



# Terrain and Obstacle Data



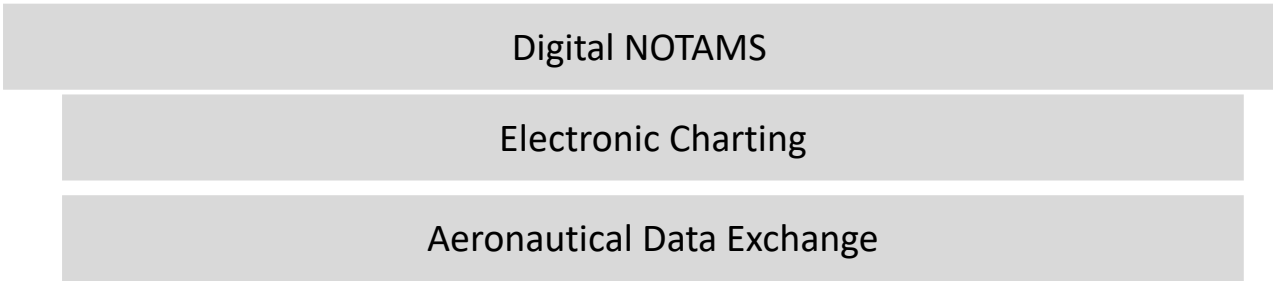
19 59'53" N | 73 44'53" E

[Workshop on Terrain and Obstacle Datasets \(TOD\)](#)

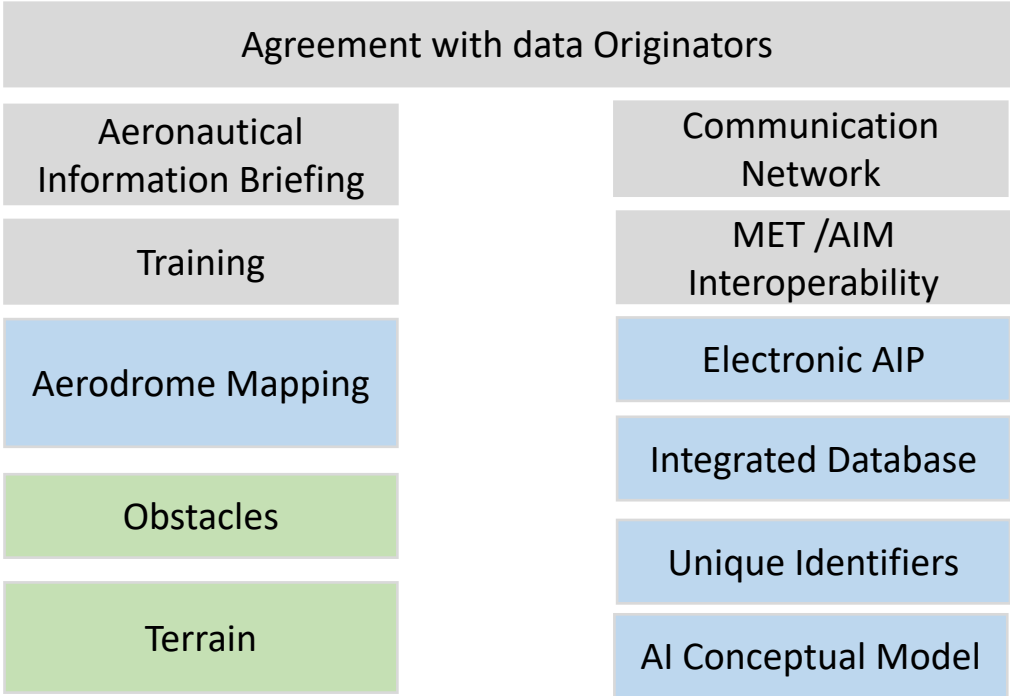
[By](#)

[Sumit Khinvasara](#)

