

# Fuzzy Matching for Risk Analysis and Risk Profile Management



**Peter Went**  
**CEO**

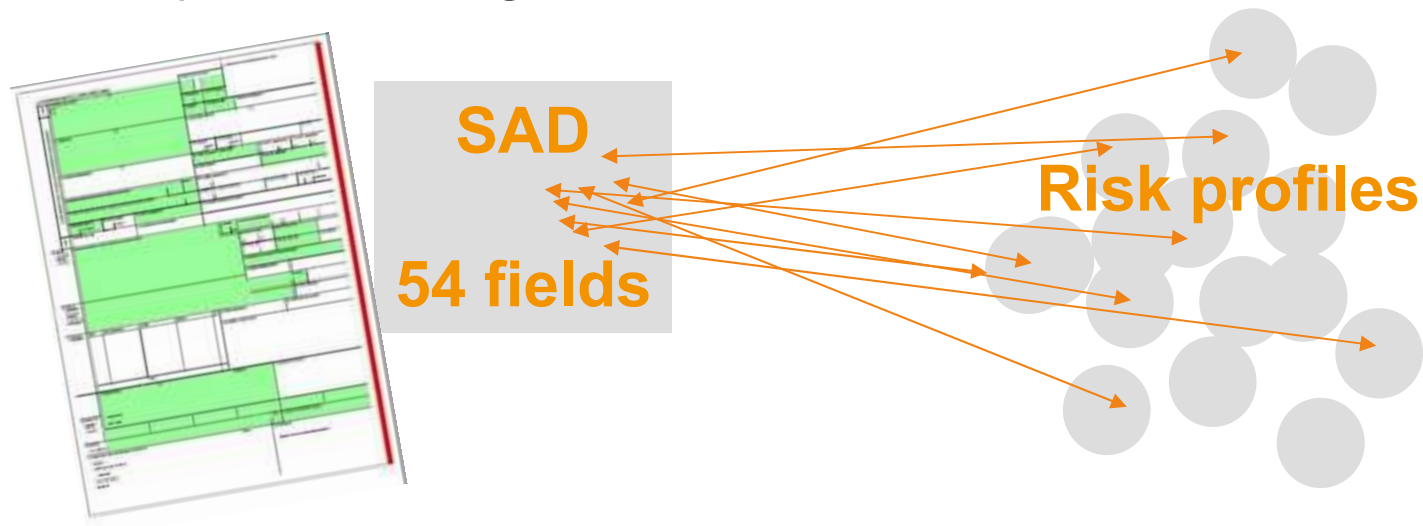


# Security in Customs Controls

- ❖ Challenge: enable Customs to focus on high risk consignments and on unreliable or unknown operators, in order to:
  - Achieve better revenue collection
  - Improve fight against frauds
  - Protect against threats
  
- ❖ Solution: make risk-information available at early stage
  - **Single Administrative Document (SAD)**
    - Streamlined from 200 separate customs declaration documents
  - **Pre-arrival / Pre-departure Information**
    - Provides customs with security-related data on goods within certain time-limits to allow for timely risk analysis prior to arrival in or departure from the EU
  - **Authorized Economic Operators (AEO)**
    - Lower risk score related to risk analysis for safety and security purposes
  
- ❖ Result: secure supply chain with safe and secure trading partners

# SAD challenges

- ❖ High volume of data
  - Worldwide container traffic 2015: 510-560 million containers
- ❖ Multiple risk factors
  - 54 fields in SAD
- ❖ Real-time availability
- ❖ High speed
- ❖ Risk profiles management



