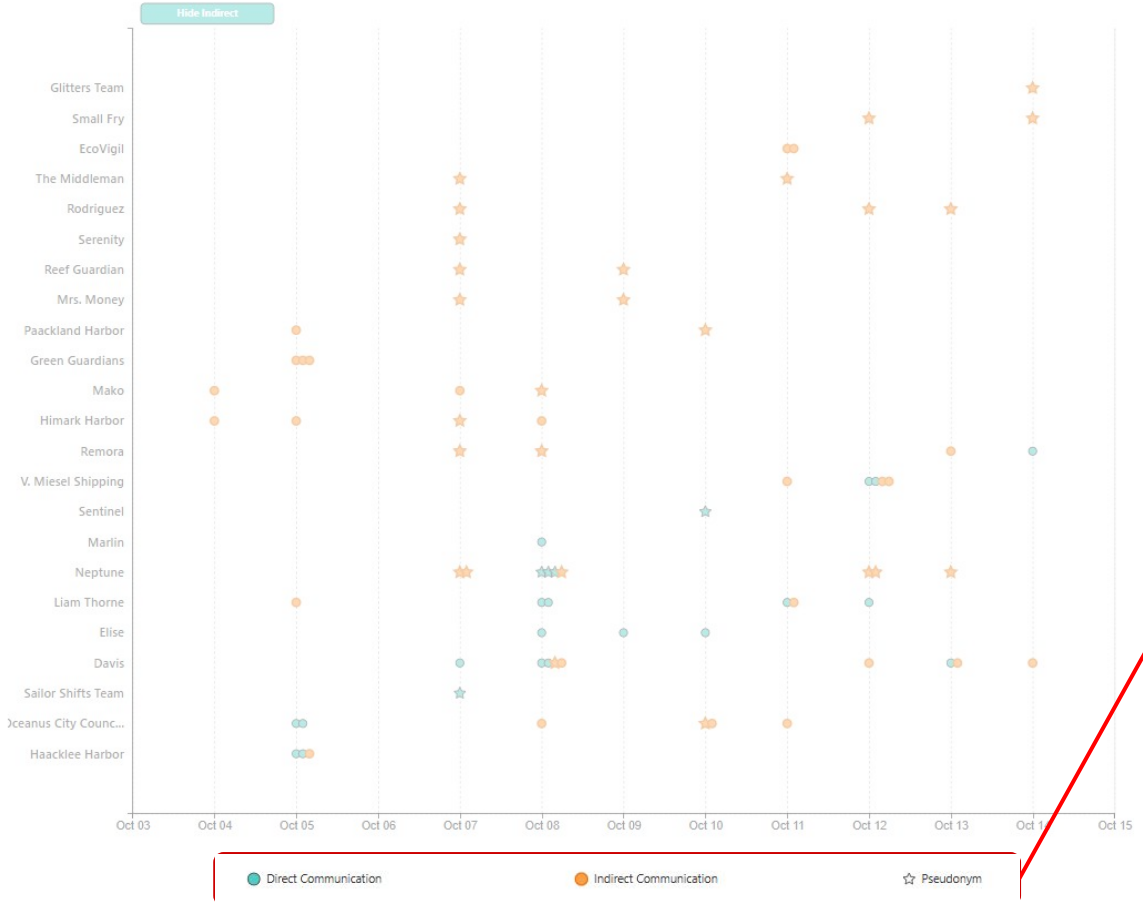



Hide Indirect
Glitters Team
Small Fry
EcoVigil
The Middleman
Rodriguez
Serenity
Reef Guardian
Mrs. Money
Paackland Harbor
Green Guardians
Mako
Himark Harbor
Remora
V. Miesel Shipping
Sentinel
Marlin
Neptune
Liam Thorne
Elise
Davis
Sailor Shifts Team
)ceanus City Counc...
Haacklee Harbor
Oct 03
Oct 04
Oct 05
Oct 06
Oct 07
Oct 08
Oct 09
Oct 10
Oct 11
Oct 12
Oct 13
Oct 14
Oct 15
Direct Communication
Indirect Communication
Pseudonym



The x-axis indicates the dates of the messages

The y-axis indicates the people with whom she communicated



Each point represents a direct (circles) or indirect (orange circles) communication, and the stars indicate the interlocutors who used one or more pseudonym