Information Management

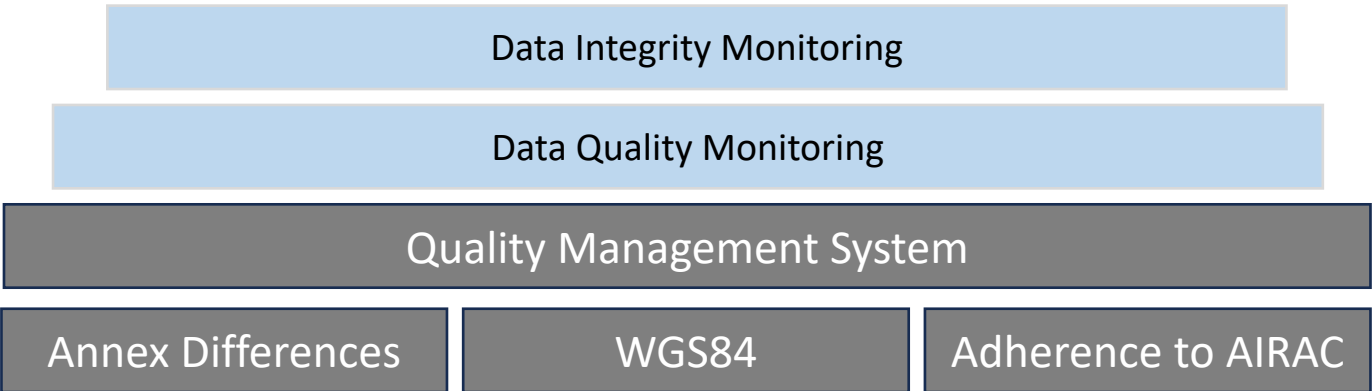


Going Digital



# Aeronautical Information Domains

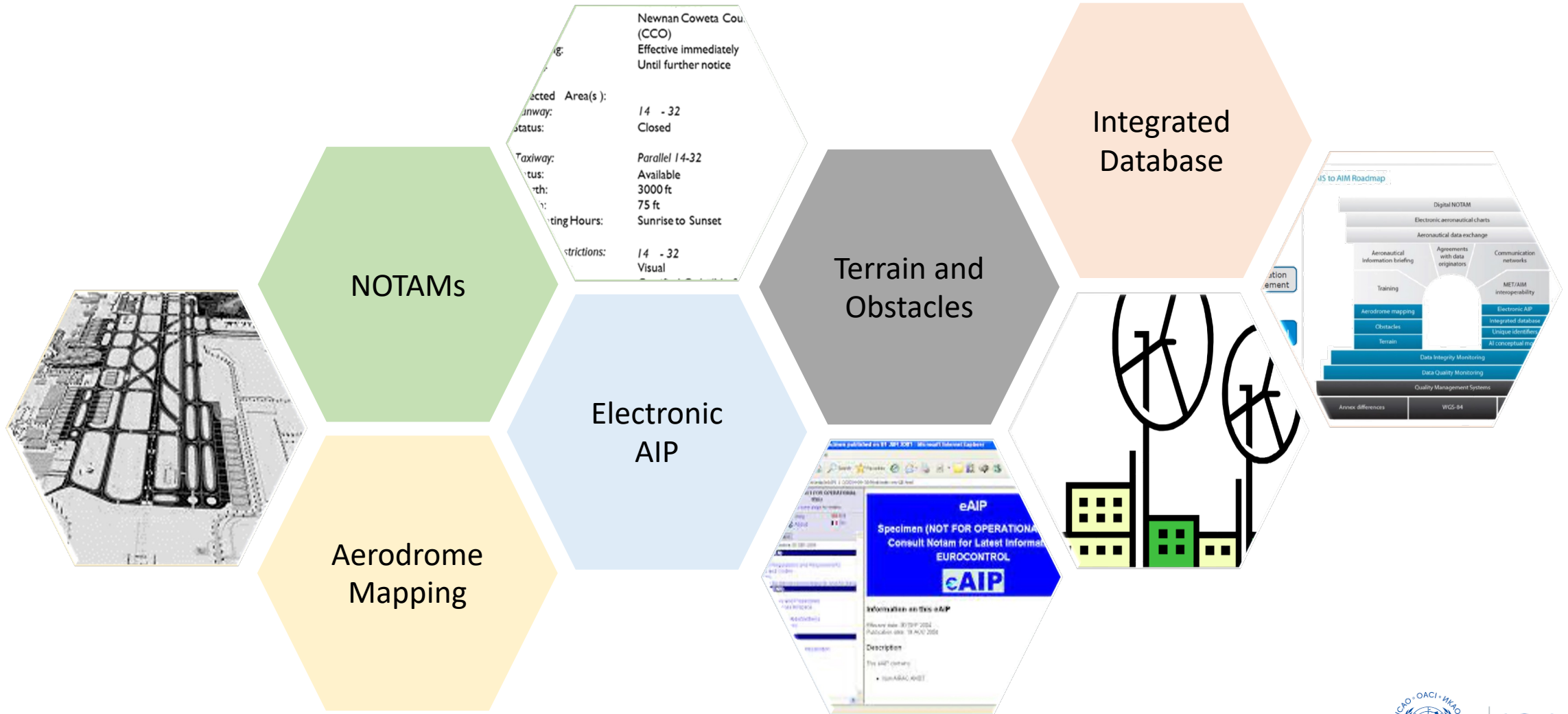
Consolidation



“aim” for AIM

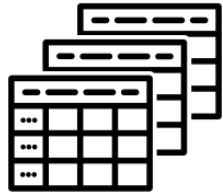


# Going Digital



# Challenge : Slow adoption of eTOD Globally

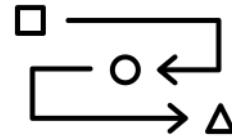
## Apprehensions



Data Redundancy



Specialists

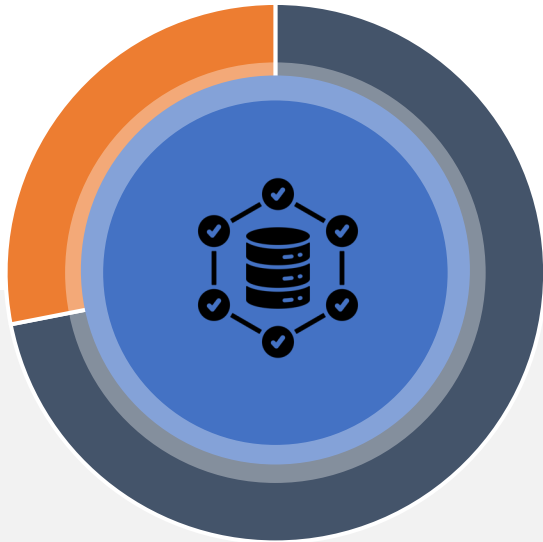


Methodology

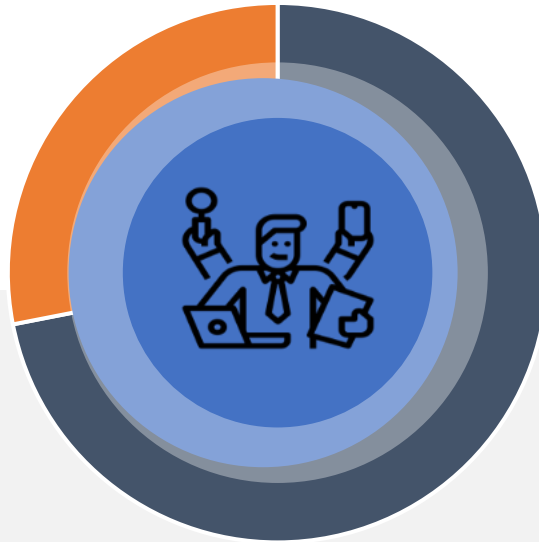


Cost / Investment

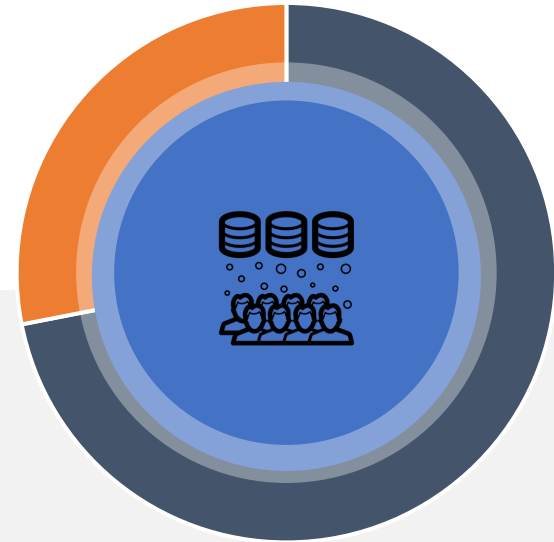
# Objectives of the Workshop



TOD  
"CONCEPTS"



ROLE  
Clarity



Hierarchical nature  
of "Concepts &  
Roles"

