Ontology Design Patterns and Abstractions in Ontology Integration

Hackathon Report

Ontology Summit 2014

MikeBennett[1], GaryBergCross[2]

29 April 2014

[1] EDM Council
[2] NSF INTEROP Project

Participants

- The following participated actively in the hackathon:
  - Anett Hoppe
  - Brand Niemann
  - Jeff Braswell
  - Max Gillmore
  - Mike Bennett
  - Mike Dean
  - Mirko Morandini
  - Tatyana Poletaeva
- Offline contributions:
  - Gary Berg-Cross

Objectives

- Explore and identify ontologies for the different types of content that relate to risk
  - events, situations, statistics, incidents, goals etc.
- Brainstorm semantic abstractions which would unify these concepts as they relate to risk, and of risk itself
- Identify ontology design patterns around these concepts
- Consider how to re-use such patterns,
  - for example taking existing patterns for Situation and Event and specializing these for Risky Situation and Risky Event
- Stand up an integration ontology for these concepts

Activities Overview

- Work was a combination of
  - on screen discussion using shared diagrams and ontology visualization tool,
  - off-line working on individual ontologies in Protégé by the different participants.
- Other participants researched possible ontologies and data sources to use,
  - this initial research was used to decide what area of risk to focus on for this application.
- The plan was to have enough information to formally specify an "app" which might be used on mobile devices.
- We chose the context of travel risk.
  - The application would provide comparative risk figures for a range of transportation modes against a single specified goal.
  - In the example, the goal was to get from the user's home in Washington DC to a conference venue in Austin, Texas by 9am on a given day.
  - A number of different options were given for completing this goal.
  - Risks would then be calculated as a product of probability and impact on that goal, with probability being determined as a simple actuarial application of historical data to present probabilities.
- Ontologies were completed by participants and loaded into a visual ontology modelling tool (VOM, from Thematix Partners)
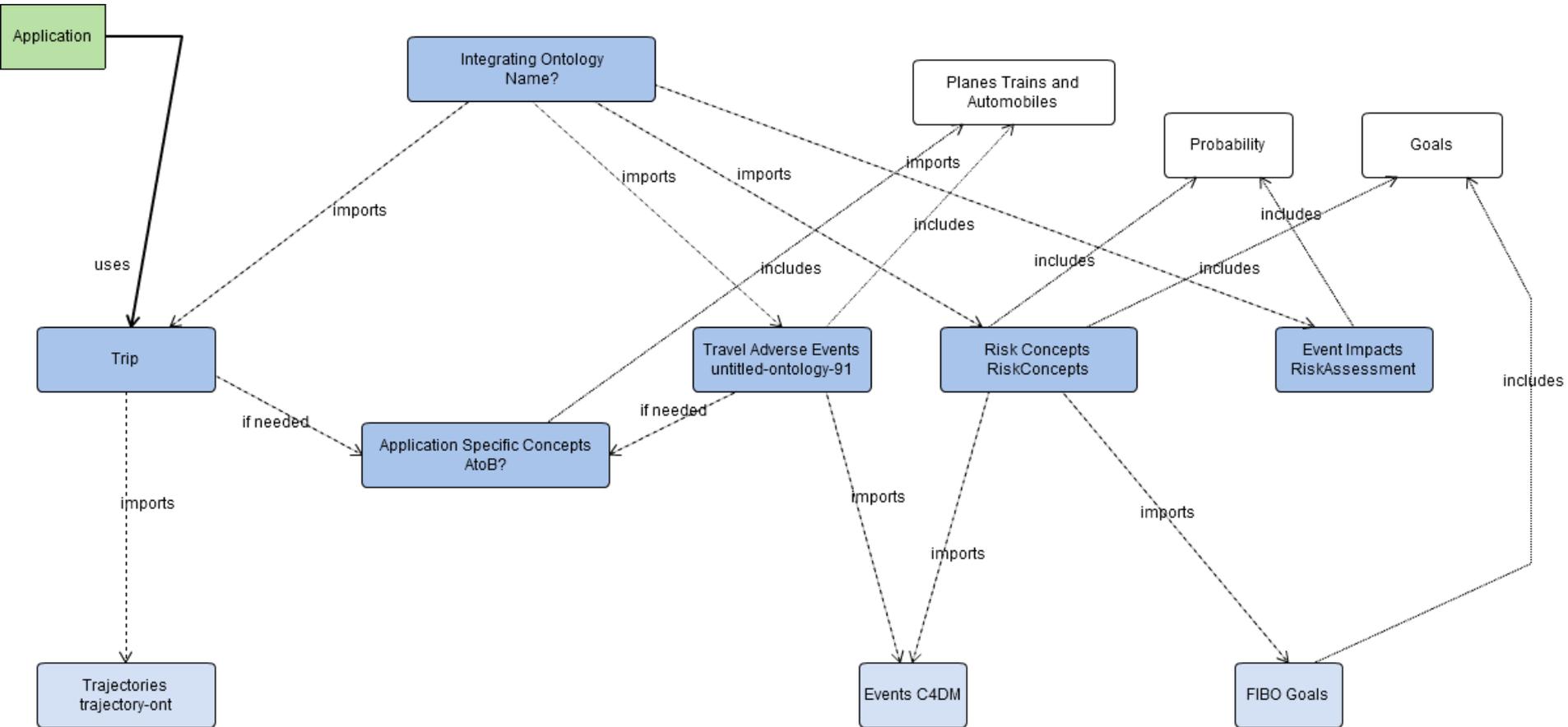- Some integration issues were left open at the end of the project.

