

# IS SNOMED-CT JUST FOR HEALTHCARE

? Petr Křemen

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“

Don't reinvent the wheel, just realign it.

– ANTHONY J. D'ANGELO

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# IS SNOMED-CT JUST FOR HEALTHCARE?

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- Can SNOMED-CT ecosystems help outside healthcare?
- Which parts of SNOMED-CT are healthcare agnostic?
- What will be the key benefits / obstacles?
- How all this might work for the *aviation safety* domain?

# ABOUT ME



## PETR KŘEMEN

- researcher, ontologist and SW developer
- focusing on description logic reasoning, query answering, web ontologies, and ontology-based information systems



01

### **QUICK INTRO TO AVIATION SAFETY REPORTING**

Let's start with an example non-healthcare domain.

02

### **SNOMEDIZING ECCAIRS**

I will describe the alignment of SNOMED-CT and ECCAIRS.

03

### **BENEFITS & CHALLENGES**

I will discuss benefits and challenges when using SNOMED-CT for ECCAIRS

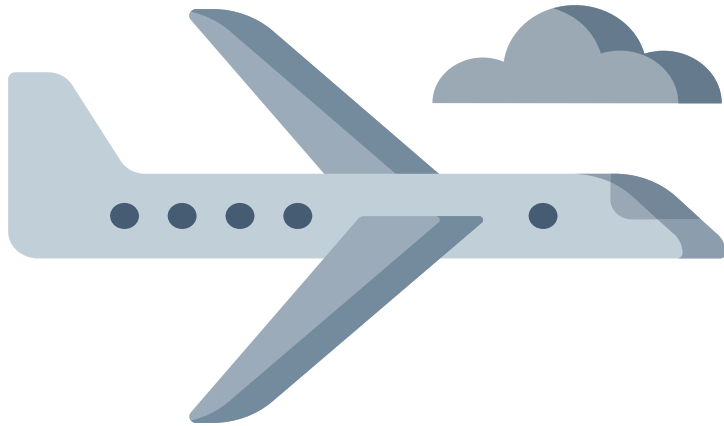
04

### **LESSONS LEARNT**

Summary and outlook

# **OUTLINE**

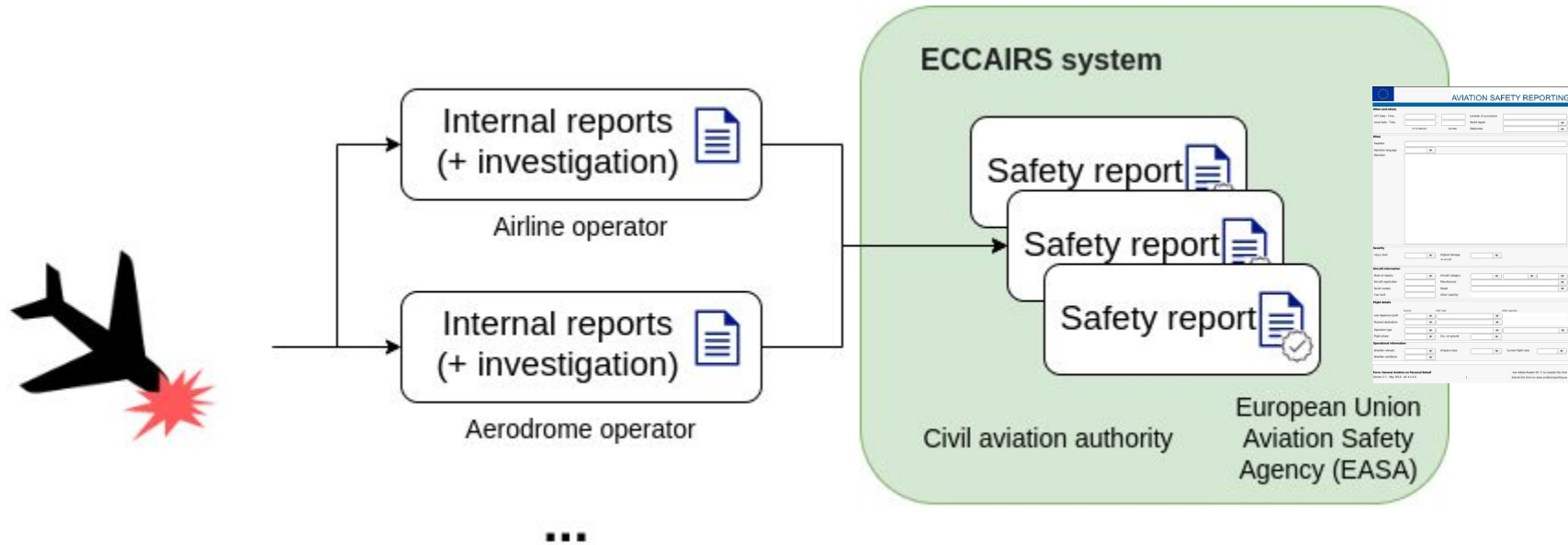
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# 01. AVIATION SAFETY REPORTING

