# AI-ARC Data Model Guide

The AI-ARC data model includes the classes: *AnomalyPrediction*, *IcepacksPrediction*, *VesselPrediction*, *Surveillance*, *Reliability* and *AIArcVessel*.

The data model classes are defined in the AIARC\_datamodel.xsd file. This file must be used to create an XML file (data) with the AI-ARC data model.

The DataModelExample.xml file presents an example of how to create an element based on the AI-ARC data model structure.

The workflow to send/receive data from Kafka (using the CISE and AI-ARC data models) is:

Diagrama

Descripción generada automáticamente

**Steps:**

1. Use the AI-ARC data model to create a file with the service data that you want to send.
2. Encode to base64 this file. (You can use any Base64 encoder, e.g. <https://www.convertstring.com/es/EncodeDecode/Base64Encode>)
3. Add the encoded file into the CISE data model:
   1. Select the CISE class where your data will be attached (examples):
      1. Reliability Assessment [EMI] -> [EventDocument](https://emsa.europa.eu/cise-documentation/cise-data-model-1.5.3/model/Document.html#eventdocument)
      2. DBN-based Anomaly Detection [IOSB] -> [EventDocument](https://emsa.europa.eu/cise-documentation/cise-data-model-1.5.3/model/Document.html#eventdocument)
      3. Prediction of Icepacks [UTU] -> [LocationDocument](https://emsa.europa.eu/cise-documentation/cise-data-model-1.5.3/model/Document.html#locationdocument)
      4. Vessel Traffic Prediction [UTU] -> [VesselDocument](https://emsa.europa.eu/cise-documentation/cise-data-model-1.5.3/model/Document.html#vesseldocument)
   2. Include the encoded file into the tag <Content> of the previous CISE class.
4. Send/Receive Kafka message.
5. Read the CISE data model and get the tag <Content> of the “Document” class.
6. Decode from base64 the file in <Content>.
7. Read the AI-ARC data model file.

## VesselPrediction Example

The following message is received from Kafka:

<Vessel xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

        xsi:noNamespaceSchemaLocation="https://cise.jrc.ec.europa.eu/datamodel/last/xsd/Vessel.xsd">

    <Identifier>

        <GeneratedBy>

            <LegalName>Fraunhofer IOSB</LegalName>

        </GeneratedBy>

        <GeneratedIn>2022-10-27T11:43:51Z</GeneratedIn>

        <UUID>359a429c-e87d-5196-bc24-7b8dc05c4758</UUID>

    </Identifier>

    <Beam>6</Beam>

    <CallSign>VNZ2089</CallSign>

    <Length>22.0</Length>

    <MMSI>503048190</MMSI>

    <ShipType>FishingVessel</ShipType>

</Vessel>

Partner must include information about vessel prediction related to this previous message. After receiving it and will include information from vessel prediction service in it.

First must prepare the data using the AI-ARC data model. The file must be:

<?xml version="1.0" encoding="UTF-8"?>

<!--

  Generated by Universidad Politecnica de Madrid (UPM) - 2023.

-->

<dtm:datamodel xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

               xsi:schemaLocation="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/DataModel ./AIARC\_datamodel.xsd"

               xmlns:dtm="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/DataModel"

               xmlns:anom="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/AnomalyPrediction"

               xmlns:ice="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/IcepacksPrediction"

               xmlns:ves="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/VesselPrediction"

               xmlns:sur="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/Surveillance"

               xmlns:rel="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/Reliability"

               >

    <VesselPredictionClass>

    <ves:PredictionAccuracy>99.2</ves:PredictionAccuracy>

    <ves:ExplanationMessage>Example of a vessel prediction explanation message.</ves:ExplanationMessage>

    <ves:PredictionTime>2023-06-05T12:15:10Z</ves:PredictionTime>

  </VesselPredictionClass>

</dtm:datamodel>

Encode base64 the AI-ARC data. (You can use any Base64 encoder, e.g. <https://www.convertstring.com/es/EncodeDecode/Base64Encode>)

After encoding you get the following:



Then, using the Document class from CISE you should include the AI-ARC data, as follow:

<Vessel xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

        xsi:noNamespaceSchemaLocation="https://cise.jrc.ec.europa.eu/datamodel/last/xsd/Vessel.xsd">

    <Identifier>

        <GeneratedBy>

            <LegalName>UTU</LegalName>

        </GeneratedBy>

        <GeneratedIn>2022-10-27T11:53:00Z</GeneratedIn>

        <UUID>f23c565f-f4bb-4188-9760-e1923603c29a</UUID>

    </Identifier>

    <!-- document about the vessel prediction attached -->

    <DocumentRel>

        <Document xsi:type="doc:VesselDocument">

            <Content><!-- AI-ARC data (Base 64 binary document) -->

                

            </Content>

        </Document>

    </DocumentRel>

    <correlatedWith>

        <GeneratedBy>

            <LegalName>Fraunhofer IOSB</LegalName>

        </GeneratedBy>

        <GeneratedIn>2022-10-27T11:43:51Z</GeneratedIn>

        <UUID>359a429c-e87d-5196-bc24-7b8dc05c4758</UUID>

    </correlatedWith>

</Vessel>

## Risk and Reliability Example

A risk message should be sent to Kafka, which includes information for the Reliability service.