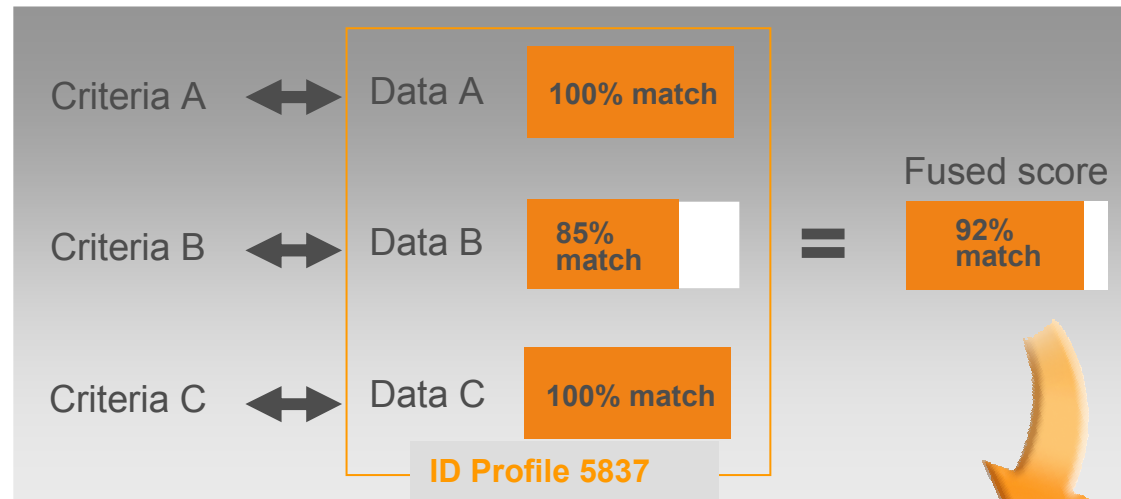
## Addressing the Challenges

### ❖ Matching risk profiles with SAD's

- Standard relational database systems not suitable for large number of criteria
- Standard relational database systems return only exact matches
- Fuzzy matching allows for:
  - **Finding similar matches**
  - **Specifying flexible numeric ranges**
  - **Assigning weights to more important criteria**
  - **Detecting (un-)intentional mistakes**

Similarity matching and scoring improves risk analysis

# Facilitating effective risk management



**Fused scores  
quickly give  
ranked results**

1	ID Profile 5837	92% match
2	ID Profile 7231	85% match
3	ID Profile 9144	79% match

# Automated Alerts

The screenshot displays the 'Cargo Alert System' window with a menu bar (File, Edit, View, Search, Help) and a table of alerts. The table columns are Vessel, Country, Shipment, Port, Risk Profile Matched, Match Score, Alert level, and Details. The 'Alert level' column uses red and yellow dots to indicate severity. Below the table is a 'Set Threat Thresholds' section with a slider set to 70.00. A callout box points to the 'Match Score' column, stating: 'Established risk profiles could be automatically matched against all incoming cargo'.

Vessel	Country	Shipment	Port	Risk Profile Matched	Match Score	Alert level	Details
HYR-6631...	BI	7259-561-B56	6B4	Trans_ship_17	99.7%	Red	▶
TUH-7793...	JH	7259-561-B57	7X9	Country_origin_33	99.3%	Red	▶
JPK-6631...	UJ	7259-561-B58	8H4	Trans_ship_75	99.2%	Red	▶
SRT-6631...	PA	7259-561-B59	7B8	Cross_over_42	97.3%	Red	▶
HYR-6631...	RT	7259-561-B60	9F3	Mineral_list_89	94.6%	Red	▶
TUH-7793...	ZL	7259-561-B61	8D3	Trans_ship_17	91.8%	Red	▶
JPK-6631...	WE	7259-561-B62	1A4	Country_origin_33	89.1%	Yellow	▶
SRT-6631...	CH	7259-561-D63	2E2	Trans_ship_75	85.9%	Yellow	▶
HYR-6631...	DE	7259-561-B64	7C1	Cross_over_42	85.1%	Yellow	▶
TUH-7793...	UJ	7259-561-B65	8H4	Mineral_list_89	85.1%	Yellow	▶
HYR-6631...	PA	7259-561-B66	6B4	Trans_ship_17	82.7%	Yellow	▶
TUH-7793...	RT	7259-561-B67	6B5	Trans_ship_18	81.9%	Yellow	▶
JPK-6631...	ZL	7259-561-B68	6B6	Trans_ship_19	78.6%	Yellow	▶

**Set Threat Thresholds**  
Drag to change values

70.00

Established risk profiles could be automatically matched against all incoming cargo

# Automated Alerts

The screenshot displays the 'Cargo Alert System' application window. It features a menu bar with 'File', 'Edit', 'View', 'Search', and 'Help'. Below the menu is a table of alerts, sorted by 'Match Score' in descending order. The table columns are: Vessel, Country, Shipment, Port, Risk Profile Matched, Match Score, Alert level, and Details. The 'Alert level' column uses red circles to indicate the severity of the alerts. At the bottom of the window, there is a 'Set Threat Thresholds' section with a slider set to 70.00 and a note 'Drag to change values'.