A non-healthcare domain - a running example

# WHAT HAPPENS AFTER AN ACCIDENT



Entities and attributes

# ECCAIRS TAXONOMY BROWSER

**ECCAIRS2 - SRIS2**

TAXONOMY BROWSER 5.1.0.0 Released Taxonomy International Organisations EASA\_ECCAIRS 16-Jun-2020

event

Occurrence

- Aircraft
  - All Attributes
    - Speed (first event)
- Events
  - All Attributes
    - Event justification
    - Event type**

**Event type**

Definition Values

type to filter

- Flight Planning and Preparation
- Ground Conflict
- Incursions
  - Apron/Ramp Incursion by a Person
  - Apron/Ramp Incursion by a Vehicle/Equipment
  - Apron/Ramp Incursion by an Aircraft
  - Apron/Ramp Incursion by Other
  - FATO Incursion by a Person
  - FATO Incursion by a Vehicle/Equipment
  - FATO Incursion by an Aircraft
  - FATO Incursion by Other
  - Runway Incursion by a Person
  - Runway Incursion by a Vehicle/Equipment**

**DEFINITION**

Value ID: 2200102

Description: Runway Incursion by a Vehicle/Equipment

Detailed: Runway incursion by a vehicle/equipment

Explanation: An event involving a runway incursion by a vehicle or equipment.

XSD Tag: 2200102

Domains:

Special Value: Normal

Parent: Incursions

**VALUE ALIAS**

Alias	Value	Default
ICAO	2200102	<input type="checkbox"/>

Entities Attributes Linked

This website is financed by Commission Europe

2.9

Download Taxonomy in XML

Value lists and values

ECCAIRS taxonomy browser at <https://e2.aviationreporting.eu/taxonomy>

# OBSTACLES FOR AVIATION ORGANIZATIONS

## ECCAIRS-COMPLIANT REPORTING

How to avoid double reporting (internally, and into ECCAIRS)?

## SAFETY DATA HARMONIZATION

How to structure internal safety reports? ECCAIRS is too coarse-grained for internal reporting.



## ECCAIRS EXPLORATION

Which parts of ECCAIRS might be relevant when reporting an occurrence on a runway?

## TOOLING

Which tools to use for managing the safety report structure, including terminology.

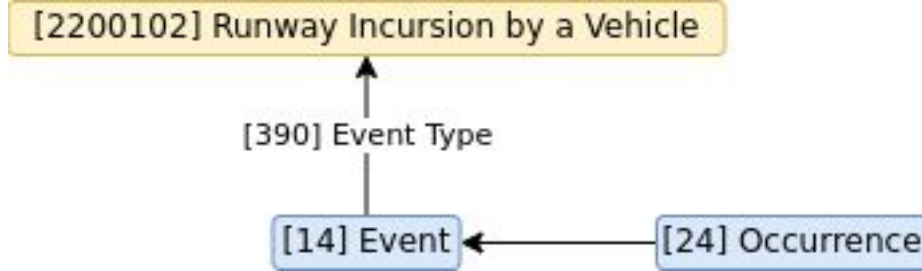


*(Photo: Transport Safety Board of Canada)*

# AVIATION SAFETY REPORTS

to improve exchange of aviation safety data between aviation organizations and regulators providing

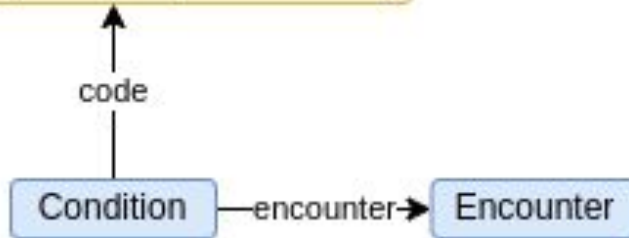
- **standardized information & data model** (ECCAIRS)
- **standardized semantics** (ECCAIRS)



# ELECTRONIC HEALTH RECORDS



287048003 | Pain in right lower limb |









to improve exchange of health data between healthcare suppliers, providing

- **standardized information & data model** (e.g. FHIR)
- **standardized semantics** (e.g. SNOMED-CT + other code systems)

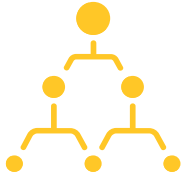


## 02. SNOMEDIZING ECCAIRS

# SNOMED-CT VS. ECCAIRS

	SNOMED-CT	ECCAIRS
SCOPE	healthcare	aviation safety
# CONCEPTS	350k+	80k+
TAXONOMY STRUCTURE	multi-hierarchy	single hierarchy
TAXONOMY DEPTH	10+	6
CONCEPT MODEL	 for validation  for reporting	 for validation  for reporting
MULTILINGUALITY		

# WHAT ARE THE COMPONENTS OF SNOMED-CT?

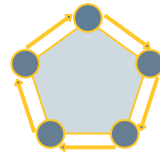


## HEALTHCARE CONTENT

Clinical findings,  
procedures, etc.