First, the Reliability class should be created (based on the AI-ARC data model). In this case, the *InvolvedServiceData* class is the only class that should be defined, as follow:

<?xml version="1.0" encoding="UTF-8"?>

<!--

  Generated by Universidad Politecnica de Madrid (UPM) - 2023.

-->

<dtm:datamodel xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

               xsi:schemaLocation="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/DataModel ./AIARC\_datamodel.xsd"

               xmlns:dtm="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/DataModel"

               xmlns:anom="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/AnomalyPrediction"

               xmlns:ice="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/IcepacksPrediction"

               xmlns:ves="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/VesselPrediction"

               xmlns:sur="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/Surveillance"

               xmlns:rel="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/Reliability"

               >

<ReliabilityClass>

    <rel:InvolvedServiceData>

        <rel:Identifier>359a429c-e87d-5196-bc24-7b8dc05c4758(UniqueIdentifier\_of\_the\_service)</rel:Identifier>

        <rel:EventInputData></rel:EventInputData>

        <rel:EventMetaData></rel:EventMetaData>

        <rel:ModelTrainingData></rel:ModelTrainingData>

        <rel:ModelTrainingMetrics></rel:ModelTrainingMetrics>

        <rel:ModelValidationData></rel:ModelValidationData>

        <rel:ModelSerializedFiles></rel:ModelSerializedFiles>

        <rel:ReferenceURI>https://example.org/test/test1?search=test-question#part2</rel:ReferenceURI>

    </rel:InvolvedServiceData>

  </ReliabilityClass>

</dtm:datamodel>

This file must be base64 encoded and included in the *Content* tag of the *RiskDocument:*

<?xml version="1.0" encoding="UTF-8"?>

<!-- Sharing suspected vessel -->

<Risk xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://cise.jrc.ec.europa.eu/datamodel/last/xsd/Risk.xsd" xsi:schemaLocation="http://www.cise.eu/datamodel/v1/entity/vessel/ https://cise.jrc.ec.europa.eu/datamodel/last/xsd/entity/vessel/Vessel.xsd" xmlns:vessel="http://www.cise.eu/datamodel/v1/entity/vessel/">

    <Identifier>

        <GeneratedBy>

            <LegalName>UoP-Risk</LegalName>

        </GeneratedBy>

        <GeneratedIn>2023-10-27T11:53:00Z</GeneratedIn>

        <UUID>c227c7f9-c4a0-42bf-a624-f60e1d968068</UUID>

    </Identifier>

    <RiskProbability>Probable</RiskProbability>

    <RiskType>IllegalImmigration</RiskType>

    <DocumentRel>

        <Document xsi:type="doc:RiskDocument">

            <Content><!-- AI-ARC Reliability data (InvolvedServiceData class) (Base 64 binary document) -->

                

            </Content>

        </Document>

    </DocumentRel>

    <InvolvedObjectRel>

        <Object xsi:type="vessel:Vessel">

            <Name>HANOVER EXPRESS</Name>

            <LocationRel>

                <Location><Geometry><Latitude>37.9333</Latitude><Longitude>23.5301</Longitude></Geometry></Location>

            </LocationRel>

            <CallSign>DFGX2</CallSign>

            <IMONumber>9343716</IMONumber>

        </Object>

    </InvolvedObjectRel>

</Risk>

Then this message is exchanged through Kafka and got by the Reliability Service partner who provides the outcomes of its service.

Then, the AI-ARC data with the outcomes of the Reliability service should be prepared:

<?xml version="1.0" encoding="UTF-8"?>

<!--

  Generated by Universidad Politecnica de Madrid (UPM) - 2023.