Hide Indirect
Glitters Team
Small Fry
EcoVigil
The Middleman
Rodriguez
Serenity
Reef Guardian
Mrs. Money
Paackland Harbor
Green Guardians
Mako
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Sentinel
Marlin
Neptune
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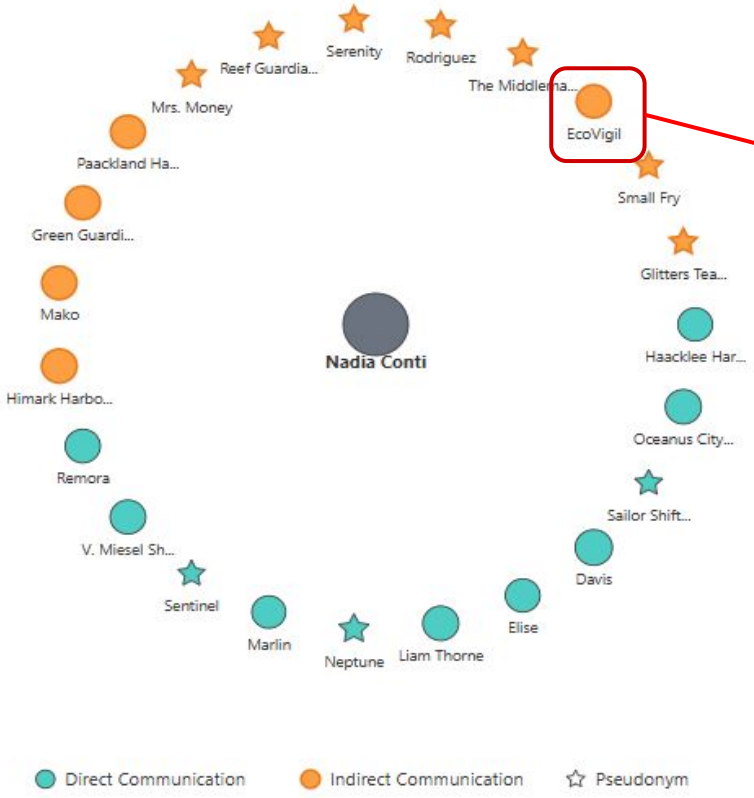
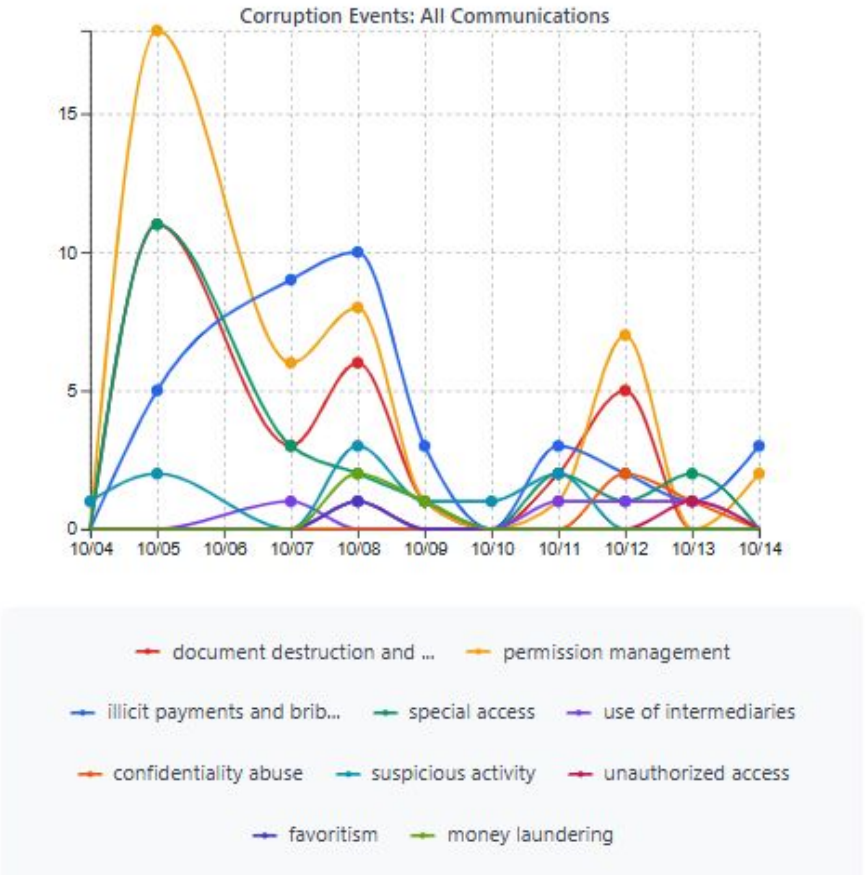
Haacklee Harbor
Oct 03
Oct 04
Oct 05
Oct 06
Oct 07
Oct 08
Oct 09
Oct 10
Oct 11
Oct 12
Oct 13
Oct 14
Oct 15
Direct Communication
Indirect Communication
Pseudonym

Nadia Conti - Ego Network

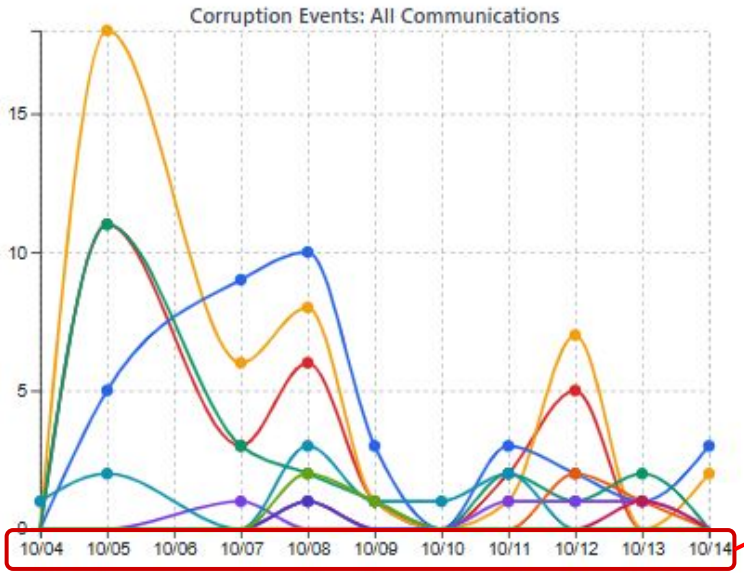


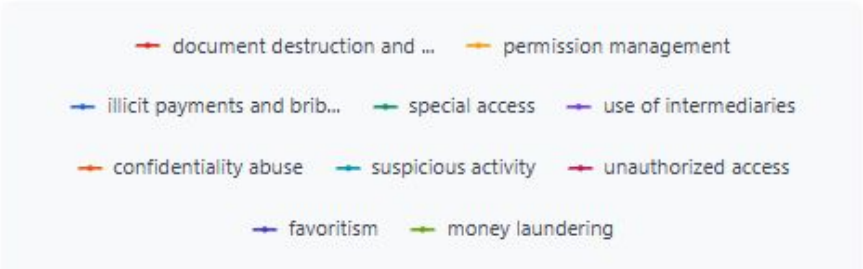
Each node represents an entity that communicated with Nadia Conti.