Vessel	Country	Shipment	Port	Risk Profile Matched	Match Score	Alert level	Details
HYR-6631...	BI	7259-561-B56	6B4	Trans_ship_17	99.7%	●	▶
TUH-7793...	JH	7259-561-B57	7X9	Country_origin_33	99.3%	●	▶
JPK-6631...	UJ	7259-561-B58	8H4	Trans_ship_75	99.2%	●	▶
SRT-6631...	PA	7259-561-B59	7B8	Cross_over_42	97.3%	●	▶
HYR-6631...	RT	7259-561-B60	9F3	Mineral_list_89	94.6%	●	▶
TUH-7793...	ZL	7259-561-B61	8D3	Trans_ship_17	91.8%	●	▶
JPK-6631...	WE	7259-561-B62	1A4	Country_origin_33	89.1%	●	▶
SRT-6631...	CH	7259-561-D63	2E2	Trans_ship_75	85.9%	●	▶
HYR-6631...	DE	7259-561-B64	7C1	Cross_over_42	85.2%	●	▶
TUH-7793...	UJ	7259-561-B65	8H4	Mineral_list_89	85.1%	●	▶
HYR-6631...	PA	7259-561-B66	6B4	Trans_ship_17	82.7%	●	▶
TUH-7793...	RT	7259-561-B67	6B5	Trans_ship_18	81.9%	●	▶
JPK-6631...	ZL	7259-561-B68	6B6	Trans_ship_19	78.6%	●	▶

**Set Threat Thresholds**  
70.00  
Drag to change values

Results can be shown in ranked order with degree of match shown either numerically or graphically. User could also sort by other columns

# Automated Alerts

The screenshot displays the 'Cargo Alert System' application window. It features a menu bar with 'File', 'Edit', 'View', 'Search', and 'Help'. Below the menu is a table with the following columns: Vessel, Country, Shipment, Port, Risk Profile Matched, Match Score, Alert level, and Details. The table lists 14 vessels with their respective match scores and alert levels. A callout box points to the 'Alert level' column, stating: 'Alerts/notifications could be issued with "above threshold" matches'. At the bottom of the window, there is a 'Set Threat Thresholds' section with a slider set to 70.00 and the instruction 'Drag to change values'.

Vessel	Country	Shipment	Port	Risk Profile Matched	Match Score	Alert level	Details
HYR-6631...	BI	7259-561-B56	6B4	Trans_ship_17	99.7%	Red	▶
TUH-7793...	JH	7259-561-B57	7X9	Country_origin_33	99.3%	Red	▶
JPK-6631...	UJ	7259-561-B58	8H4	Trans_ship_75	99.2%	Red	▶
SRT-6631...	PA	7259-561-B59	7B8	Cross_over_42	97.3%	Red	▶
HYR-6631...	RT	7259-561-B60	9F3	Mineral_list_89	94.6%	Red	▶
TUH-7793...	ZL	7259-561-B61	8D3	Trans_ship_17	91.8%	Red	▶
JPK-6631...	WE	7259-561-B62	1A4	Country_origin_33	89.1%	Yellow	▶
SRT-6631...	CH	7259-561-D63	2E2	Trans_ship_75	85.9%	Yellow	▶
HYR-6631...	DE	7259-561-B64	7C1	Cross_over_42	85.2%	Yellow	▶
TUH-7793...	UJ	7259-561-B65	8H4	Mineral_list_89	85.1%	Yellow	▶
HYR-6631...	PA	7259-561-B66	6B4	Trans_ship_17	82.7%	Yellow	▶
TUH-7793...	RT	7259-561-B67	6B5	Trans_ship_18	81.9%	Yellow	▶
JPK-6631...	ZL	7259-561-B68	6B6	Trans_ship_19	78.6%	Yellow	▶

**Set Threat Thresholds**  
Drag to change values

70.00

Alerts/notifications could be issued with "above threshold" matches

# Automated Alerts

The screenshot displays the 'Cargo Alert System' interface. At the top is a menu bar with 'File', 'Edit', 'View', 'Search', and 'Help'. Below the menu is a table with the following columns: Vessel, Country, Shipment, Port, Risk Profile Matched, Match Score, Alert level, and Details. The table lists 15 vessels with their respective match scores and alert levels. A callout box points to the 'Alert level' column, stating: 'Thresholds can easily be adjusted to accommodate changing conditions'. Below the table is a 'Set Threat Thresholds' control panel with a slider ranging from 70.00 to 90.00. The slider is currently set at 70.00, and the alert levels in the table correspond to the color-coded segments of the slider: green (70.00-85.00), yellow (85.00-90.00), and red (90.00+).