# TOD Concepts

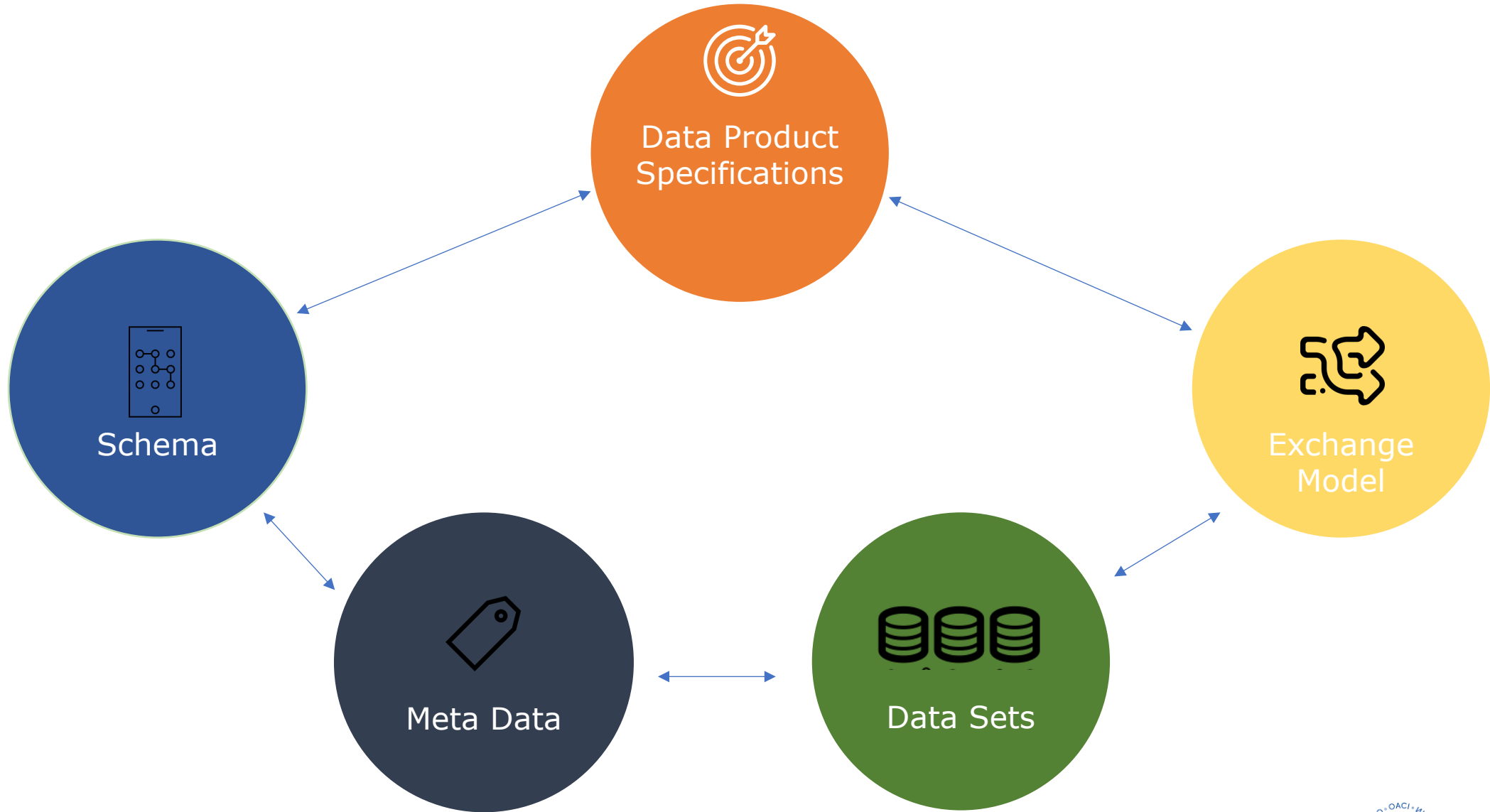


Digital Data Sets



Coverage Areas

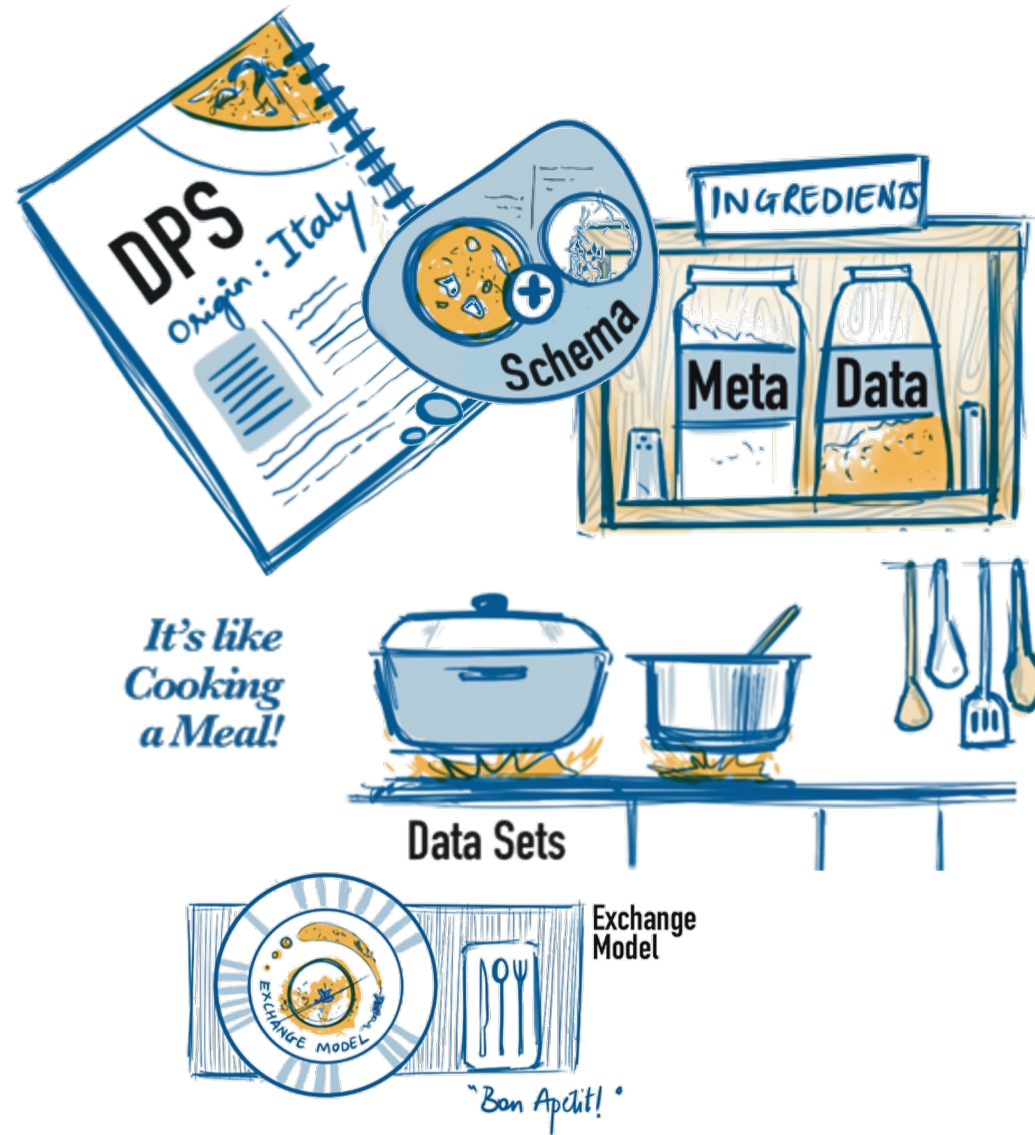
# Digital Data Set



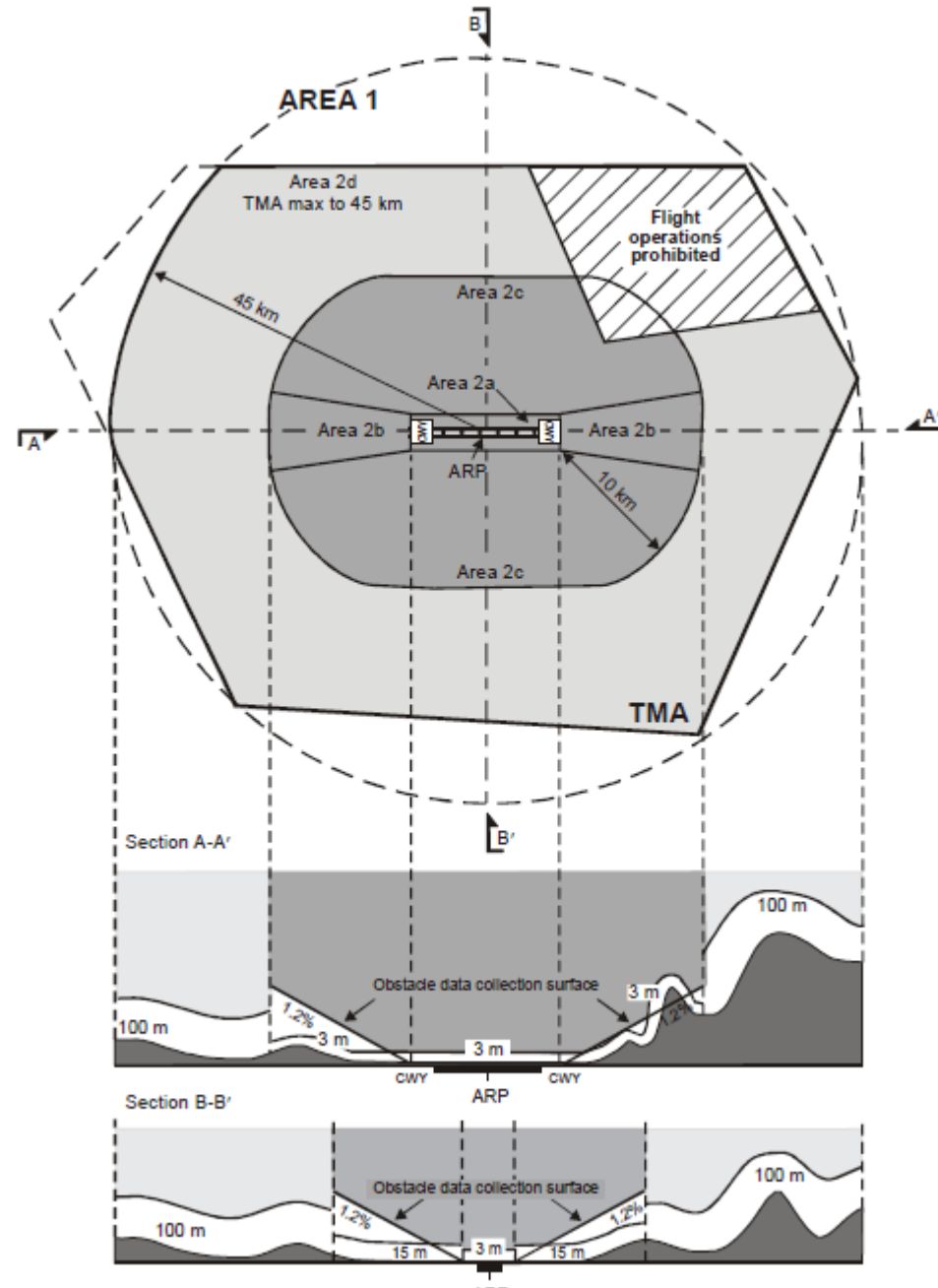
All of them together makes an Airport or State eTOD compliant