## INFRASTRUCTURE

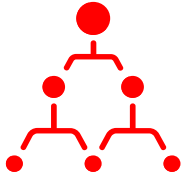
ECL, Concept model,  
Identifiers, Classification,  
Mapping mechanism,  
Distribution management



## TOOLS

Terminology servers,  
Authoring tools, etc.

# WHAT IS REUSABLE?

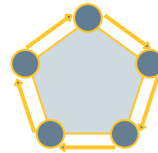


## AVIATION SAFETY CONTENT

Occurrences, Aircraft, etc.

## INFRASTRUCTURE

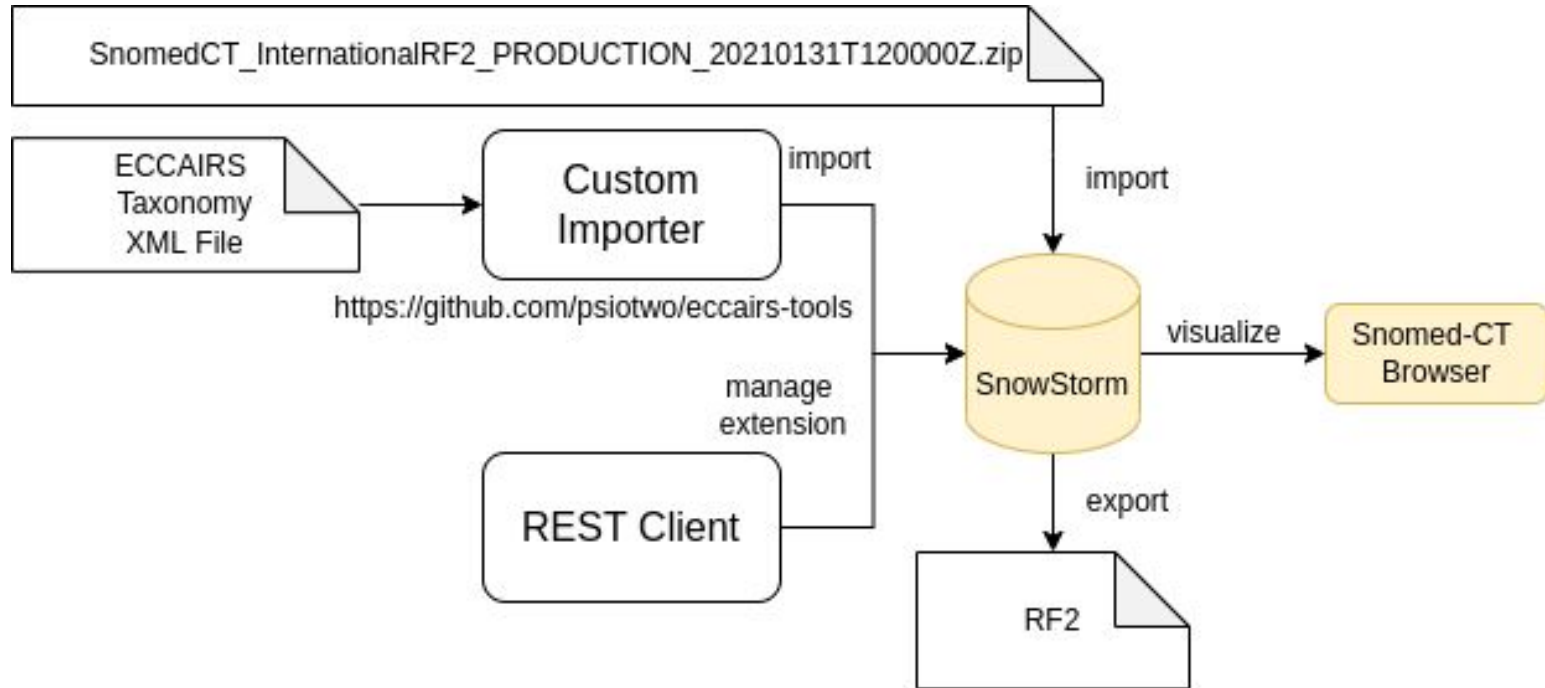
ECL, Concept model,  
Identifiers, Inference,  
Mapping mechanism,  
Distribution management