Vessel	Country	Shipment	Port	Risk Profile Matched	Match Score	Alert level	Details
HYR-6631...	BI	7259-561-B56	6B4	Trans_ship_17	99.7%		
TUH-7793...	JH	7259-561-B57	7X9	Country_origin_33	99.3%		
JPK-6631...	UJ	7259-561-B58	8H4	Trans_ship_75	99.2%		
SRT-6631...	PA	7259-561-B59	7B8	Cross_over_42	97.3%		
HYR-6631...	RT	7259-561-B60	9F3	Mineral_list_89	94.6%		
TUH-7793...	ZL	7259-561-B61	8D3	Trans_ship_17	91.8%		
JPK-6631...	WE	7259-561-B62	1A4	Country_origin_33	89.1%		
SRT-6631...	CH	7259-561-D63	2E2	Trans_ship_75	85.9%	●	▶
HYR-6631...	DE	7259-561-B64	7C1	Cross_over_42	85.2%	●	▶
TUH-7793...	UJ	7259-561-B65	8H4	Mineral_list_89	85.1%	●	▶
HYR-6631...	PA	7259-561-B66	6B4	Trans_ship_17	82.7%	●	▶
TUH-7793...	RT	7259-561-B67	6B5	Trans_ship_18	81.9%	●	▶
JPK-6631...	ZL	7259-561-B68	6B6	Trans_ship_19	78.6%	●	▶

**Set Threat Thresholds**  
Drag to change values

70.00 90.00

# Defined Risk Profiles

**Define Criteria**

Method of Transportation (MOT)		<input type="checkbox"/>	
Shipping Weight (SHIPWT)	5,000	<input checked="" type="checkbox"/>	
Country Code	UK	<input checked="" type="checkbox"/>	
Value	\$43,560	<input checked="" type="checkbox"/>	
Port of Entry or Export	CEG	<input checked="" type="checkbox"/>	
Date		<input type="checkbox"/>	
Container Code		<input type="checkbox"/>	
Container Number		<input type="checkbox"/>	
Goods Description	steel tubing	<input checked="" type="checkbox"/>	
Vessel Name	Star of the Sea	<input checked="" type="checkbox"/>	

**Risk Profile Name**  
Tranship\_17

Delete Risk Profile  
Save Risk Profile

**Current Result List**

Vessel	Country	Shipment	Port	Risk Profile Matched	Match
HYR-6631...	BI	7259-561-B56	6B4	Trans_ship_17	
TUH-7793...	JH	7259-561-B57	7X9	Country_origin_33	
IND-6631...	LI	7259-561-B58	8H4	Trans_ship_75	

Query criteria can be entered in ad-hoc selection from any combination of possibly hundreds of fields

# Defined Risk Profiles

**Define Criteria**

Method of Transportation (MOT)		<input type="checkbox"/>	
Shipping Weight (SHIPWT)	5,000	<input checked="" type="checkbox"/>	
Country Code	UK	<input checked="" type="checkbox"/>	
Value	\$43,560	<input checked="" type="checkbox"/>	
Port of Entry or Export	CEG	<input checked="" type="checkbox"/>	
Date		<input type="checkbox"/>	
Container Code		<input type="checkbox"/>	
Container Number		<input type="checkbox"/>	
Goods Description	steel tubing	<input checked="" type="checkbox"/>	
Vessel Name	Star of the Sea	<input checked="" type="checkbox"/>	

**Risk Profile Name**

- Tranship\_17
- Delete Risk Profile
- Save Risk Profile

**Current Result List**

Vessel	Country	Shipment	Port	Risk Profile Matched	Mat
HYR-6631...	BI	7259-561-B56	6B4	Trans_ship_17	
TUH-7793...	JH	7259-561-B57	7X9	Country_origin_33	
IND-6631...	LI	7259-561-B58	8Y4	Trans_ship_17	

Once a combination of search criteria is tuned to find suspicious cargo, it can be saved as a 'Risk profile' against which any incoming manifest will be matched

# Defined Risk Profiles

**Define Criteria**

Method of Transportation (MOT)		<input type="checkbox"/>	
Shipping Weight (SHIPWT)	5,000	<input checked="" type="checkbox"/>	
Country Code	UK	<input checked="" type="checkbox"/>	
Value	\$43,560	<input checked="" type="checkbox"/>	
Port of Entry or Export	CEG	<input checked="" type="checkbox"/>	
Date		<input type="checkbox"/>	
Container Code		<input type="checkbox"/>	
Container Number		<input type="checkbox"/>	
Goods Description	steel tubing	<input checked="" type="checkbox"/>	
Vessel Name	Star of the Sea	<input checked="" type="checkbox"/>	