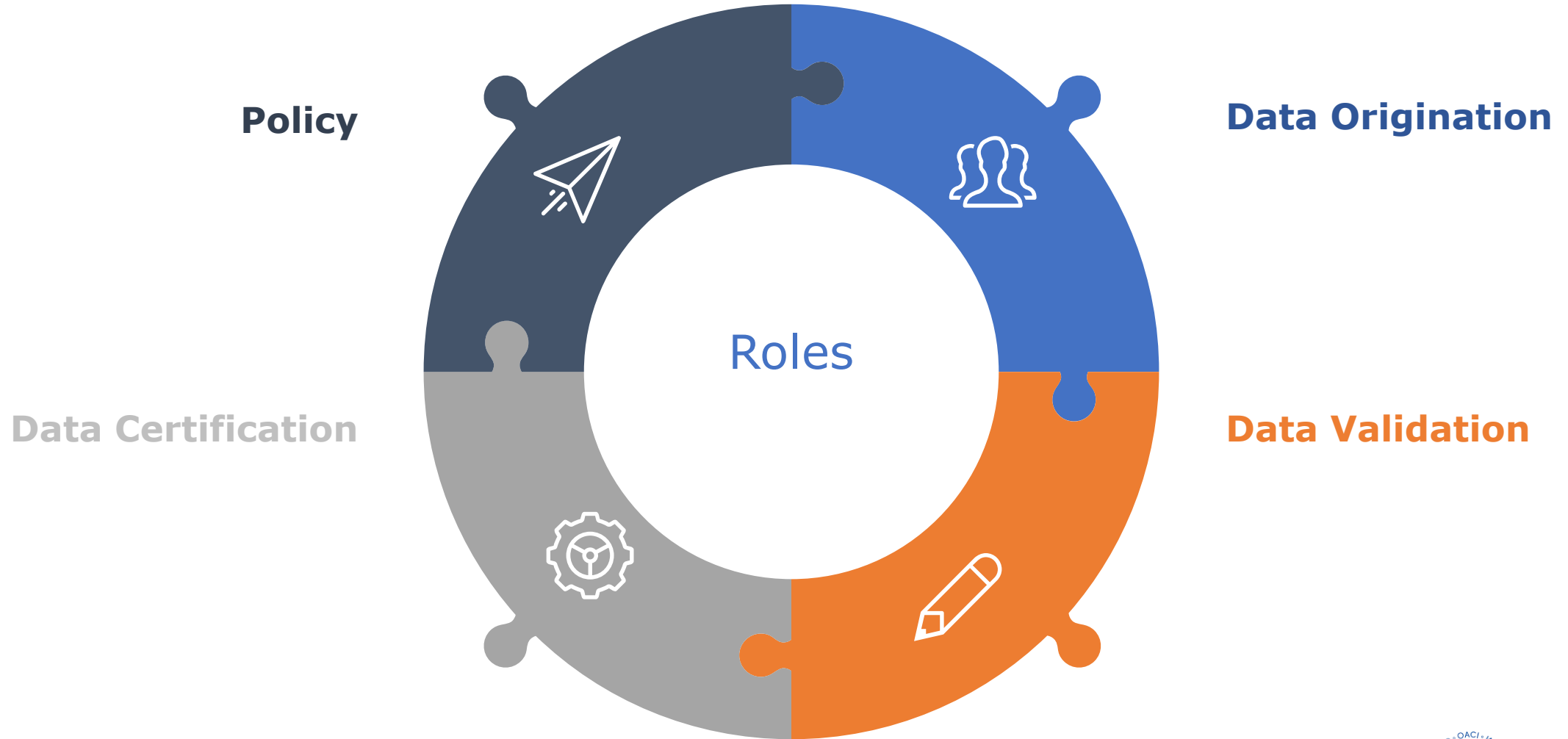
# Digital Data Sets



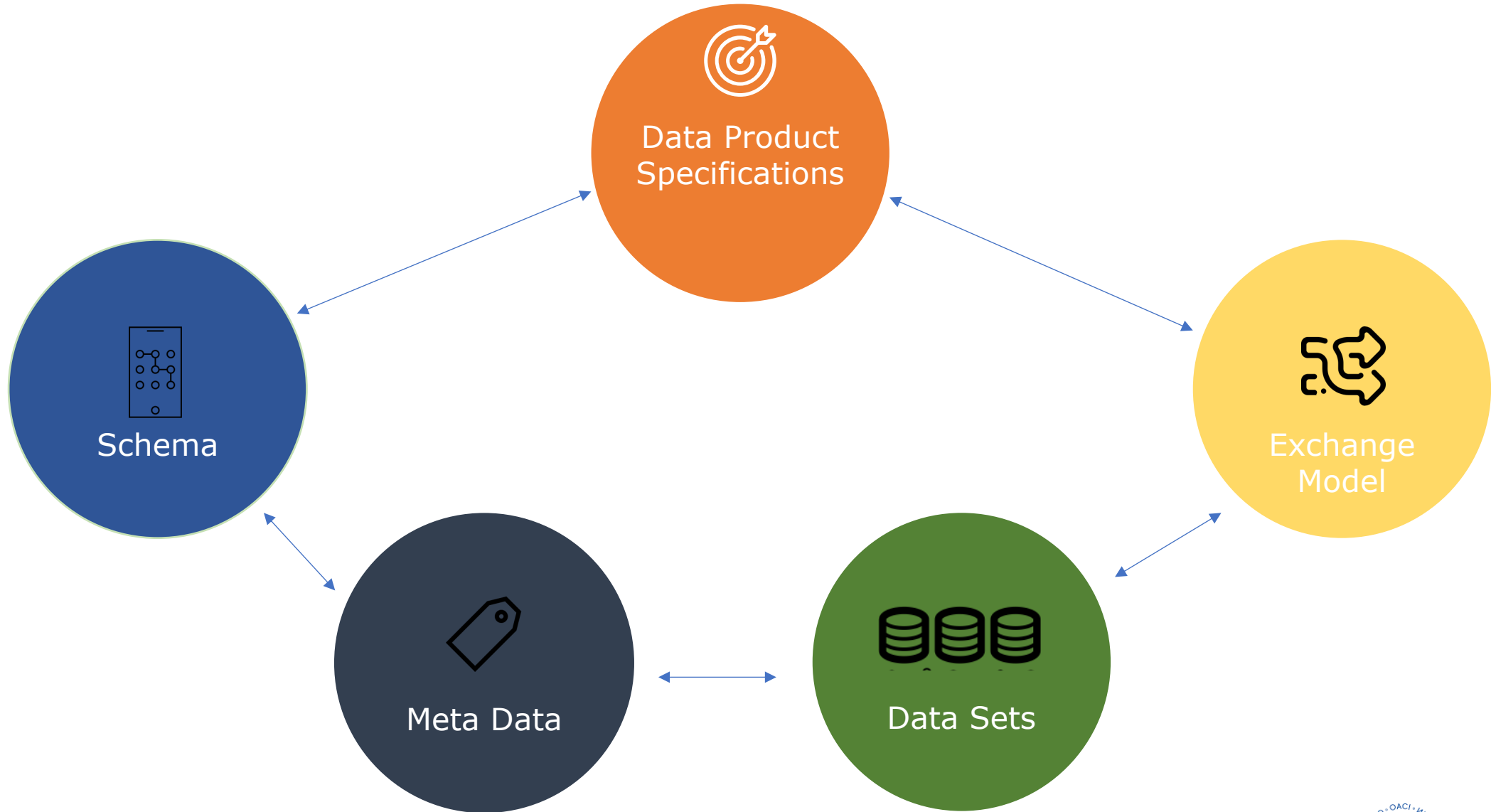
# Coverage Areas



# Role Clarity



# Digital Data Set

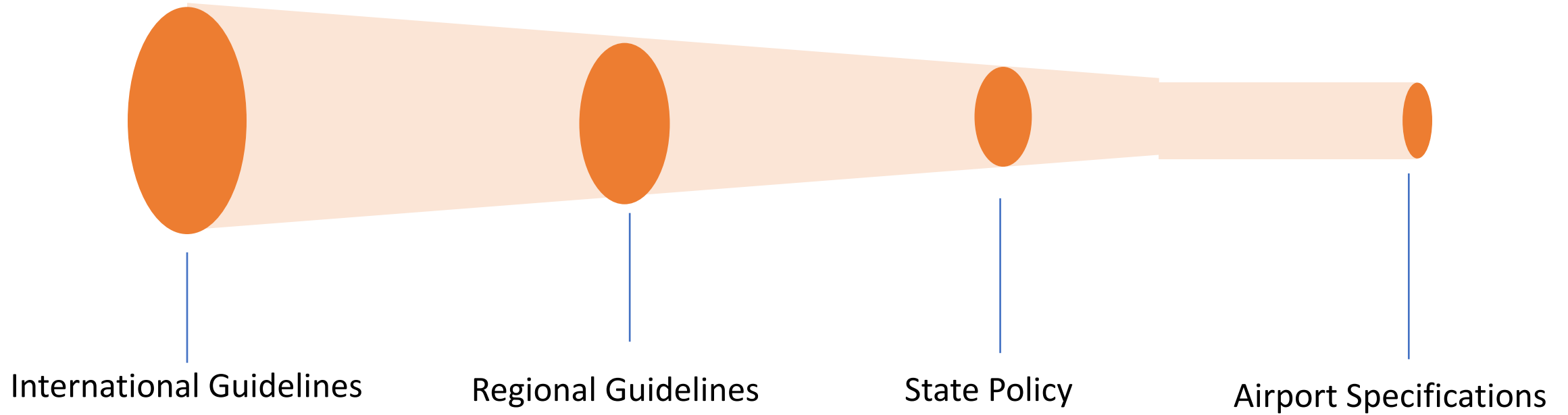


All of them together makes eTOD compliant



Frame of reference derived from various guidelines and specifications

# Funnel





DPS

# International Guidelines

Region	Name of Organisation	Document Name	Document Number	Key Pointers
Global	ICAO	Guidelines for Electronic Terrain Obstacle and Aerodrome Mapping Information	Doc 9881 Doc 10066	Defining Technical Requirements Quality, Meta Data, Scope etc
	Euro Control	Eurocontrol Terrain and Obstacle Data Manual	Edition 3	Implementation Matter. Chapter 4, 4.2 TOD Policy Process 4.3 Policy Scope 4.4 Functions and Responsibilities  Appendix C National TOD Policy Template



# Funnel

International Guidelines -> Regional Guideline

Region	Name	Document Name	Document Number	Key Pointers
Regional Regulatory Body	ICAO MID	AIM Planning and Implementation Guidance Material	008	





# Funnel

International Reference > Regional Guidelines-> State Policy

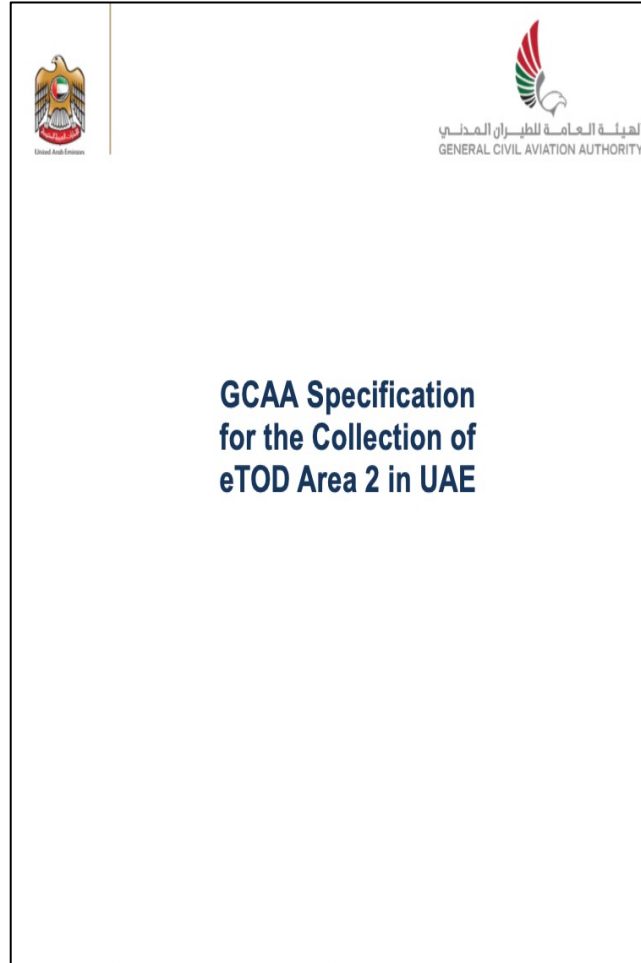
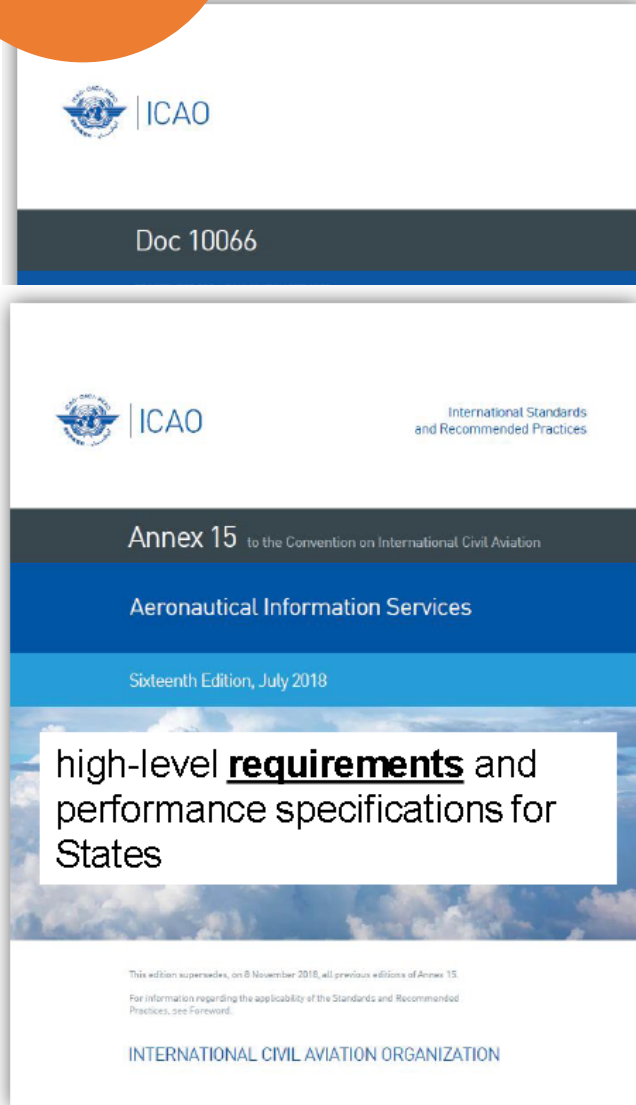
## State Policy