## TOOLS

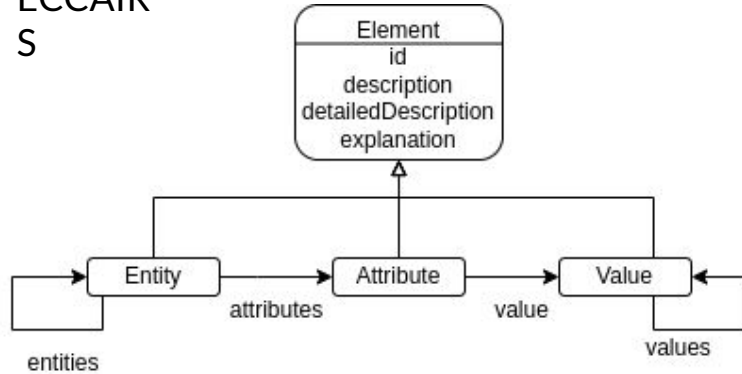
Terminology servers,  
Authoring tools, etc.

# PIPELINE

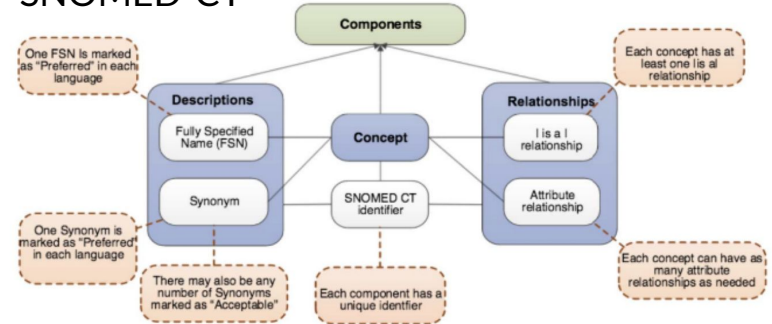


# CONCEPT MODEL ALIGNMENT

ECCAIR  
S



SNOMED-CT



Taken from <https://www.snomed.org/snomed-ct/five-step-briefing>

## Mapping ECCAIRS to SNOMED-CT

- Entity, Attribute, Value
- Entity.entities
- Entity.attributes.value
- Attribute
- Value.values
- id
- description + semantic tag (entity, attribute, value)
- description
- detailedDescription
- explanation

- ⇒ Concept
- ⇒ *refers to* relationship type
- ⇒ Relationship, RefSet
- ⇒ Relationship type
- ⇒ inverse of IS-A
- ⇒ *has* ECCAIRS id relationship type
- ⇒ FSN
- ⇒ PREFERRED SYNONYM in "en"
- ⇒ SYNONYM
- ⇒ DEFINITION





**03.**

**BENEFITS &  
CHALLENGES**

# BENEFIT #1: ECCAIRS EXPLORATION

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- faceted search in SNOMED-CT Browser
- Using ECL queries explore the ECCAIRS content.

# SNOMED-CT BROWSER: MORE ADVANCED EXPLORATION

The screenshot displays the SNOMED CT Browser interface. At the top, navigation options include 'Taxonomy', 'Search', 'Favorites', and 'Reset'. The search bar contains the term 'Incursion', with 19 matches found in 0.297 seconds. The search results are filtered by 'Active concepts only' and 'Description type: All'. The results list includes various concepts such as 'Incursions (value)', 'Runway Incursion (Entity)', and 'FATO Incursion by a Person (value)'. A callout points to the search bar with the text 'Search across ECCAIRS entities, values, attributes'. The right panel shows the 'Concept Details' for '[2200000] Incursions (value)', including its SCTID, a list of children, and an axiom: 'Has ECCAIRS id -> 2200000'. A callout points to this axiom with the text 'ECCAIRS identification'. The bottom callout points to the search bar with the text 'Search across ECCAIRS value lists'.

SNOMED CT Browser

Release: Code system ECCAIRS | Version: 2021-01-05 | Perspective: Full | Feedback | About

Search: incursion

Options: Search: Prefix any order | Status: Active concepts only | Description type: All | Language Refsets | Group by concept | ECCAIRS module...

Filter results by Language: english

Filter results by Semantic Type: Entity (1), value (18)

Filter results by Refset: OWL axiom reference set (19), [390] Event type (value) reference set (17), [430] Occurrence category (value) reference set (1)