Corruption Events Timeline



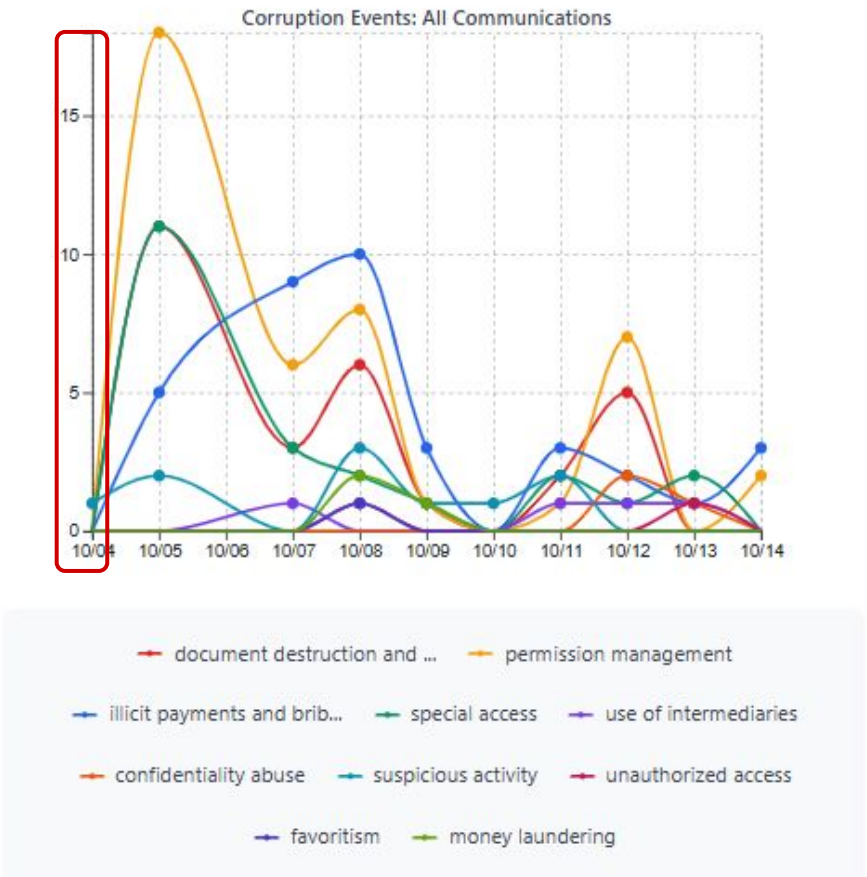
Corruption Events Timeline





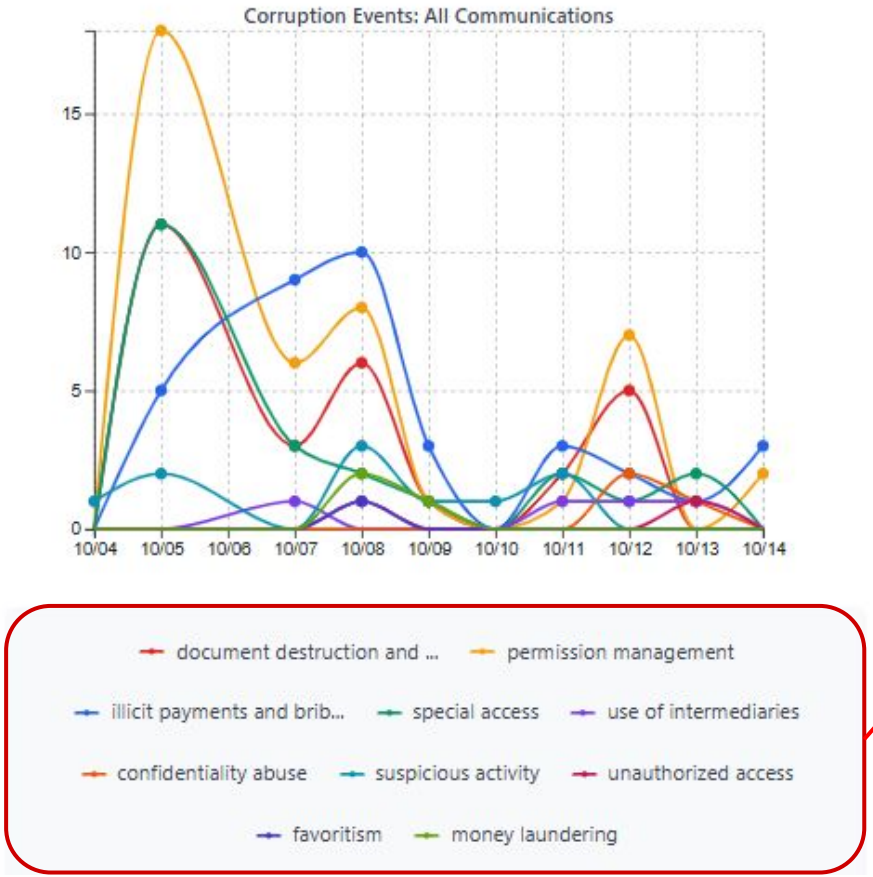
Each node represents an entity that communicated with Nadia Conti.

Corruption Events Timeline



The vertical axis indicates the number of corruption events on that day

Corruption Events Timeline



The color of each corruption event is indicated here.

Corpus Keywords Cloud

This Keyword Cloud displays the most frequently used words; the size is based on occurrences and the color on corruption events

Message analysis

Communications: 75 | **Corruption Events:** 10 | **Keywords Found:** 32

permission management (43 occurrences)

Keywords: cancel , permit , approval , canceled , cancellation , approved , authorization

Messages (43):

Haacklee Harbor, this is Nadia Conti. I need to cancel the special access corridor arrangements for Nemo Reef immediately. Plans have changed due to unforeseen circumstances. Destroy all related documentation. I'll contact you when we're ready to proceed with alternative locations.

direct - 2040-10-05

Ms. Conti, this is Oceanus City Council. We need clarification regarding your canceled Nemo Reef event arrangements at Haacklee Harbor. Please explain your documentation destruction request immediately. This relates to our newly expedited permit approvals.

direct - 2040-10-05

Ms. Conti, this is Oceanus City Council. We need clarification regarding your canceled Nemo Reef event arrangements at Haacklee Harbor. Please explain your documentation destruction request immediately. This relates to our newly expedited permit approvals.