"Specification for collection of eTOD Area 2 in UAE"

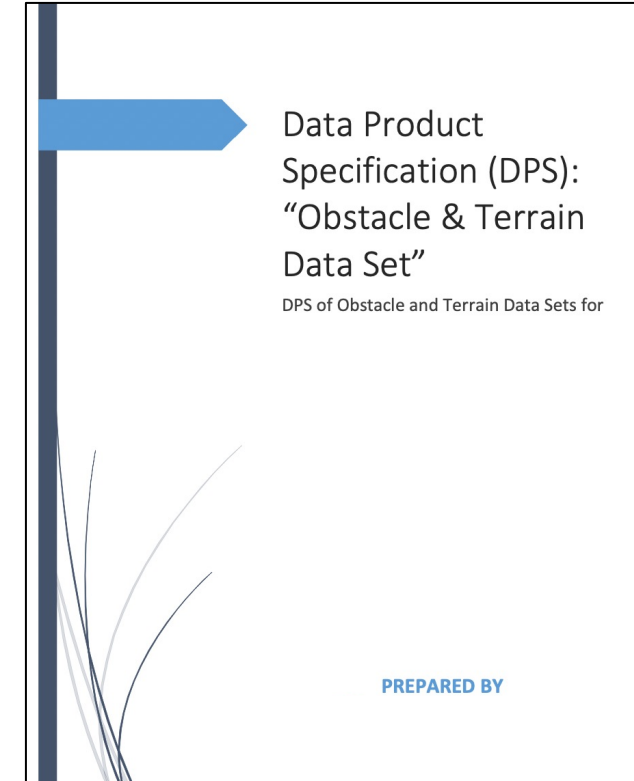


# Funnel

International Reference > Regional Guidelines-> State Policy -> Airport Specific



## 1<sup>st</sup> Deliverable





DPS



## Table of Contents

1. Data Product Specification (Obstacle Data) ..... Specification

- 1.1. Overview .....
- 1.2. Specification Scope .....
- 1.3. Data Product Identification .....
- 1.4. Data content and structure .....
- 1.5. Reference System .....
- 1.6. Data Quality .....
- 1.7. Data Capture .....
- 1.8. Data Maintenance .....
- 1.9. Data Portrayal .....
- 1.10. Data Product Delivery .....
- 1.11. Metadata .....

2. Data Product Specification (Terrain Data) .....

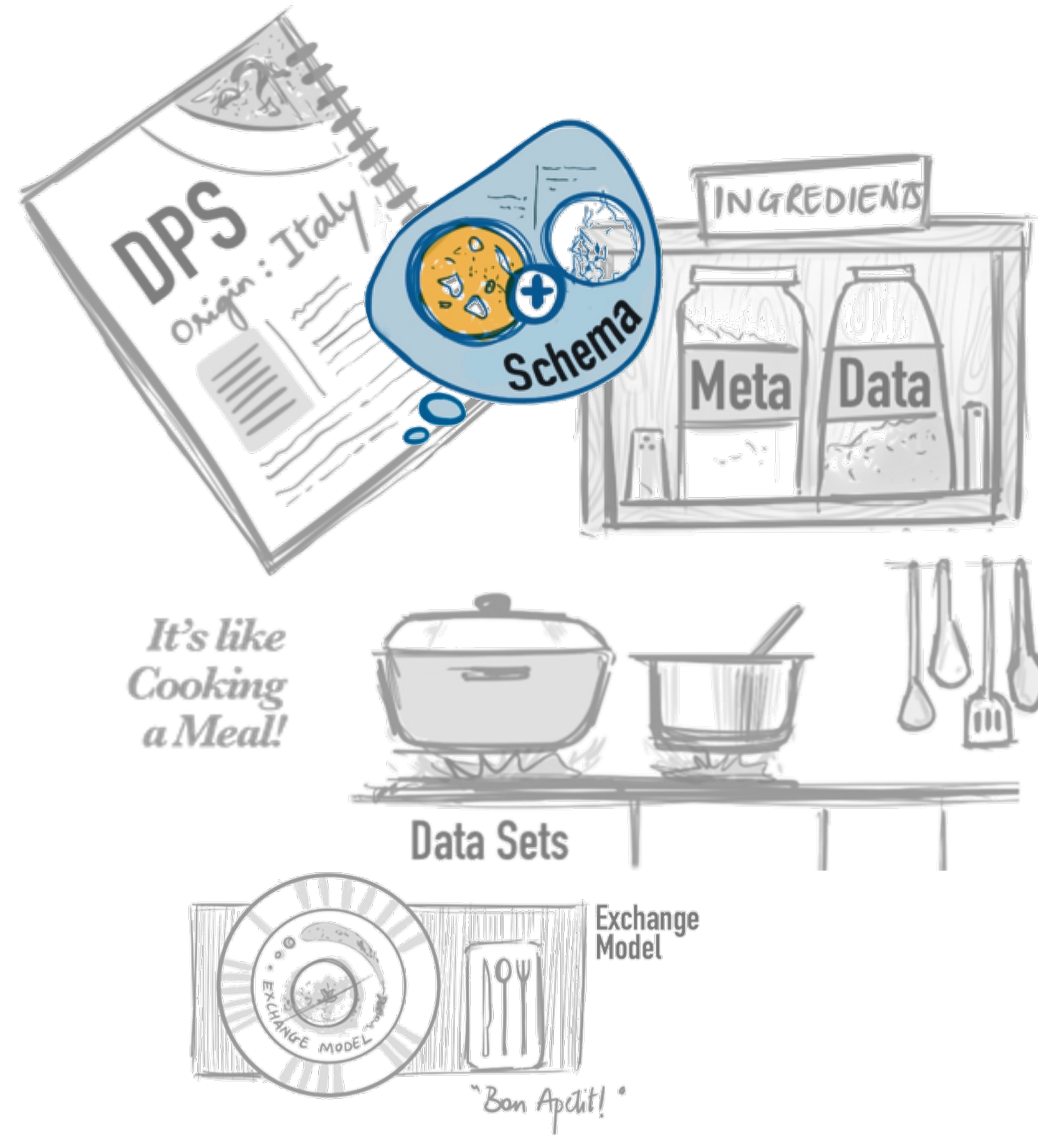
- 2.1. Overview .....
- 2.2. Specification Scope .....
- 2.3. Data Product Identification .....
- 2.4. Data content and structure .....
- 2.5. Reference System .....
- 2.6. Data Quality .....

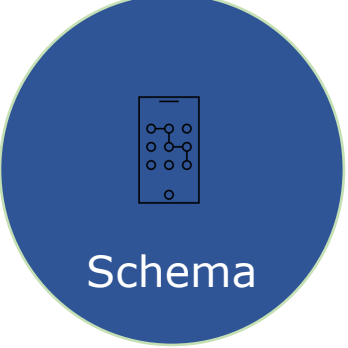




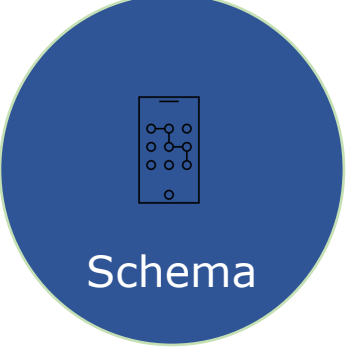
Why DPS should be 1<sup>st</sup> Deliverable?