Initial Research / Scoping

- Brand: We should consider creation of ontologies as a bottom up exercise from the available data
  - In fact we did both bottom up and top down since the aim of the hackathon was to address reuse
- Looked at available datasets for bottom up ontology articulation
  - Available datasets on traffic and transport incidents
  - Looked at ontology and data for drug trials adverse effects
- Mike: examined a drug trials adverse effect ontology for reusable concepts about adverse
  - In fact "Adverse Effect" was specific to drug effects.
  - Corresponded with ontology authors (BC Cancer Research Institute and others) who took an action to make the term more abstract in line with its label
- Elected to go with "Travel Adverse Events" as our risk focus

Ontologies Activities

- Mirko: General risk terms ontology
  - Derived by abstraction from more specific terms in open source software risks ontology
- Anett: Ontology of travel adverse effects
  - derived from the example datasets
- Mike D: Ontology for "Trip" concepts
  - Derived by extension from "Trajectory" ontology
- Max: Ontology for impacts of events
  - Derived from Max's working extensions to FIBO models
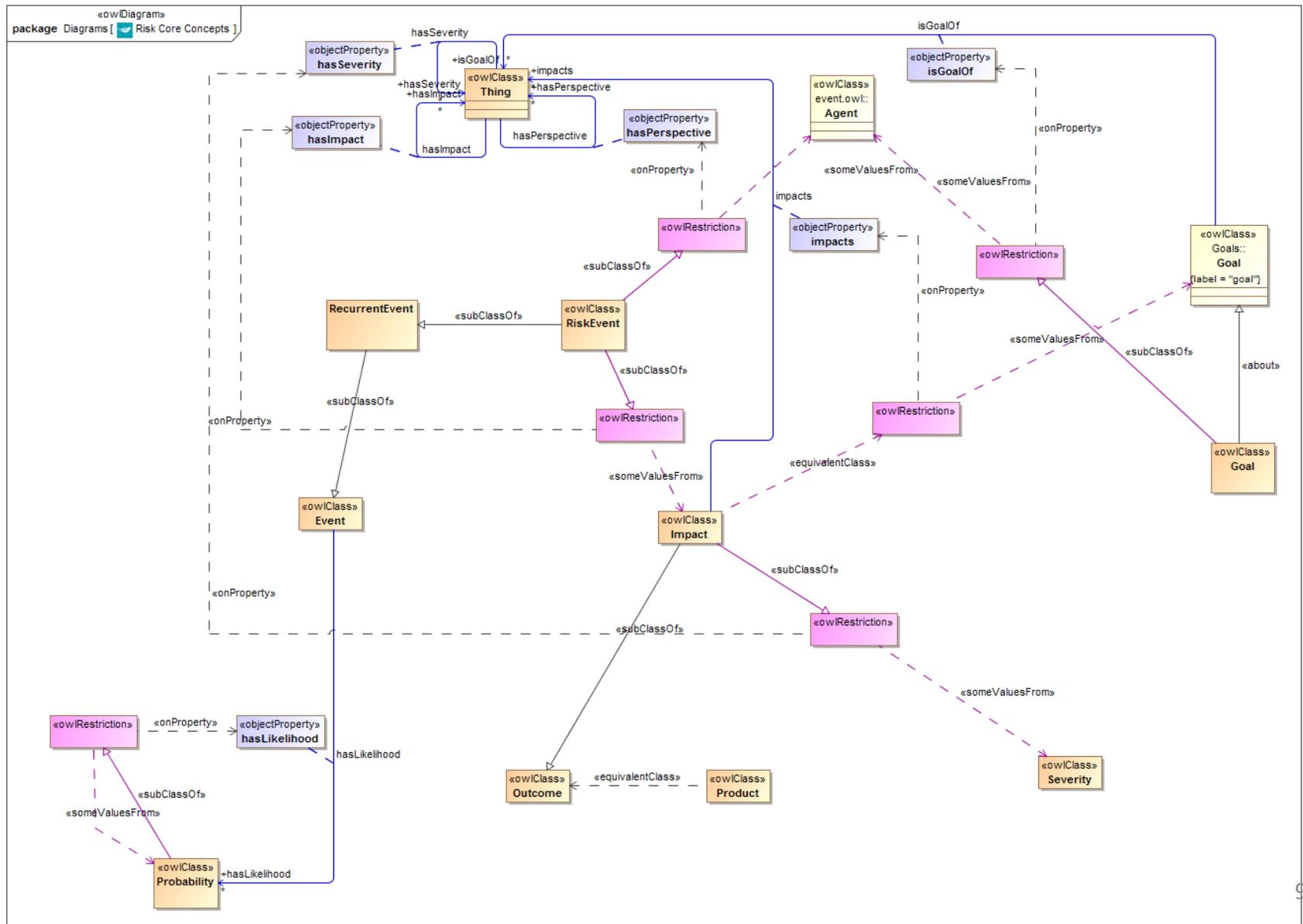- Tatyana: Further refinement / extension of the event impacts ontology
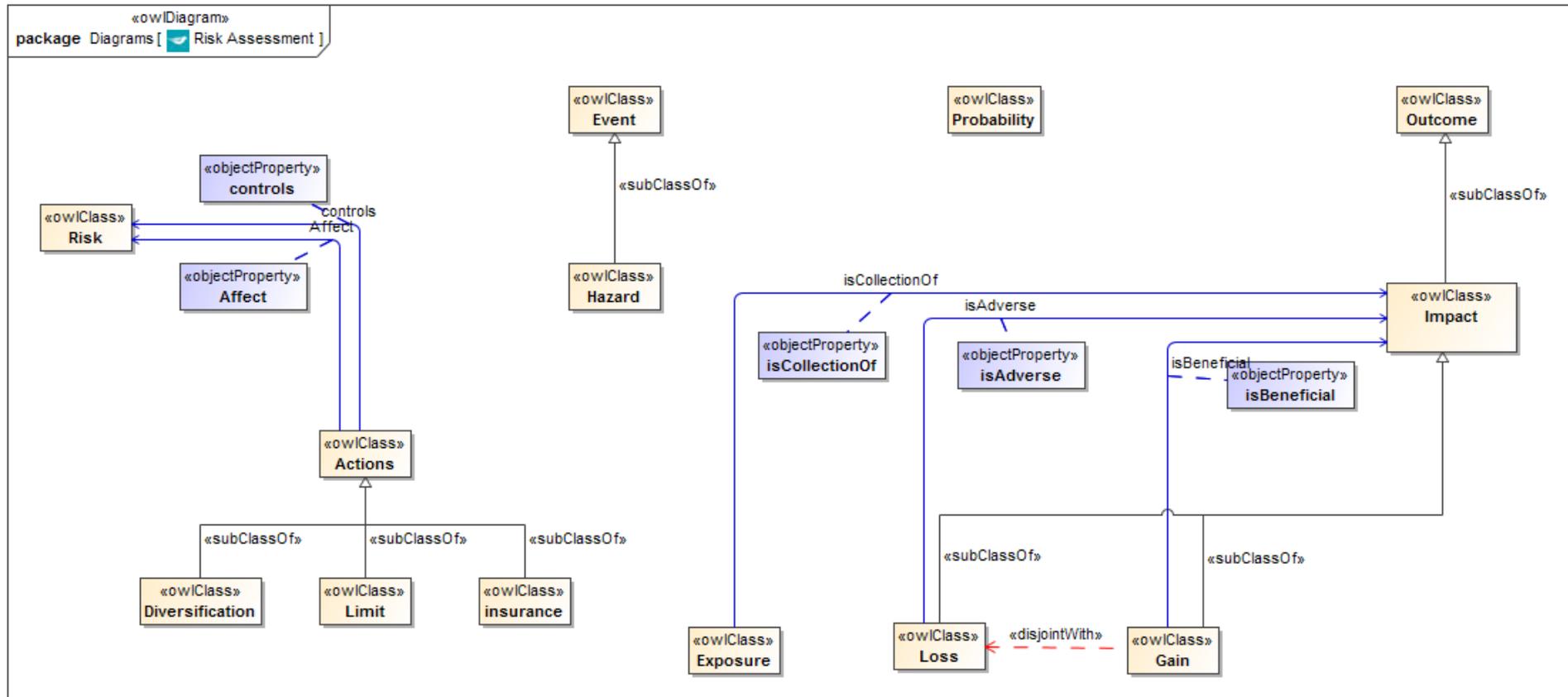
Ontologies