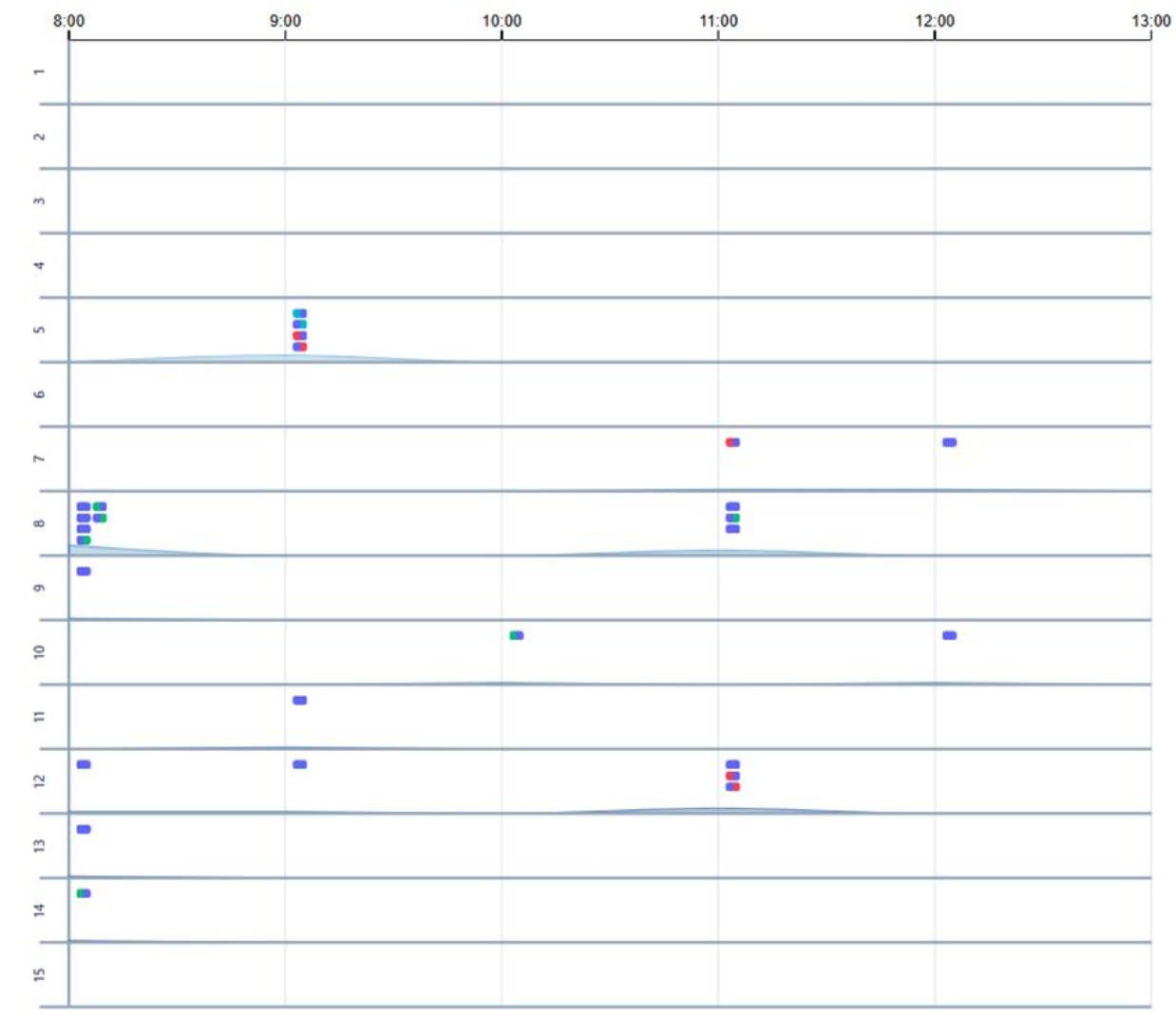
direct - 2040-10-05

Ms. Conti, this is Oceanus City Council. We need clarification regarding your canceled Nemo Reef event arrangements at Haacklee Harbor. Please explain your documentation destruction request

Here we have a message analysis where it is ordered according to the corruption events.

Illustrative Case:

Summarize Nadia’s actions visually.



Nadia Conti (N)
27 comms

Rodriguez (R)
22 comms

The Middleman (F)
21 comms

Marlin (B)
18 comms

Serenity (C)
18 comms

Seawatch (D)

Click on entities to filter communications

Reset Filter

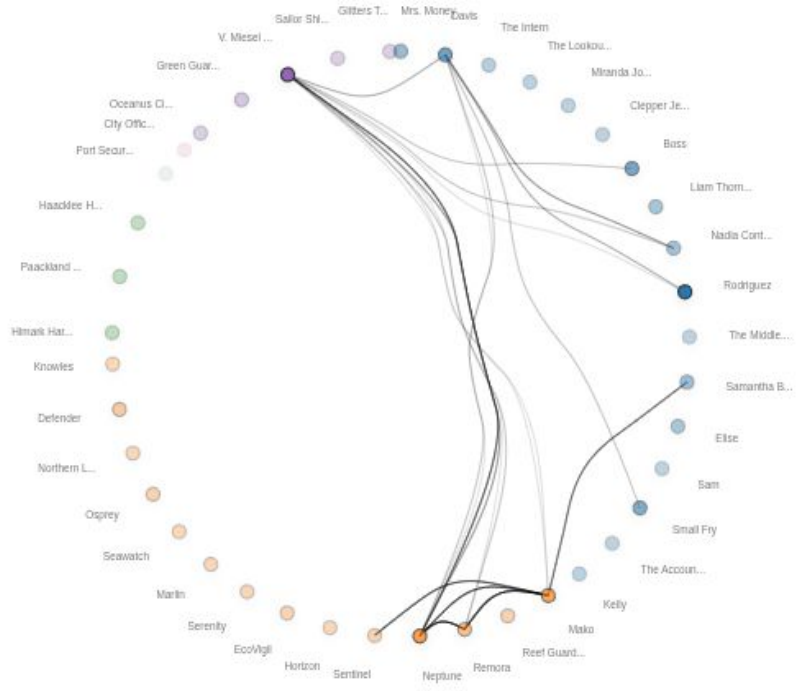
The "Permit" Topic

Topic Extraction Method: LDA with BOW

Topic Count: 20
Auto
5 20

Select Topic: Topic 10: need, operations, m

Model Quality:
Coherence: 0.294
Perplexity: 735.7
Diversity: 0.595



Topic Details

Topic 10

Method: lda (BOW)