# Digital Data Sets

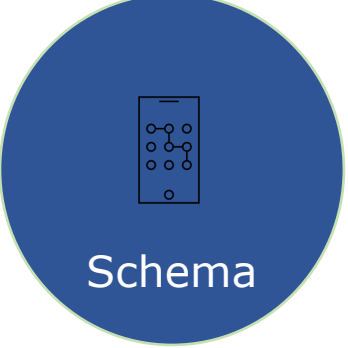




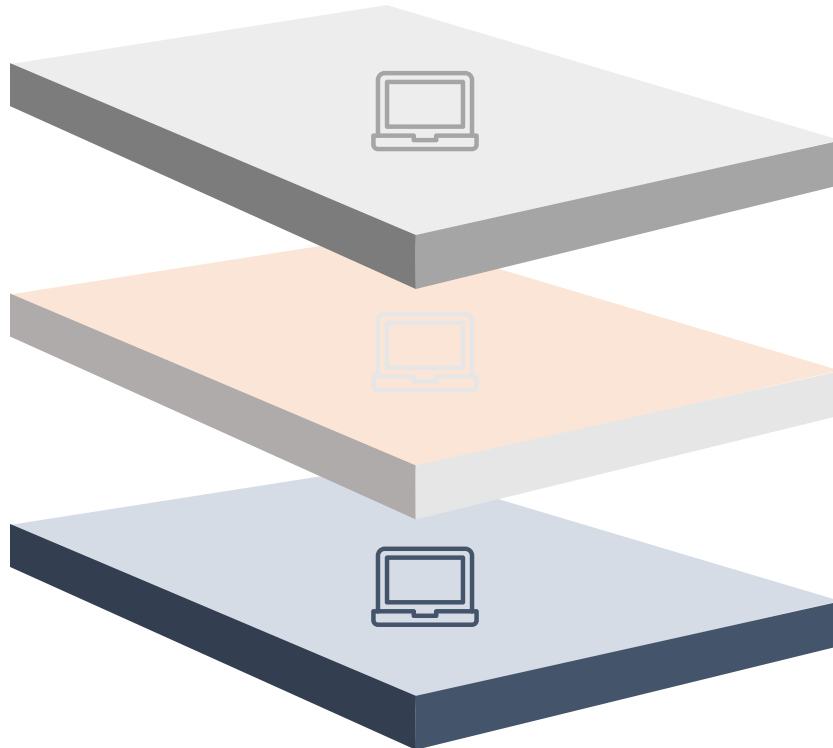
# Structure of relationship between multiple data points of Real World Entities in Digital Format



Schema is a Declaration represented by XML Code



# Schema

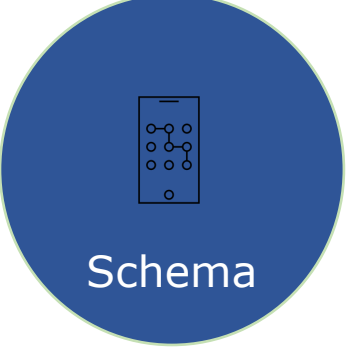


Features -> Real World Entities

Objects -> Its representation in Digital Format

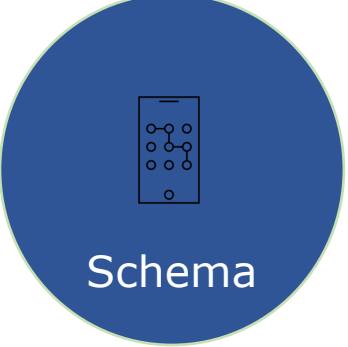
Attributes -> Its identification





Developing relation between Objects and its attributes (properties) is responsibility of Schema

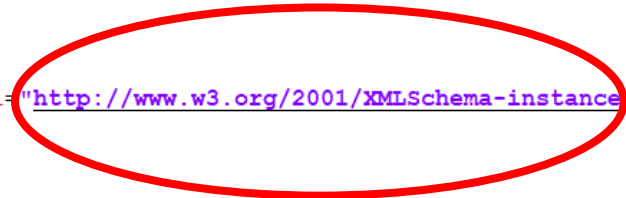
Predefined format of relationship



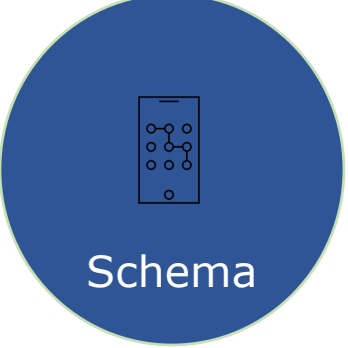
# Schema

<<feature>> Runway	
◆	designator : TextDesignatorType
◆	type : CodeRunwayType
◆	nominalLength : ValDistanceType
◆	lengthAccuracy : ValDistanceType
◆	nominalWidth : ValDistanceType
◆	widthAccuracy : ValDistanceType
◆	widthShoulder : ValDistanceType
◆	lengthStrip : ValDistanceType
◆	widthStrip : ValDistanceType
◆	lengthOffset : ValDistanceSignedType
◆	widthOffset : ValDistanceSignedType
◆	abandoned : CodeYesNoType

```
<?xml version="1.0" encoding="UTF-8"?>
<AIXMBasicMessage xmlns:gts="http://www.isotc211.org/2005/gts" xmlns:gco="http://www.isotc211.org/2005/gco" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:gml="http://www.opengis.net/gml"
  <aixm-5.1:messageMetadata>
    <gmd:MD_Metadata>
      <gmd:characterSet>
        <gmd:MD_CharacterSetCode codeList="http://www.aixm.aero/schema/5.1/ISO_19139_Schemas/resources/Codelist/gmxCodeLists.xml#MD_CharacterSetCode" codeListValue="utf8"
      </gmd:characterSet>
```



# Schema Output



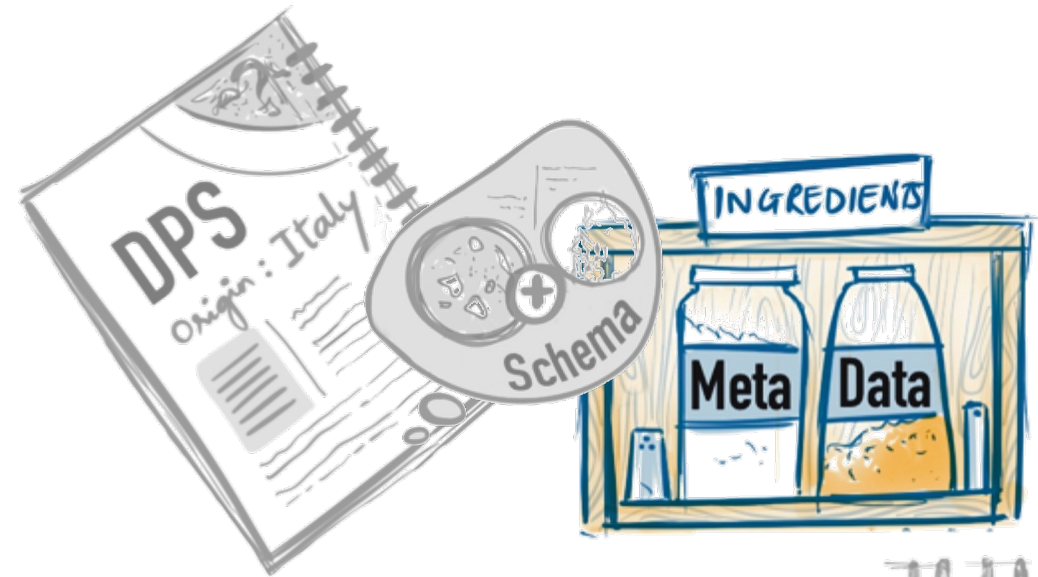
Schema

```

</aixm-5.1:featureMetadata>
<aixm-5.1:timeSlice>
  <aixm-5.1:VerticalStructureTimeSlice gml:id="gmlIDR1">
    <gml:validTime>
      <gml:TimePeriod gml:id="gmlIDV0">
        <gml:beginPosition>2018-04-24T00:00:00.000Z</gml:beginPosition><gml:endPosition indeterminatePosition="unknown"/>
      </gml:TimePeriod>
    </gml:validTime>
    <aixm-5.1:interpretation>BASELINE</aixm-5.1:interpretation>
    <aixm-5.1:sequenceNumber>1</aixm-5.1:sequenceNumber>
    <aixm-5.1:correctionNumber>0</aixm-5.1:correctionNumber>
    <aixm-5.1:name>AEROBRIDGE</aixm-5.1:name>
    <aixm-5.1:type xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:nil="true"/>
    <aixm-5.1:lighted>YES</aixm-5.1:lighted>
    <aixm-5.1:markingICAOStandard>YES</aixm-5.1:markingICAOStandard>
    <aixm-5.1:group>NO</aixm-5.1:group>
    <aixm-5.1:part>
      <aixm-5.1:VerticalStructurePart gml:id="gmlIDSS0">
        <aixm-5.1:verticalExtent uom="M">9</aixm-5.1:verticalExtent>
        <aixm-5.1:verticalExtentAccuracy uom="M">0.5</aixm-5.1:verticalExtentAccuracy>
        <aixm-5.1:visibleMaterial xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:nil="true"/>
        <aixm-5.1:horizontalProjection_surfaceExtent>
          <aixm-5.1:ElevatedSurface srsName="urn:ogc:def:crs:EPSG::4326" gml:id="VT0">
            <gml:patches>
              <gml:PolygonPatch>
                <gml:exterior>
                  <gml:LinearRing>
                    <gml:posList> 13.20142058 77.70824464 13.20138598 77.70824386 13.20138180 77.70824376 13.20127499
                  </gml:LinearRing>
                </gml:exterior>
              </gml:PolygonPatch>
            </gml:patches>
            <aixm-5.1:horizontalAccuracy uom="M">0.5</aixm-5.1:horizontalAccuracy>
            <aixm-5.1:elevation uom="M">930.4</aixm-5.1:elevation>
            <aixm-5.1:verticalDatum>EGM_08</aixm-5.1:verticalDatum>
            <aixm-5.1:verticalAccuracy uom="M">0.5</aixm-5.1:verticalAccuracy>
          </aixm-5.1:ElevatedSurface>
        </aixm-5.1:horizontalProjection_surfaceExtent>
      </aixm-5.1:VerticalStructurePart>
    </aixm-5.1:part>
  </aixm-5.1:VerticalStructureTimeSlice>
</aixm-5.1:timeSlice>

```

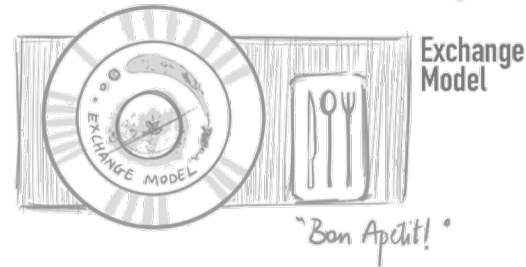
# Digital Data Sets



*It's like  
Cooking  
a Meal!*



Data Sets



Exchange  
Model

"Bon Appetit!"