-->

<dtm:datamodel xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

               xsi:schemaLocation="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/DataModel ./AIARC\_datamodel.xsd"

               xmlns:dtm="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/DataModel"

               xmlns:anom="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/AnomalyPrediction"

               xmlns:ice="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/IcepacksPrediction"

               xmlns:ves="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/VesselPrediction"

               xmlns:sur="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/Surveillance"

               xmlns:rel="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/Reliability"

               >

  <ReliabilityClass>

    <rel:ReliabilityScore>97.9</rel:ReliabilityScore>

    <rel:ReliabilityMessage>Example of reliability message.</rel:ReliabilityMessage>

    <rel:ReliabilityMetrics>

        <rel:S\_train>0.63</rel:S\_train>

        <rel:S\_distance>0.73</rel:S\_distance>

        <rel:S\_xAI>0.92</rel:S\_xAI>

        <rel:Other>QW5vdGhlciBtZXRyaWMgdmFsdWUgY2FuIGJlIGluY2x1ZGVkLg==</rel:Other>

        <rel:s\_trainDescription>Description message of s\_train metric.</rel:s\_trainDescription>

        <rel:s\_distanceDescription>Description message of s\_distance metric.</rel:s\_distanceDescription>

        <rel:s\_xAIDescription>Description message of s\_xAI metric.</rel:s\_xAIDescription>

        <rel:OtherDescription>Description message of other metric.</rel:OtherDescription>

    </rel:ReliabilityMetrics>

  </ReliabilityClass>

</dtm:datamodel>

Encode the previous file and include it in the *Content* tag of CISE and include the *correlatedWith* tag with the information of the initial Risk message:

<?xml version="1.0" encoding="UTF-8"?>

<!-- Sharing suspected vessel -->

<Risk xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://cise.jrc.ec.europa.eu/datamodel/last/xsd/Risk.xsd" xsi:schemaLocation="http://www.cise.eu/datamodel/v1/entity/vessel/ https://cise.jrc.ec.europa.eu/datamodel/last/xsd/entity/vessel/Vessel.xsd" xmlns:vessel="http://www.cise.eu/datamodel/v1/entity/vessel/">

    <Identifier>

        <GeneratedBy>

            <LegalName>FhG-EMI-RLS</LegalName>

        </GeneratedBy>

        <GeneratedIn>2023-10-27T11:53:00Z</GeneratedIn>

        <UUID>7ada42a5-59fd-42fa-9781-7ed6693a5968</UUID>

    </Identifier>

    <DocumentRel>

        <Document xsi:type="doc:RiskDocument">

            <Content><!-- AI-ARC Reliability data (ReliabilityScore, ReliabilityMessage and ReliabilityMetrics classes) (Base 64 binary document) -->

                

            </Content>

        </Document>

    </DocumentRel>

    <correlatedWith>

        <GeneratedBy>

            <LegalName>UoP-Risk</LegalName>

        </GeneratedBy>

        <GeneratedIn>2023-10-27T11:53:00Z</GeneratedIn>

        <UUID>c227c7f9-c4a0-42bf-a624-f60e1d968068</UUID>

    </correlatedWith>

</Risk>

## Anomaly and Reliability Example

An Anomaly message should be sent to Kafka, which includes information for the Reliability service.

First, the Reliability class should be created (based on the AI-ARC data model). In this case, the *InvolvedServiceData* class is the only class that should be defined, and include information of the Anomaly service as follow:

<?xml version="1.0" encoding="UTF-8"?>

<!--

  Generated by Universidad Politecnica de Madrid (UPM) - 2023.

-->

<dtm:datamodel xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

               xsi:schemaLocation="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/DataModel ./AIARC\_datamodel.xsd"

               xmlns:dtm="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/DataModel"

               xmlns:anom="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/AnomalyPrediction"

               xmlns:ice="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/IcepacksPrediction"

               xmlns:ves="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/VesselPrediction"

               xmlns:sur="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/Surveillance"

               xmlns:rel="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/Reliability"

               >

  <ReliabilityClass>

    <rel:InvolvedServiceData>

        <rel:Identifier>359a429c-e87d-5196-bc24-7b8dc05c4758(UniqueIdentifier\_of\_the\_service)</rel:Identifier>

        <rel:EventInputData></rel:EventInputData>

        <rel:EventMetaData></rel:EventMetaData>

        <rel:ModelTrainingData></rel:ModelTrainingData>

        <rel:ModelTrainingMetrics></rel:ModelTrainingMetrics>

        <rel:ModelValidationData></rel:ModelValidationData>

        <rel:ModelSerializedFiles></rel:ModelSerializedFiles>

        <rel:ReferenceURI>https://example.org/test/test1?search=test-question#part2</rel:ReferenceURI>

    </rel:InvolvedServiceData>

  </ReliabilityClass>

</dtm:datamodel>

This file must be base64 encoded and included in the *Content* tag of the *EventDocument:*

<?xml version="1.0" encoding="UTF-8"?>

<!-- Sharing speed alert -->

<Anomaly xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://cise.jrc.ec.europa.eu/datamodel/last/xsd/Anomaly.xsd" xsi:schemaLocation="http://www.cise.eu/datamodel/v1/entity/vessel/ https://cise.jrc.ec.europa.eu/datamodel/last/xsd/entity/vessel/Vessel.xsd" xmlns:vessel="http://www.cise.eu/datamodel/v1/entity/vessel/">