MESSAGES	AVG. LENGTH	AVG. SCORE
29	34.4	0.591

need, operations, miesel, permit, neptune, mako, cr 7844, cr, 7844, permit cr

Top Entities

V. Miesel Shipping	0.452
Rodriguez	0.194
Neptune	0.128
Mako	0.112
Davis	0.103
Boss	0.095

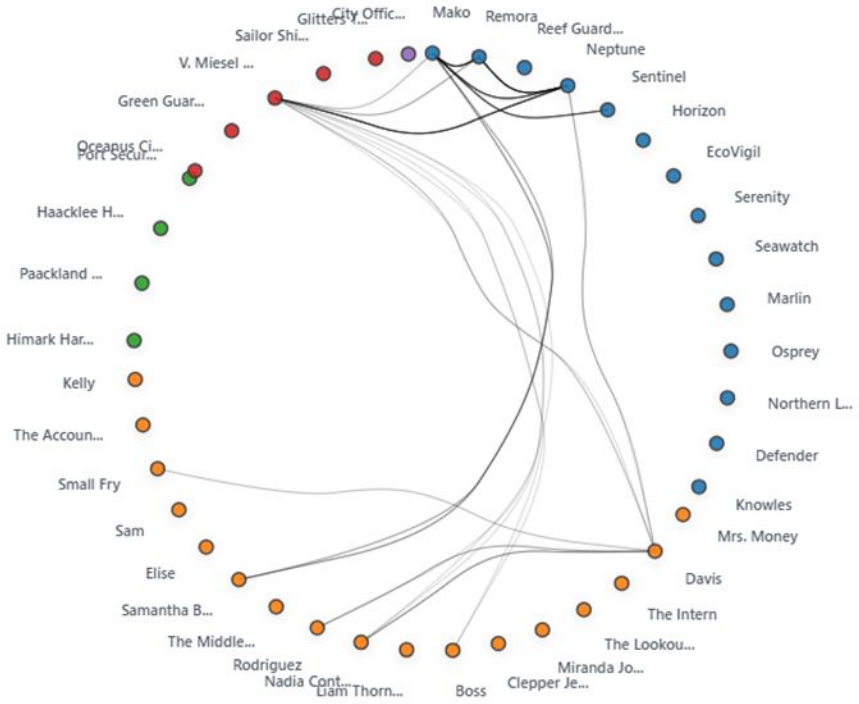
Topic Extraction Method: LDA with BOW

Topic Count: 20
Auto
5 20

Select Topic: Topic 10: need, operations, m

Model Quality:
Coherence: 0.294
Perplexity: 735.7
Diversity: 0.595

Reset View



Topic Details

Topic 10

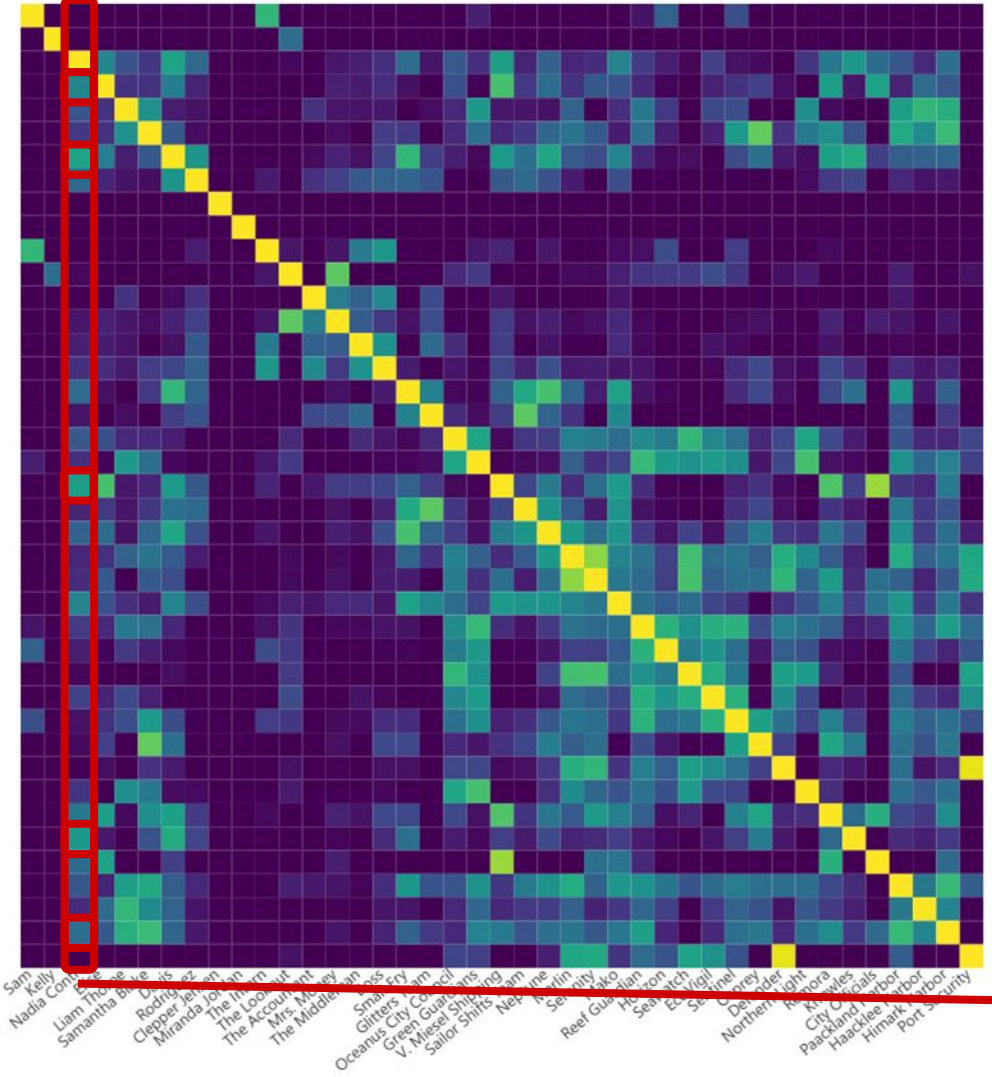
Method: lda (BOW)

MESSAGES	AVG. LENGTH	AVG. SCORE
29	34.4	0.591

need operations miesel permit neptune
mako 7844 cr 7844 cr permit cr

Top Entities

Mrs. Money	0.051
Samantha Blake	0.044
Nadia Conti	0.040
Defender	0.033
Liam Thorne	0.033
Elise	0.031
Green Guardians	0.030