# Meta Data is Characteristics of Data



Determine the fitness for use without evaluating data itself



# International Guidelines

Region	Name of Organization	Document Name	Document Number	Key Pointers
International	International Organization for Standards	Geographic information Metadata Part 1: Fundamentals	ISO 19115	
	ICAO	PANS - AIM	Doc 10066	5.3 Meta Data
				Doc 9881



# Data about Data

Meta Data Elements	Attributes
Overview	Citation / Date / UoM / Responsible Party
Identification	Language
Quality	Declaration
Maintenance	Frequency (List)
Reference System	Identified of Ref Sys
Distribution	Responsible Party
Extent	Geographical Extent



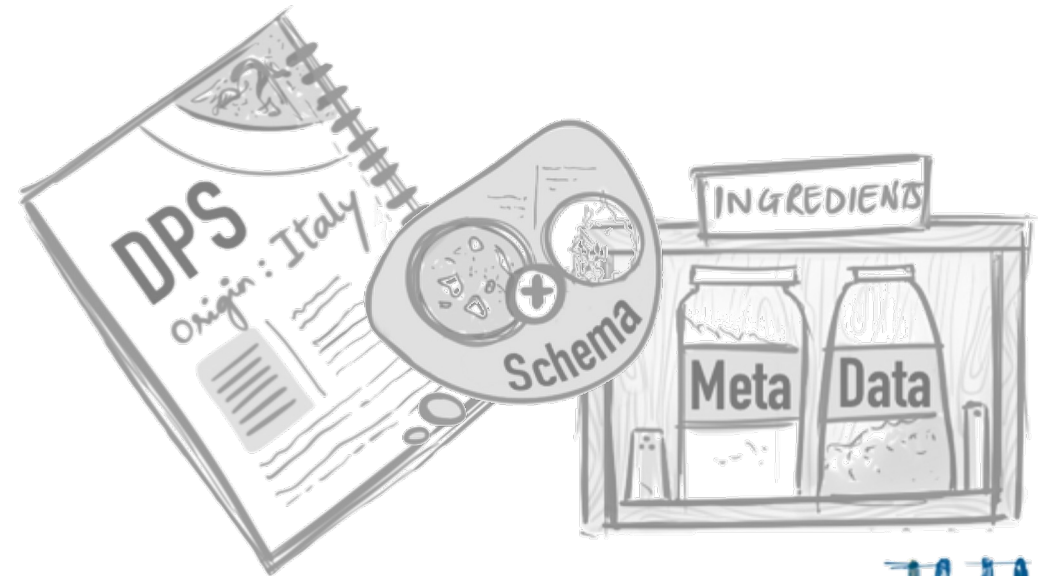


```
<aixm-5.1:Metadata>
  <gmd:MD_Metadata>
    <gmd:contact/>
    <gmd:dateStamp>
      <gco:DateTime>2023-10-02T00:00:00.000Z</gco:DateTime>
    </gmd:dateStamp>
    <gmd:identificationInfo><!--Area of coverage-->
      <gmd:MD_Identifier>
        <gmd:citation>
          <gmd:CI_Citation>
            <gmd:title>
              <gco:CharacterString>eng>eTOD Area 2(a) Coverage</gco:CharacterString>
            </gmd:title>
            <gmd:date>
              <gmd:CI_Date>
                <gmd:date>
                  <gco:DateTime>2023-10-02T00:00:00.000Z</gco:DateTime>
                </gmd:date>
                <gmd:dateType>
                  <gmd:CI_DateTypeCode codeList="http://www.aixm.aero/schema/5.1/IS
                  </gmd:CI_DateTypeCode>
                </gmd:dateType>
              </gmd:CI_Date>
            </gmd:date>
          </gmd:CI_Citation>
        </gmd:citation>
        <gmd:abstract>
          <gco:CharacterString>The area coverage of the eTOD Area 2(a) data set</gco:Charact
        </gmd:abstract>
        <gmd:language>
          <gco:CharacterString>eng</gco:CharacterString>
        </gmd:language>
        <gmd:extent>
          <gmd:EX_Extent>
```



```
<hasMember>
  <aixm-5.1:ContactInformation gml:id="gmlIDCI_1_OA" gml:schema="http://www.aixm.aero/schema/5.1" gml:id="guid.bc026d97-9c1c-4b08-8f23-68e513c4a016">
    <gml:identifier codeSpace="urn:uuid:bc026d97-9c1c-4b08-8f23-68e513c4a016">
      <gml:identifier codeSpace="urn:uuid:bc026d97-9c1c-4b08-8f23-68e513c4a016">
        <aixm-5.1:timeSlice>
          <gml:TimePeriod gml:id="gmlIDTP1_OA">
            <gml:beginPosition>2023-10-02T00:00:00.000Z</gml:beginPosition>
            <gml:endPosition indeterminatePosition="unknown"/>
          </gml:TimePeriod>
        </gml:validTime>
        <aixm-5.1:interpretation>BASELINE</aixm-5.1:interpretation>
        <aixm-5.1:sequenceNumber>1</aixm-5.1:sequenceNumber>
        <aixm-5.1:correctionNumber>0</aixm-5.1:correctionNumber>
        <aixm-5.1:featureLifetime>
          <gml:TimePeriod gml:id="gmlIDFLTP_1_OA">
            <gml:beginPosition>2023-10-02T00:00:00.000Z</gml:beginPosition>
            <gml:endPosition indeterminatePosition="unknown"/>
          </gml:TimePeriod>
        </aixm-5.1:featureLifetime>
        <aixm-5.1:name>RAS-AL-KHAIMAH INTERNATIONAL AIRPORT</aixm-5.1:name>
        <aixm-5.1:designator>OMRK</aixm-5.1:designator>
        <aixm-5.1:type>OTHER</aixm-5.1:type>
        <aixm-5.1:military>CIVIL</aixm-5.1:military>
        <aixm-5.1:contact>
          <aixm-5.1:ContactInformation gml:id="gmlIDCI_1_OA">
            <aixm-5.1:name>RAS-AL-KHAIMAH INTERNATIONAL AIRPORT</aixm-5.1:name>
            <aixm-5.1:title>DATA COLLECTION FOR ETOD AND OLS SURVEY</aixm-5.1:title>
            <aixm-5.1:address>
              <aixm-5.1:PostalAddress gml:id="gmlIDPA_1_OA">
                <aixm-5.1:deliveryPoint>RAS-AL-KHAIMAH INTERNATIONAL AIRPORT</aixm-5.1:deliveryPoint>
                <aixm-5.1:city>RAS-AL-KHAIMAH</aixm-5.1:city>
                <aixm-5.1:administrativeArea>UAE</aixm-5.1:administrativeArea>
                <aixm-5.1:postalCode>501</aixm-5.1:postalCode>
                <aixm-5.1:country>UAE </aixm-5.1:country>
              </aixm-5.1:PostalAddress>
            </aixm-5.1:address>
            <aixm-5.1:networkNode>
              <aixm-5.1:OnlineContact gml:id="gmlIDOC_1_OA">
                <aixm-5.1:linkage>www.rakairport.com</aixm-5.1:linkage>
                <aixm-5.1:eMail>ran.singh@rakairport.com</aixm-5.1:eMail>
              </aixm-5.1:OnlineContact>
            </aixm-5.1:networkNode>
            <aixm-5.1:phoneFax>
              <aixm-5.1:TelephoneContact gml:id="gmlIDTC_1_OA">
                <aixm-5.1:voice>971504329733</aixm-5.1:voice>
                <aixm-5.1:facsimile>97172448199</aixm-5.1:facsimile>
              </aixm-5.1:TelephoneContact>
            </aixm-5.1:phoneFax>
          </aixm-5.1:ContactInformation>
        </aixm-5.1:contact>
      </gml:identifier>
    </aixm-5.1:ContactInformation>
  </hasMember>
```