The ontologies:

1. `RiskConcepts`
   - Importing `C4DM` Events ontology
   - Importing FIBO `Goals` ontology
2. `RiskAssessment`
   - extended for positive versus negative outcomes of an event;
3. `untitled-ontology-91` "Travel Adverse Events"
   - Importing `C4DM` Events ontology
   - based on available sources of historical statistical data
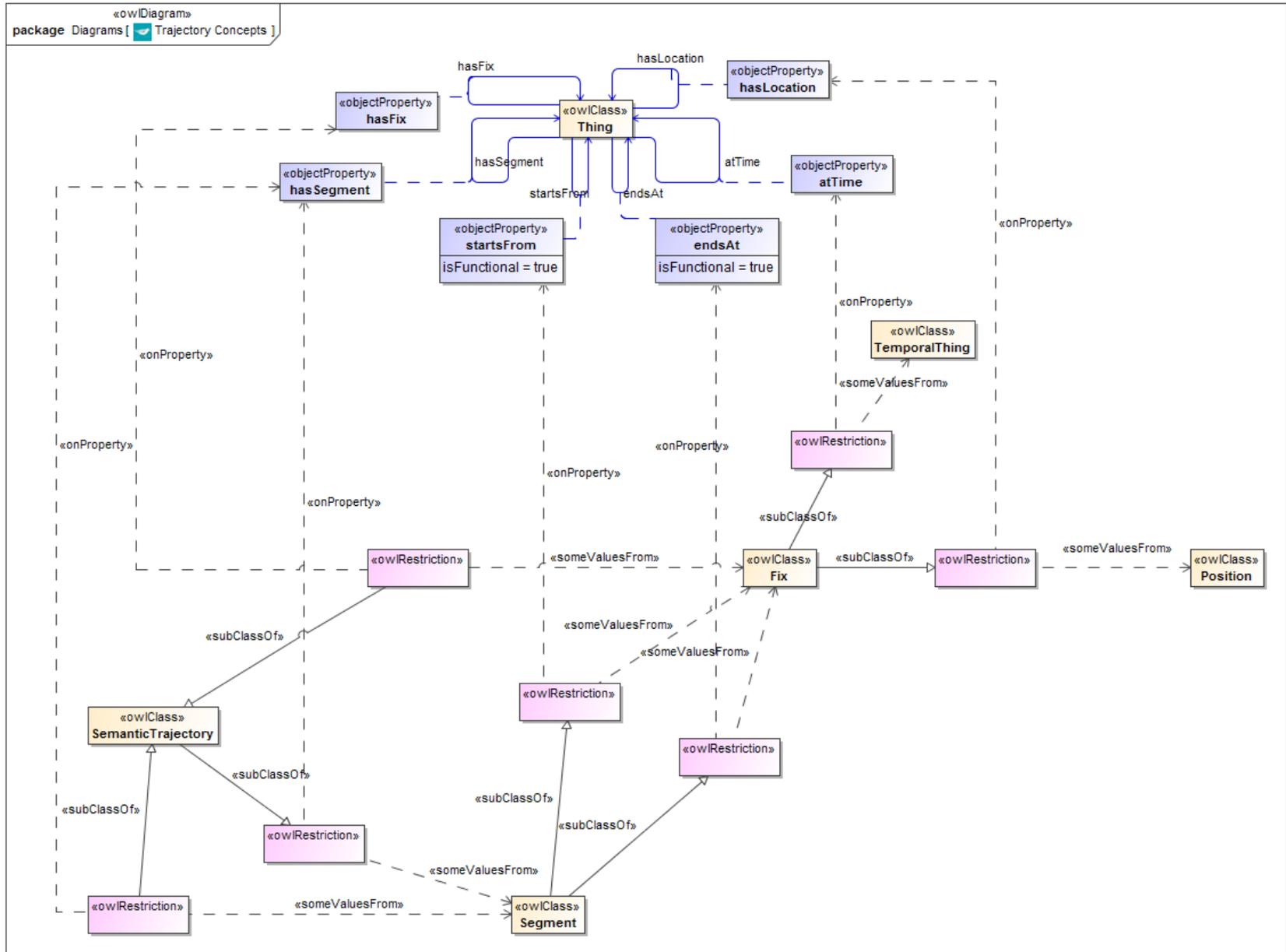4. `Trip`
   - Importing `Trajectory`;