**Risk Profile Name**  
Tranship\_17

Delete Risk Profile

Save Risk Profile

**Current Result List**

Vessel	Country	Shipment	Port	Risk Profile Matched	Match Score
HYR-6631...	BI	7259-561-B56	6B4	Trans_ship_17	99.7%
TUH-7793...	JH	7259-561-B57	7X9	Country_origin_33	99.3%
IPK-6631...	LI	7259-561-B58	8Y4	Trans_ship_75	99.2%

Weights can be set to give most important criteria more influence in the results. Items not selected would not be matched

# Defined Risk Profiles

**Cargo Alert System**

File Edit View Search Help

**Define Criteria**

Method of Transportation (MOT)		<input type="checkbox"/>	
Shipping Weight (SHIPWT)	5,000	<input checked="" type="checkbox"/>	
Country Code	UK	<input checked="" type="checkbox"/>	
Value	\$43,560	<input checked="" type="checkbox"/>	
Port of Entry or Export	CEG	<input checked="" type="checkbox"/>	
Date		<input type="checkbox"/>	
Container Code		<input type="checkbox"/>	
Container Number		<input type="checkbox"/>	
Goods Description	steel tubing	<input checked="" type="checkbox"/>	
Vessel Name	Star of the Sea	<input checked="" type="checkbox"/>	

**Risk Profile M**

Tranship\_17

Delete Risk

Save Risk

**Current Result List**

Vessel	Country	Shipment	Port	Risk Profile Matched	Match Score	Alert level	Details
HYR-6631...	BI	7259-561-B56	6B4	Trans_ship_17	99.7%		
TUH-7793...	JH	7259-561-B57	7X9	Country_origin_33	99.3%		
HYR-6631...	BI	7259-561-B58	8H4	Trans_ship_17	99.2%		

Display could show current profile search result to help tune risk profile definition

# Adjudication Assistance

**Cargo Alert System**

File Edit View Search Help

**Risk Profile Name**  
Tranship\_17

**Risk Profile Definition**

Field Name	Criteria	Data Found	Score
Method of Transportation (MOT)		not used	
Shipping Weight (SHIPWT)	5,000	4,500	85.7%
Country Code	UK	UK	100%
Value	\$43,560	38,000	92.0%
Port of Entry or Export	CEG	CEG	100%
Date		not used	
Container Code		not used	
Container Number	MZ7-4548823	MZ7-45488	
Goods Description	steel tubing	Miraflex st	
Vessel Name	Star of the Sea	Star of the	

Overall Score: 96%

Buttons: Edit Risk Profile, Delete Risk Profile, Save Risk Profile

Details of each match explain how the score was calculated to show which items matched and how closely they matched

# Adjudication Assistance

**Cargo Alert System**  
File Edit View Search Help

**Risk Profile Name**  
Tranship\_17

Risk Profile Definition		Match Details
Field Name	Criteria	Data Found
Method of Transportation (MOT)		not used
Shipping Weight (SHIPWT)	5,000	4,500
Country Code	UK	UK
Value	\$43,560	38,000
Port of Entry or Export	CEG	CEG
Date		not used
Container Code		not used
Container Number	MZ7-4548823	MZ7-4548828
Goods Description	steel tubing	Miraflex steel tubing .75" dia
Vessel Name	Star of the Sea	Star of the Sea

Edit Risk Profile Delete Risk Profile Save Risk Profile

Similar, but not exact matching values highlighted, showing which items could be of interest and speeding up the adjudication process

## Take-away

- ❖ Customs efforts in securing the supply chain will greatly benefit from advanced fuzzy matching methods
  - Scoring and ranking improves risk analysis
  - Score analytics enables advanced risk profile management
- ❖ WCC has 13 years of experience in large-scale programs involving advanced search and match
  - Market leader in Public Employment Services
  - Thought leader in Identity and Identification markets
    - Multi-modal biometric and biographic fusion
  - Strong system integrator relationships
- ❖ WCC's Search and Match platform is trusted and proven
  - Deployed at Irish Revenue Commissioners to improve post-compliance audit activities

# THANK YOU FOR YOUR ATTENTION

## QUESTIONS?

**Peter Went**  
**CEO**  
[pwent@wcc-group.com](mailto:pwent@wcc-group.com)  
**+31.30.750.3200**