Elise

Davis

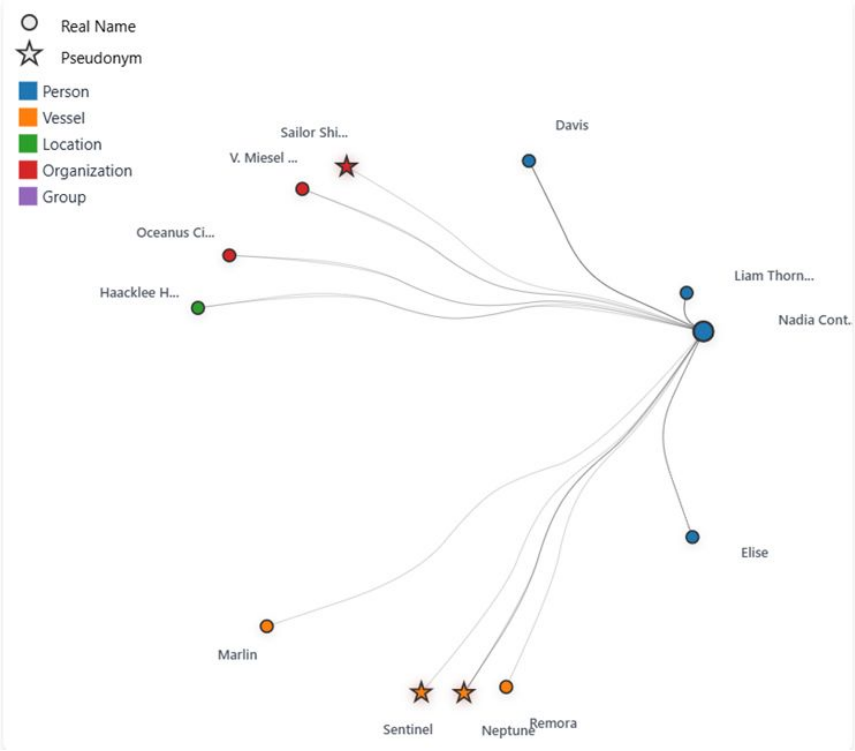
Rodriguez

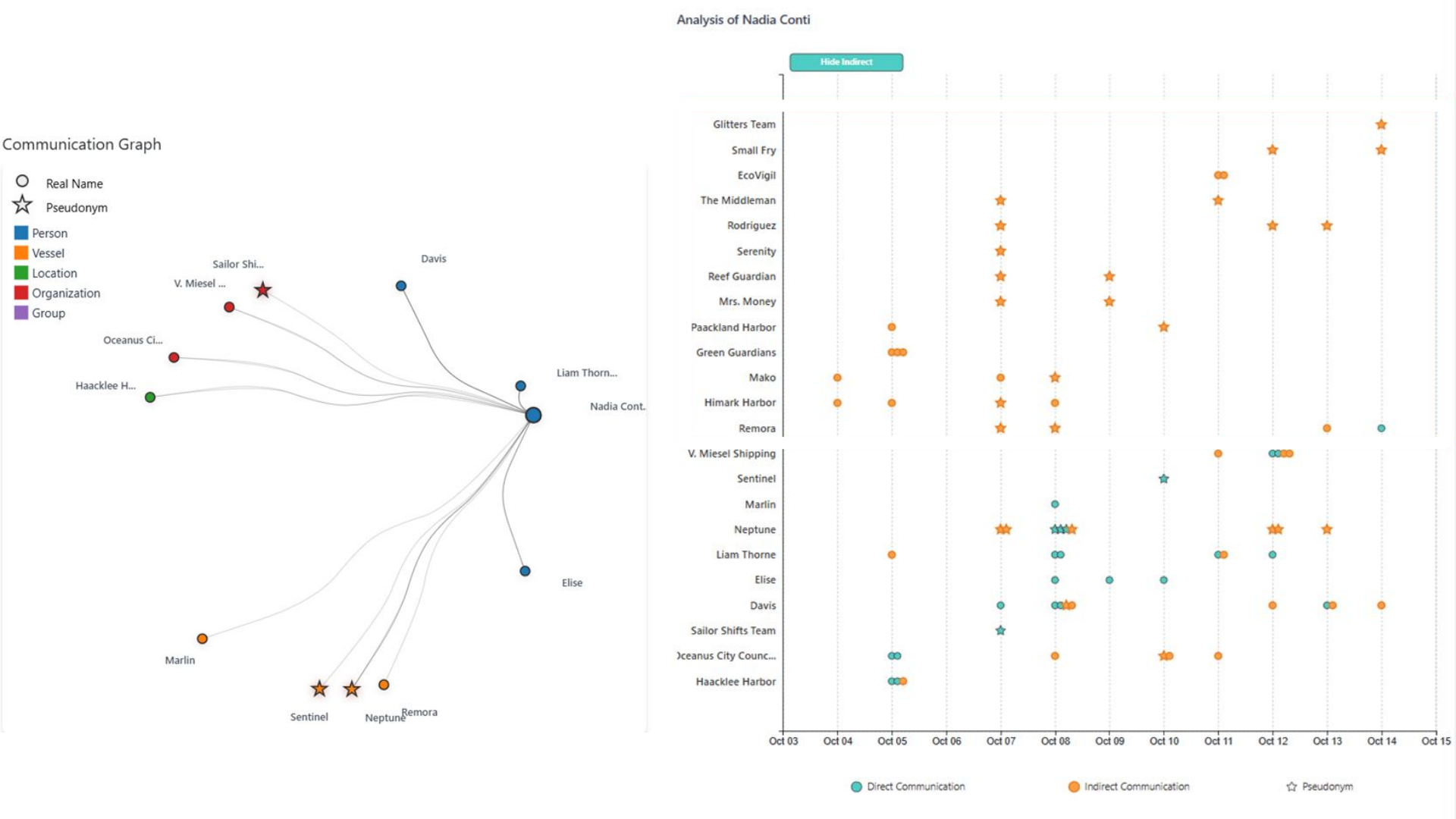
V. Miesel

Knowles

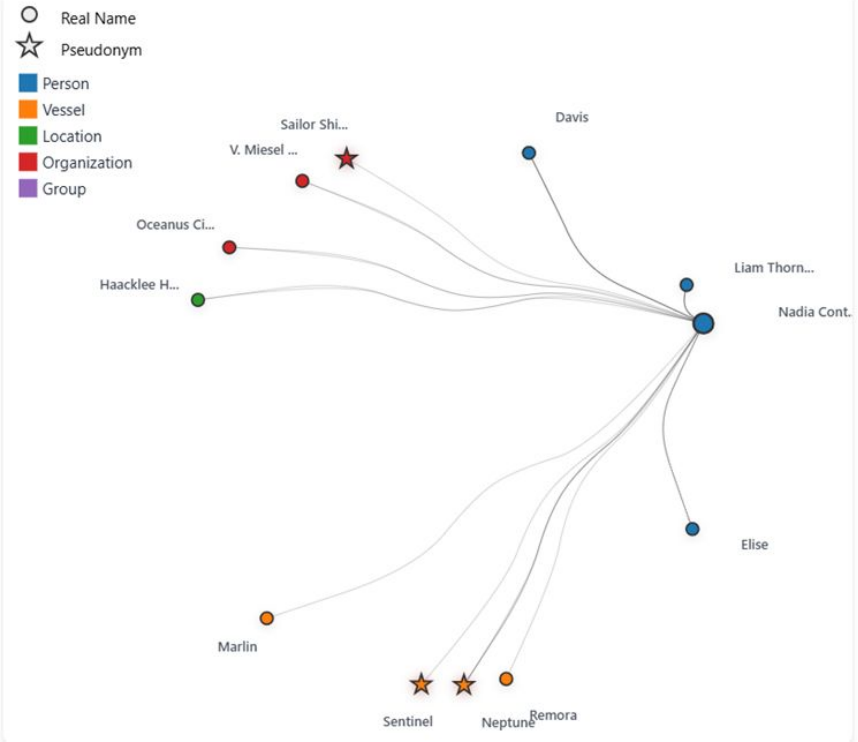
Nadia Conti

Communication Graph

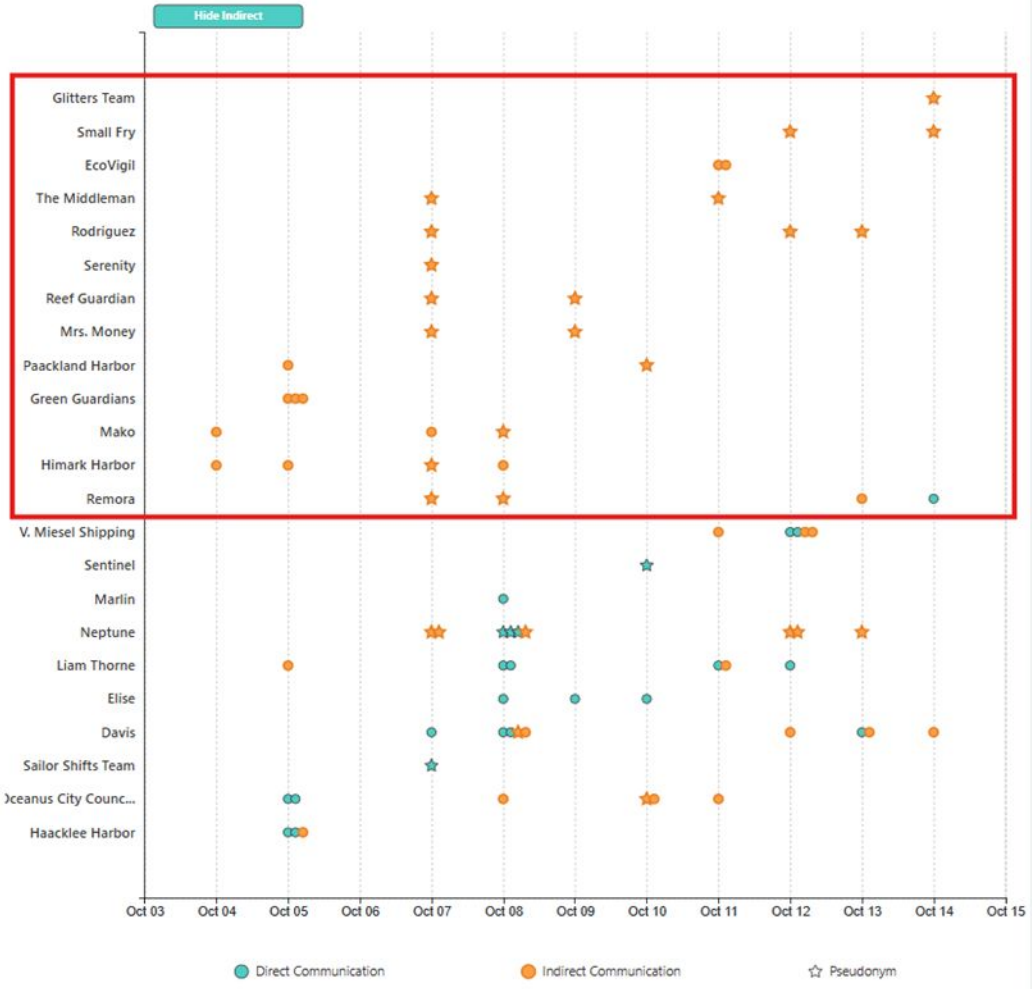



Analysis of Nadia Conti
Hide Indirect
Communication Graph
Real Name
Pseudonym
Person
Vessel
Location
Organization
Group
Sailor Shi...
V. Miesel ...
Davis
Oceanus Ci...
Haacklee H...
Liam Thorn...
Nadia Cont.
Elise
Marlin
Sentinel
Neptune
Remora
Glitters Team
Small Fry
EcoVigil
The Middleman
Rodriguez
Serenity
Reef Guardian
Mrs. Money
Paackland Harbor
Green Guardians
Mako
Himark Harbor
Remora
V. Miesel Shipping
Sentinel
Marlin
Neptune
Liam Thorne
Elise
Davis
Sailor Shifts Team
Oceanus City Counc...
Haacklee Harbor
Oct 03
Oct 04
Oct 05
Oct 06
Oct 07
Oct 08
Oct 09
Oct 10
Oct 11
Oct 12
Oct 13
Oct 14
Oct 15
Direct Communication
Indirect Communication
Pseudonym