Concept	Value
Incursions	[2200000] Incursions (value)
Runway Incursion	[47] Runway Incursion (Entity)
FATO Incursion by Other	[99012397] FATO Incursion by Other (value)
Runway Incursion by Other	[99012398] Runway Incursion by Other (value)
Taxiway Incursion by Other	[99012399] Taxiway Incursion by Other (value)
FATO Incursion by a Person	[99010382] FATO Incursion by a Person (value)
Runway Incursion by a Person	[2200103] Runway Incursion by a Person (value)
Taxiway Incursion by a Person	[2200203] Taxiway Incursion by a Person (value)
Apron/Ramp Incursion by Other	[99012396] Apron/Ramp Incursion by Other (value)
FATO Incursion by an Aircraft	[99010381] FATO Incursion by an Aircraft (value)
Runway Incursion by an Aircraft	[2200101] Runway Incursion by an Aircraft (value)
Taxiway Incursion by an Aircraft	[2200201] Taxiway Incursion by an Aircraft (value)
Apron/Ramp Incursion by a Person	[2200303] Apron/Ramp Incursion by a Person (value)
Apron/Ramp Incursion by an Aircraft	[2200301] Apron/Ramp Incursion by an Aircraft (value)
FATO Incursion by a Vehicle/Equipment	[99010383] FATO Incursion by a Vehicle/Equipment (value)
Runway Incursion by a Vehicle/Equipment	[2200102] Runway Incursion by a Vehicle/Equipment (value)
Taxiway Incursion by a Vehicle/Equipment	[2200202] Taxiway Incursion by a Vehicle/Equipment (value)



Concept Details: [2200000] Incursions (value)

Axiom: Has ECCAIRS id -> 2200000

Children (16): [2200101] Runway Incursion by an Aircraft (value), [2200102] Runway Incursion by a Vehicle/Equipment (value), [2200103] Runway Incursion by a Person (value), [2200201] Taxiway Incursion by an Aircraft (value), [2200202] Taxiway Incursion by a Vehicle/Equipment (value), [2200203] Taxiway Incursion by a Person (value), [2200301] Apron/Ramp Incursion by an Aircraft (value), [2200302] Apron/Ramp Incursion by a Vehicle/Equipment (value), [2200303] Apron/Ramp Incursion by a Person (value), [99010381] FATO Incursion by an Aircraft (value), [99010382] FATO Incursion by a Person (value), [99010383] FATO Incursion by a Vehicle/Equipment (value), [99012396] Apron/Ramp Incursion by Other (value), [99012397] FATO Incursion by Other (value), [99012398] Runway Incursion by Other (value), [99012399] Taxiway Incursion by Other (value)

# SNOMED-CT BROWSER: VALUE LIST VIEW

SNOMED CT Browser

Release: Code system ECCAIRS | Version: 2021-01-05 | Perspective: Full | Feedback | About |  | 

Taxonomy | Search | Favorites | Refset

Search

Options

Type at least 3 characters ✓ Example: *shou fra*

Search: Prefix any order

Status: Active concepts only

Description type: All

Language Refsets

Group by concept

ECCAIRS module... x

Filter results by Language

english 1

Filter results by Semantic Tag

Filter results by Refset

event type reference set

1 matches found in 0.214 seconds.