Risk Concepts Ontology

Risk Assessments / Impacts

Travel Adverse Events (part)

Trajectory (external)

Trip

- No diagrams available
- Content:
  - Individuals (stations, airports etc.)
    - Move to Application ontology
  - Trip features (segments etc.)
  - Individual trip trajectories
    - Framed using concepts from Trajectory ontology

Activities

- For **Trip**, **RiskConcepts** and **Risk Assessment**, participants created or adapted formal OWL ontologies in Protégé.
- Ingested into the Visual Ontology Modeler (VOM) tool from Thematix
- All ontologies were in OWL.
  - Syntaxes used were N3, Turtle and RDF/XML.
  - Diagrams were created in the VOM tool for each ontology to better understand the content
  - These were laid out along similar lines to the available conceptual diagrams in the reference sources for this work.
- The aim was to create an integrating ontology which would import these and define the overall application ontology.
- **Travel Adverse Events** was a bottom-up creation of the ontology directly from the available data.
  - This ontology is very extensive and covers multiple modes of transport and multiple ultimate causes of delays, accidents and the like.

End State

- At the completion of the hackathon, the following things are left as "an exercise for the reader":
  1. Integrating the concepts into a single ontology;
     - Concepts and patterns agreed and incorporated in individual ontologies;
     - If we were to do this as a commercial product we would re-define the modular structure of the complete set of ontologies to reflect the separate concerns.
  2. Additional risk factors in the Trip ontology
     - Rental car types, aircraft body types etc.
     - These would form the basis for looking for statistical data sets about these risks.
  3. Rolling up types of travel event for which there are statistics (such as bridge strikes, traffic jams) into broader events which are elements of the trajectory itself
     - Describe events in terms of missed connections, failure to complete a leg of the journey etc.

Observations

- Property Domain and Range
  - Some ontologies have overly generalized domain and range
  - Good reasons for this in application ontology development
  - **Best practice in application ontology ≠ best practice for re-usability**

- Tooling:
  - Visualization: Very helpful in understanding ontology content
  - Integration: Did not find any
  - **Need suitable integration-level tooling for ontology development**

- Trajectory ontology reuse
  - Extensible beyond travel, to logistics etc.
  - Similar abstractions would apply for financial cashflows…

Summary and Conclusions

- Started with common ODPs for Risk, Trajectory, Event
- Development and Reuse:
  - **Bottom-up:** ontology from example data taking into account those same ODPs
  - **Extension:** take a general ontology and extend into application area
  - **Abstraction**: take a more specific ontology and hand-create more abstract ontology
  - **Integration**: identify common concepts, related concepts
- Further opportunities
  - **Extension:** what we did could be further extended into other use cases
  - **Abstraction:** What we did could be further abstracted and extended e.g. into cashflow risks