    <Identifier>

        <GeneratedBy>

            <LegalName>TREE-Anomaly</LegalName>

        </GeneratedBy>

        <GeneratedIn>2023-03-31T11:53:00Z</GeneratedIn>

        <UUID>c72058fa-c800-481a-9bab-f4576f896821</UUID>

    </Identifier>

    <DocumentRel>

        <Document xsi:type="doc:EventDocument">

            <Content><!-- AI-ARC Reliability data (InvolvedServiceData class) (Base 64 binary document) -->

                

            </Content>

        </Document>

    </DocumentRel>

    <InvolvedObjectRel>

        <Object xsi:type="vessel:Vessel">

            <Name>HANOVER EXPRESS</Name>

            <LocationRel>

                <Location><Geometry><Latitude>37.9333</Latitude><Longitude>23.5301</Longitude></Geometry></Location>

            </LocationRel>

            <CallSign>DFGX2</CallSign>

            <IMONumber>9343716</IMONumber>

        </Object>

        <ObjectRole>Participant</ObjectRole>

    </InvolvedObjectRel>

    <AnomalyType>VesselWithErraticMovements</AnomalyType>

</Anomaly>

Then this message is exchanged through Kafka and got by the Reliability Service partner who provides the outcomes of its service.

Then, the AI-ARC data including the outcomes of the Reliability service should be prepared:

<?xml version="1.0" encoding="UTF-8"?>

<!--

  Generated by Universidad Politecnica de Madrid (UPM) - 2023.

-->

<dtm:datamodel xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

               xsi:schemaLocation="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/DataModel ./AIARC\_datamodel.xsd"

               xmlns:dtm="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/DataModel"

               xmlns:anom="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/AnomalyPrediction"

               xmlns:ice="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/IcepacksPrediction"

               xmlns:ves="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/VesselPrediction"

               xmlns:sur="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/Surveillance"

               xmlns:rel="https://raw.githubusercontent.com/AI-ARC/AIARC-Data-model-v1/main/Reliability"

               >

  <ReliabilityClass>

    <rel:ReliabilityScore>97.9</rel:ReliabilityScore>

    <rel:ReliabilityMessage>Example of reliability message.</rel:ReliabilityMessage>

    <rel:ReliabilityMetrics>

        <rel:S\_train>0.63</rel:S\_train>

        <rel:S\_distance>0.73</rel:S\_distance>

        <rel:S\_xAI>0.92</rel:S\_xAI>

        <rel:Other>QW5vdGhlciBtZXRyaWMgdmFsdWUgY2FuIGJlIGluY2x1ZGVkLg==</rel:Other>

        <rel:s\_trainDescription>Description message of s\_train metric.</rel:s\_trainDescription>

        <rel:s\_distanceDescription>Description message of s\_distance metric.</rel:s\_distanceDescription>

        <rel:s\_xAIDescription>Description message of s\_xAI metric.</rel:s\_xAIDescription>

        <rel:OtherDescription>Description message of other metric.</rel:OtherDescription>

    </rel:ReliabilityMetrics>

  </ReliabilityClass>

</dtm:datamodel>

Encode the previous file and include it in the *Content* tag of CISE message and include also the *correlatedWith* tag with the information of the initial Anomaly message:

<?xml version="1.0" encoding="UTF-8"?>

<!-- Sharing speed alert -->

<Anomaly xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="https://cise.jrc.ec.europa.eu/datamodel/last/xsd/Anomaly.xsd" xsi:schemaLocation="http://www.cise.eu/datamodel/v1/entity/vessel/ https://cise.jrc.ec.europa.eu/datamodel/last/xsd/entity/vessel/Vessel.xsd" xmlns:vessel="http://www.cise.eu/datamodel/v1/entity/vessel/">

    <Identifier>

        <GeneratedBy>

            <LegalName>FhG-EMI-RLS</LegalName>

        </GeneratedBy>

        <GeneratedIn>2023-03-31T12:00:00Z</GeneratedIn>

        <UUID>7ada42a5-59fd-42fa-9781-7ed6693a5968</UUID>

    </Identifier>

    <DocumentRel>

        <Document xsi:type="doc:EventDocument">

            <Content><!-- AI-ARC Reliability data (ReliabilityScore, ReliabilityMessage and ReliabilityMetrics classes) (Base 64 binary document) -->

                

            </Content>

        </Document>

    </DocumentRel>

    <correlatedWith>

        <GeneratedBy>

            <LegalName>TREE-Anomaly</LegalName>

        </GeneratedBy>

        <GeneratedIn>2023-03-31T11:53:00Z</GeneratedIn>

        <UUID>c72058fa-c800-481a-9bab-f4576f896821</UUID>

    </correlatedWith>

</Anomaly>