Event type reference set [390] Event type (value) reference set

All results are displayed

Event types

Concept Details | Expression Constraint Queries

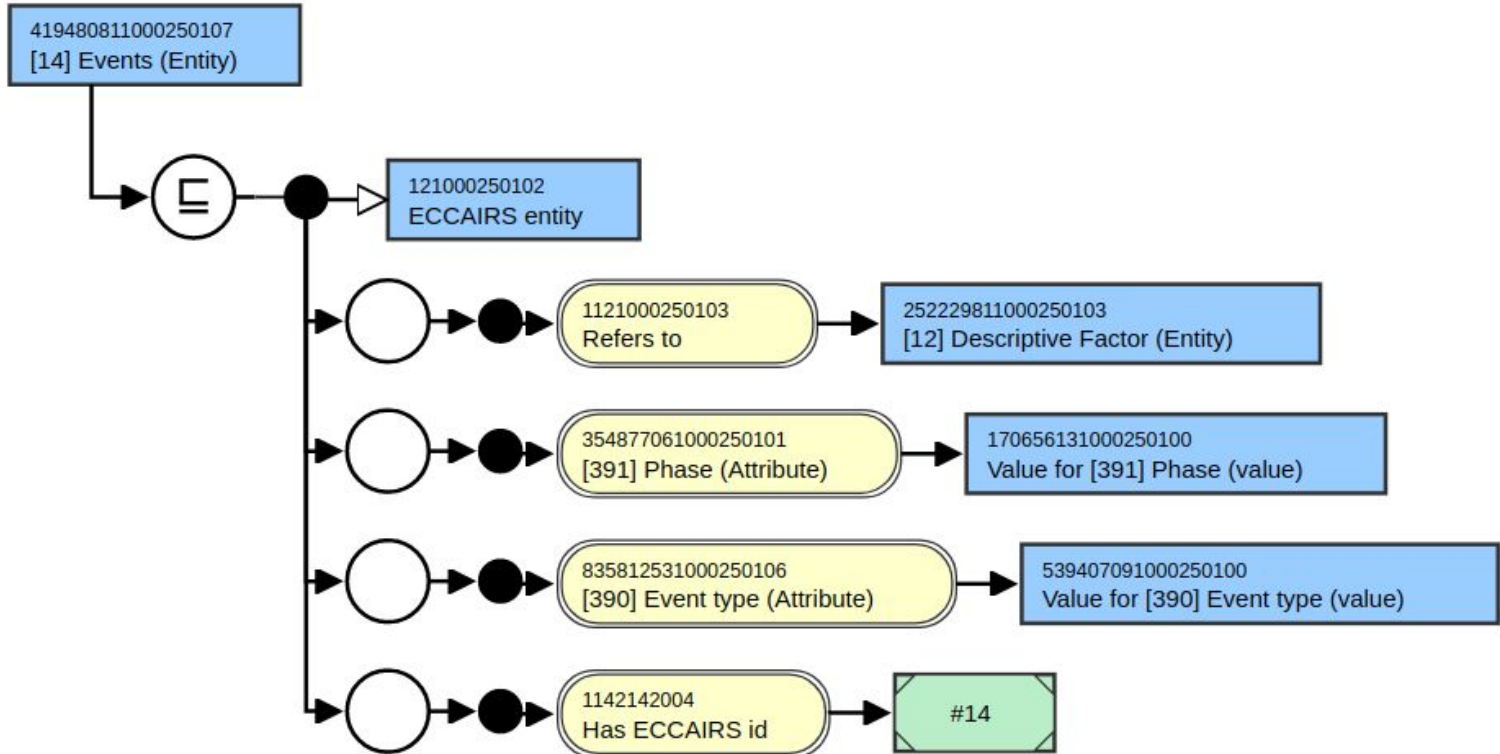
Concept Details

Summary | Details | Diagram | Expression | Refsets | Members | History | References

Stated | Inferred

Term	Preferred Term	Concept Id
[99010228] Hail Damage (value)	Hail Damage	553755731000250100
[99010229] Lightning Strike Damage (value)	Lightning Strike Damage	624431451000250109
[2060200] FOD Damage (value)	FOD Damage	169160891000250103
[2060300] Ground Resonance Damage (value)	Ground Resonance Damage	423231891000250100
[3190000] Flight Cancellation (value)	Flight Cancellation	778248601000250108
[3200000] Flight Delay (value)	Flight Delay	146903261000250103
[3020000] Emergency Situations (value)	Emergency Situations	480964111000250100
[99010142] Return to Stand (value)	Return to Stand	446980371000250102
[99010058] Landing With Fuel Reserve Below Regulatory Minimum (value)	Landing With Fuel Reserve Below Regulatory Minimum	408428281000250108
[3220000] Handling Check (value)	Handling Check	415243561000250102
[99010146] Landing Following Unstabilised Approach	Landing Following Unstabilised Approach	795131191000250109

# SNOMED-CT BROWSER: CONCEPT DETAIL



# BASIC ECL QUERIES

- Which event types can I choose from (including those defined in my extension)

^ 73214130001 | RefSet for Event types |

- Which subcategory of event types *Runway incursion by a vehicle* belongs to?

> 805569581000250104 |Runway incursion by a vehicle|

AND

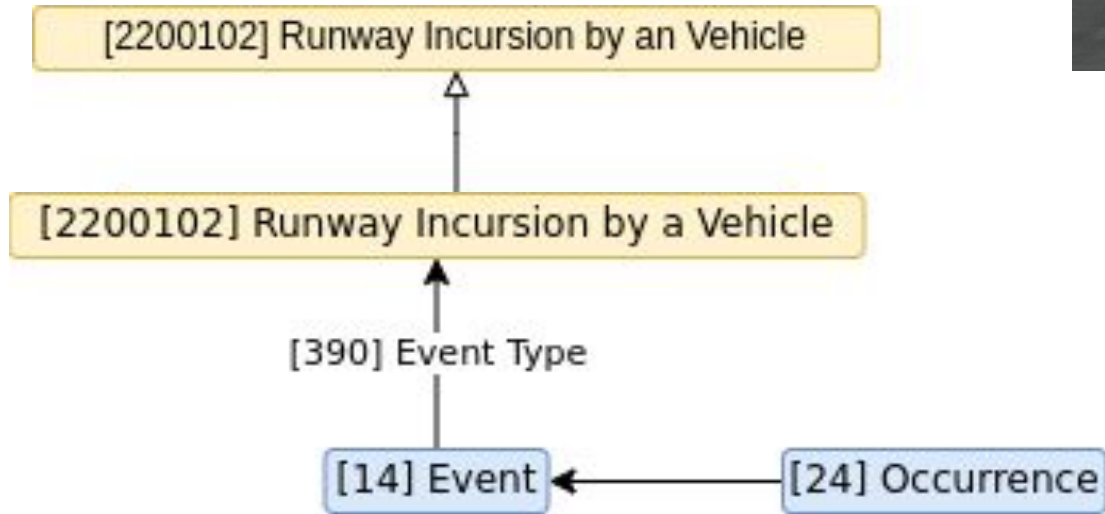
<! 539407091000250100 | Value for [390] Event|