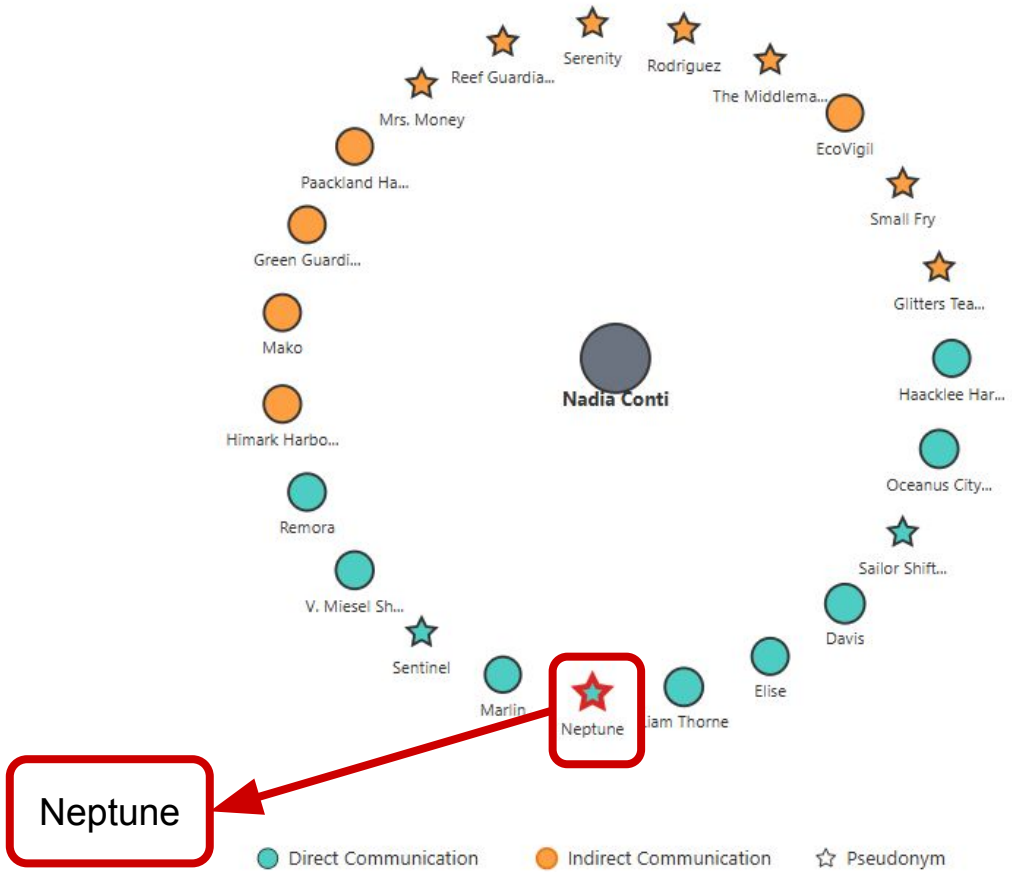
Communication Graph



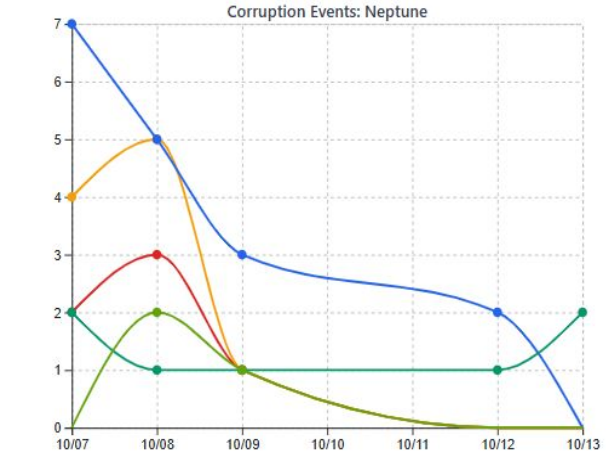
Analysis of Nadia Conti



Nadia Conti - Ego Network



Corruption Events Timeline



document destruction and ... | permission management | illicit payments and brib... | special access | money laundering

Message analysis

Communications: 18 | **Corruption Events:** 5 | **Keywords Found:** 13

illicit payments and bribery (17 occurrences)

Keywords: funding , cost , payment , protocol

Messages (17):

Neptune to Nadia. I'm aware of the foundation work concerns. We're delivering the additional heavy equipment today as requested. Will meet you at 0600 as planned to discuss resource adjustments and review modified equipment specifications that Elise has approved funding for.

direct - 2040-10-08

Neptune, Nadia here. Just confirming our 0600 meeting at the marina. I've reviewed the modified equipment specs with The Accountant. Please bring detailed timeline for foundation work and cost implications. We need to stay under radar.

direct - 2040-10-08

Neptune captain here. Elise, we're ready for your arrival at 0500 tomorrow. Need you to meet Mako and Remora captains to establish payment protocols. We've identified an alternative route around the eastern reef that should better accommodate our more delicate equipment. [via Elise]

indirect - 2040-10-07

Neptune captain here. Elise, we're ready for your arrival at 0500 tomorrow. Need you to meet Mako and Remora captains to establish payment protocols. We've identified an alternative route

Corruption Keywords Cloud

Findings

- We identified that most of Nadia's indirect messages were sent using pseudonyms.

- Most of the messages pertain to corruption.

- Most of the messages occurred during the first two weeks of those two weeks.

Contributions

Contributions

Our Achievement: Our Visual Analytics System successfully integrated temporal, network, and topic analysis to answer the challenge questions.

The Key Insight: The pseudonym detection method (using the heatmap and chat view) was critical. It unlocked the coded language and hidden relationships.

The Final Result: We provided a comprehensive dashboard that delivers clear, visual evidence of the covert coordination and corruption network centered around Nadia Conti.

THANKS!

VIS2025

Interactive Platform for the Visual Analysis of Suspicious Communication Patterns

Andres De la Puente, Juliano Genari, Marcelo Baez, Felipe Moreno-Vera, and Jorge Poco

Fundação Getulio Vargas / Visual Data Science Lab
www.visualdslab.com

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