# BENEFIT #2: CUSTOM EXTENSIONS

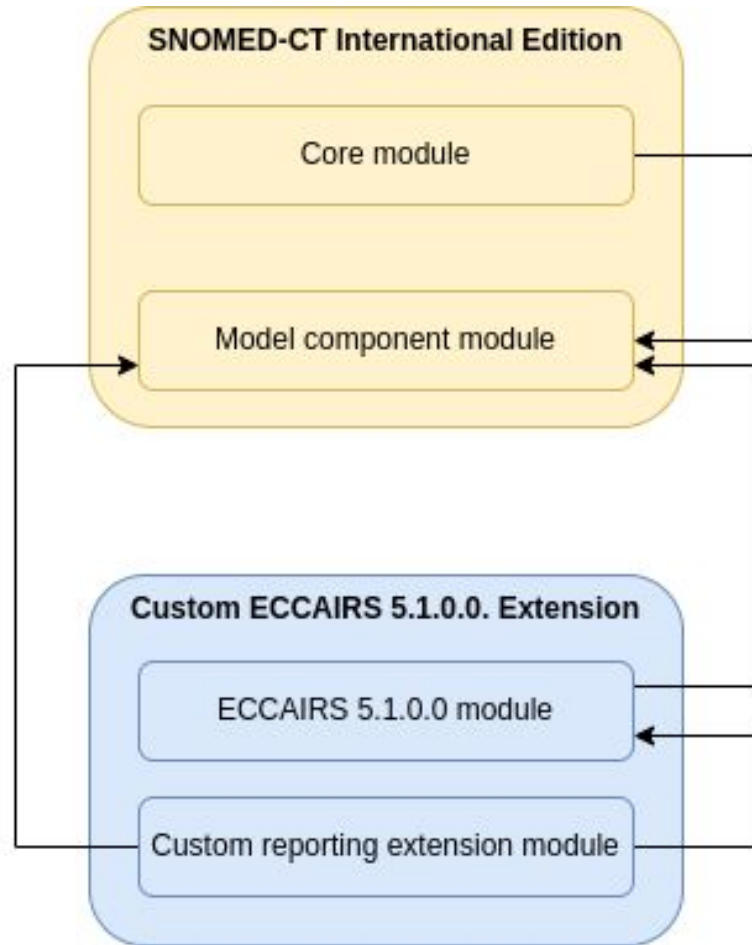
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- introducing ECCAIRS-compatible values for reporting
- translating ECCAIRS
- extension architecture

# WHAT IF MORE DETAIL IS NEEDED?



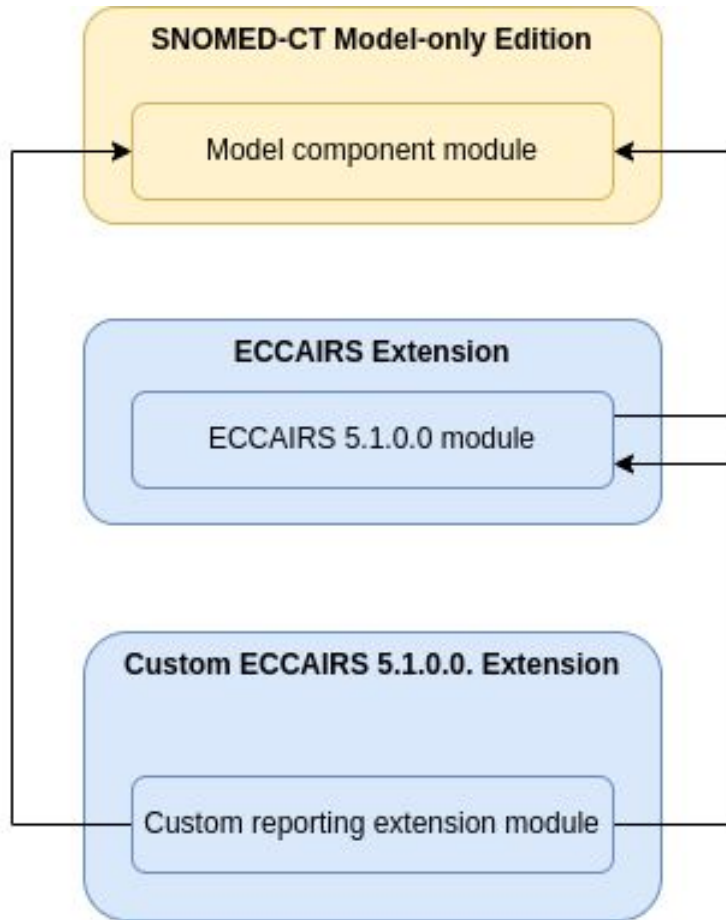
- Subsumption (Find the closest ECCAIRS parent) allows ECCAIRS-compatible reporting to the authorities



## CURRENT EXTENSION ARCHITECTURE

- brings in the huge healthcare content (Core Module)
- requires an aviation organization to take care of the ECCAIRS module.

# CURRENT EXTENSION ARCHITECTURE



- scales down the data
- splits responsibilities

# BENEFIT #3: TAXONOMY SIMPLIFICATION AND EXPLORABILITY

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- ontology modeling
- post-coordinated expressions + ECL
- defining pre-coordinated concepts

# REFINING VALUES THROUGH ONTOLOGY MODELING



- Ontological modeling of the ECCAIRS taxonomy
- (see references for a paper on ontological analysis of ECCAIRS)

```
245972451000250103 |Runway Incursion by a Vehicle|  
=== 245972451000250103 | Incursion | :  
  { 131000250103 |Has agent| = 141000250103 | Vehicle | }  
  { 151000250107 |Has location| = 171000250109 | Runway | }
```

# ECL QUERIES

- Having an occurrence on a runway, which event types, descriptive factors and explanatory factors would be relevant?

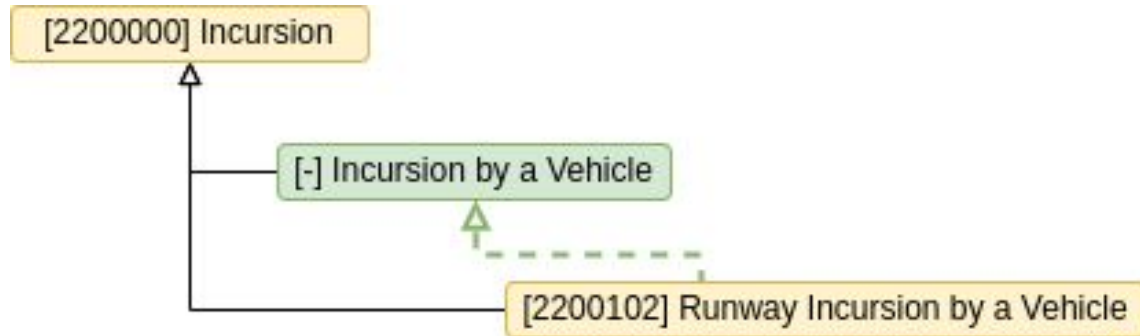
< \*: 73214130001 | has location | = 73214130001 | Runway |

- Having a vehicle participating in the occurrence, which event types would be relevant?

^ 73214130001 | RefSet for Event types | AND < \*: 73214130001 | has agent | = < 73214130001 | Vehicle |

# DEFINE PRECOORDINATED CONCEPTS

```
245972451000250103 |Incursion by a Vehicle|  
=== 245972451000250103 | Incursion | :  
    { 131000250103 |Has Agent| = 141000250103 | Vehicle | }
```



# CHALLENGE #1: IDENTIFIER MANAGEMENT

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Each system uses its own identification scheme - SCTID vs. ECCAIRS custom identifiers.

Incorporating ECCAIRS identifiers into SNOMED-CT can be done using:

- custom data attribute (e.g. has ECCAIRS id)
- a new refset (simple map)

But the question is what is the support of SNOMED-CT tools for accessing the mapped ids in queries (ECL, API queries).

# CHALLENGE #2: PROPER CONCEPTUALIZATION WITH SNOMED-CT CONTENT

Aircraft	Aircraft, device (physical object)
Aircraft	[4] Aircraft (Entity)

What would be the benefits/costs of semantically aligning the content?

# CHALLENGE #3: ORGANIZATIONAL ASPECTS

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- SNOMED-CT licensing,
- collaboration with a different sector



**04.**

**SUMMARY**

# TAKE AWAYS



## CONTENT REFINEMENT

Guidance through semantic modeling of the taxonomy



## CUSTOM EXTENSION

SNOMED-CT supports creating and management of extensions



## TOOL REUSE

SNOMED-CT provides tools which can be reused.



## ORGANIZATIONAL ASPECTS

SNOMED-CT licensing, collaboration with another sector



## TECHNICAL ASPECTS

Identification mapping, different evolution cycles of the terminologies



## PROPER CONCEPTUALIZATION

Conceptual alignment with healthcare questionable

# THANKS!

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# RESOURCES

- ECCAIRS taxonomy browser  
<https://e2.aviationreporting.eu/taxonomy>
- Sample ECCAIRS to SnowStorm transformer  
<https://github.com/psiotwo/eccairs-tools>
- Petr Kremen, et al. **Ontological Foundations of European Coordination Centre for Accident and Incident Reporting Systems**. J. Aerosp. Inf. Syst. 14(5): 279-292 (2017)