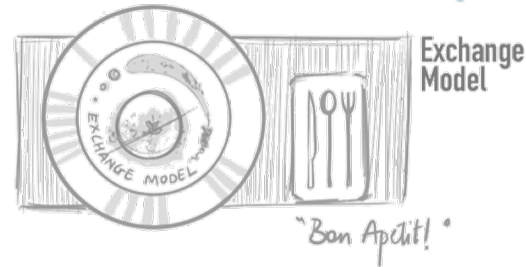
# Digital Data Sets



*It's like  
Cooking  
a Meal!*



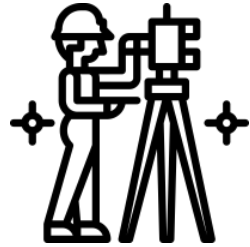
**Data Sets**





Data Set are absolute values

# Critical Process



Data Origination



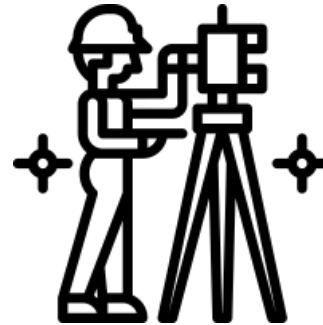
Data Validation



# Obstacle Data Origination



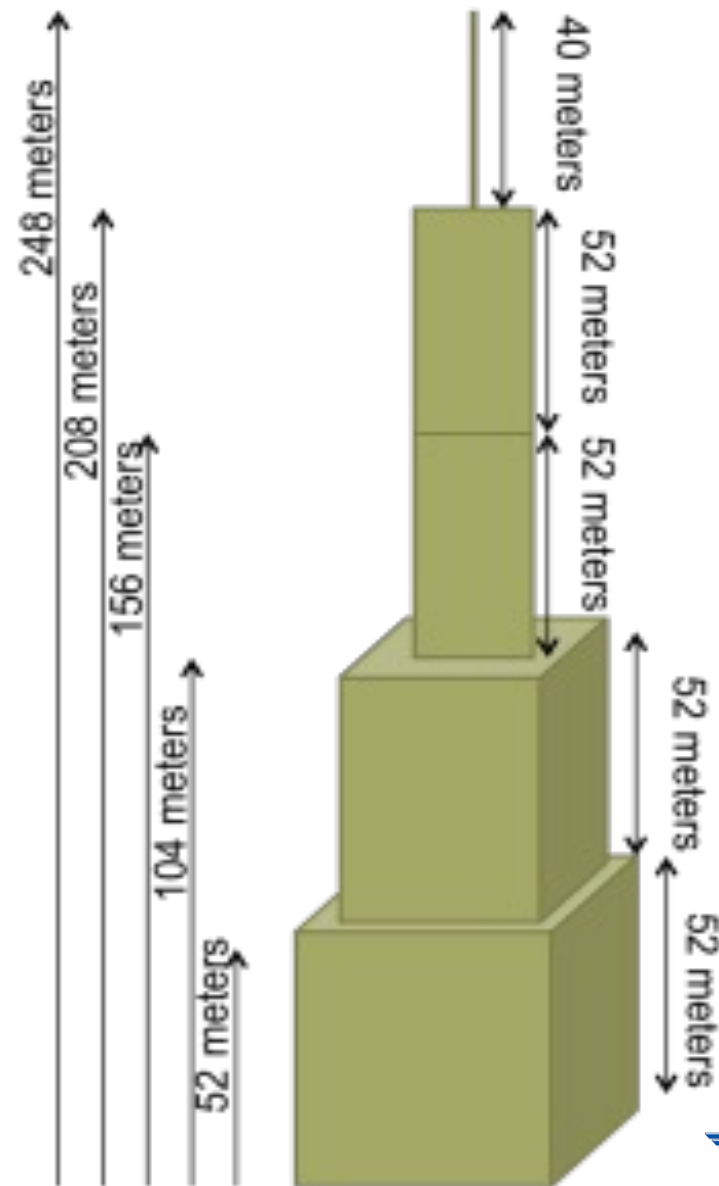
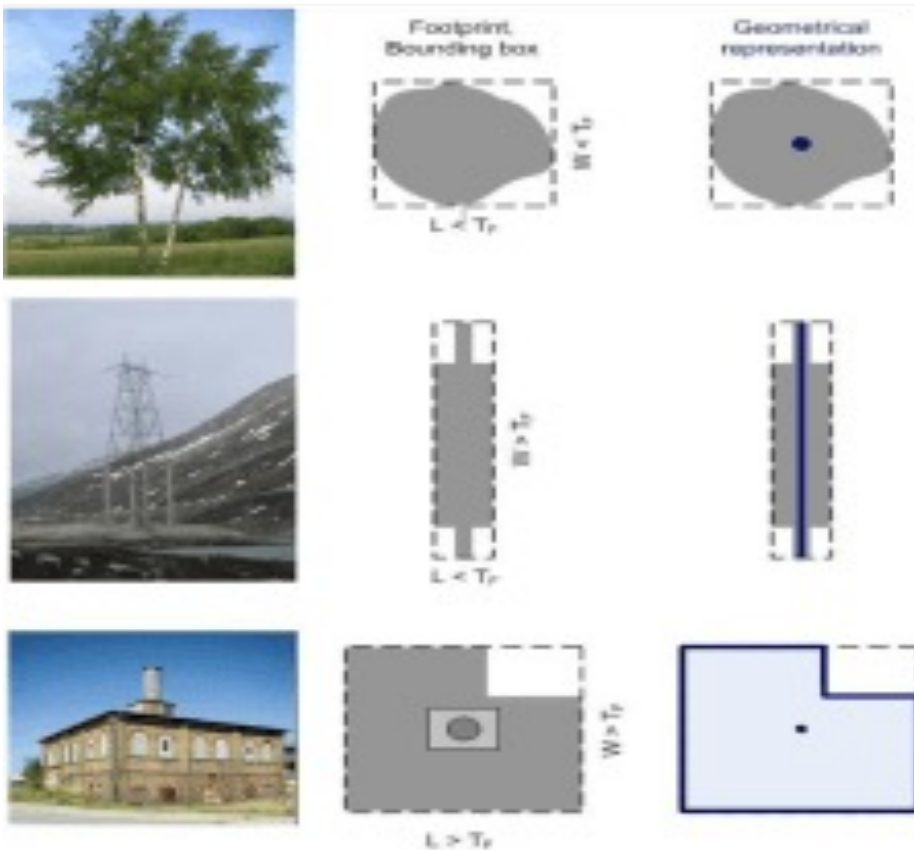
Satellite Images



Terrestrial Survey



# Obstacle Data Modelling





# Obstacle Data Numerical Requirements

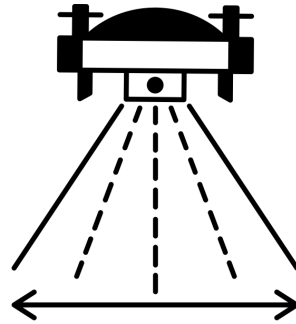
Property Sub-property	Data Type	Description	Accuracy	Integrity	Origin type	Pub. Resolution	Chart Resolution
Obstacle identifier	Text	Unique identifier of obstacle					
Geometry type	Code list	An indication whether the obstacle is a point, line or polygon.					
Horizontal position	Point Line Polygon	Horizontal position of obstacle					
		Obstacles in Area 1	50 m	routine	surveyed	1 sec	as plotted
		Obstacles in Area 2	5 m	essential	surveyed	1/10 sec	1/10 sec
		Obstacles in Area 3	0.5 m	essential	surveyed	1/10 sec	1/10 sec
Horizontal extent	Distance	Horizontal extent of the obstacle					
Elevation	Elevation	Elevation of the highest point of the obstacle.					
		Obstacles in Area 1	30 m	routine	surveyed	1 m or 1 ft	3 m (10 ft)
		Obstacles in Area 2	3 m	essential	surveyed	1 m or 1 ft	1 m or 1 ft
		Obstacles in Area 3	0.5 m	essential	surveyed	0.1 m or 0.1 ft 0.01 m	1 m or 1 ft
Height	Height	Height of the obstacle above ground					
		Obstacles in Area 1	30 m	routine	surveyed	1 m or 1 ft	3 m (10 ft)
		Obstacles in Area 2	3 m	essential	surveyed	1 m or 1 ft	1 m or 1 ft
		Obstacles in Area 3	0.5 m	essential	surveyed	0.1 m or 0.1 ft 0.01 m	1 m or 1 ft
Obstacles in Area 4	1 m	essential	surveyed	0.1 m	1 m or 1 ft		
Date and time stamp	Date	Date and time the obstacle was created					
Effectivity	Text	Effectivity of temporary types of obstacles					
Lighting Colour Type	Text	Colour of the obstacle lighting Type of lighting					
Marking	Text	Type of marking of obstacle					
Material	Text	Predominant surface material of the obstacle					
Operator / Owner	Text	Name and Contact information of obstacle operator or owner					



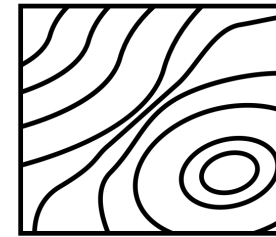
# Terrain Data Origination - Sources



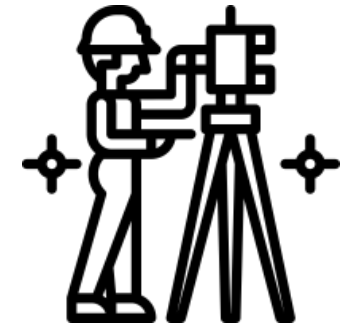
Remote Sensing



LiDAR Survey



National Geodetic Agency



Ground Control Points

# Critical Process



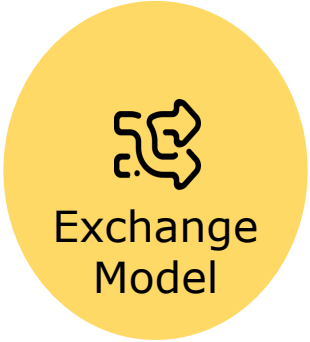
Data Origination



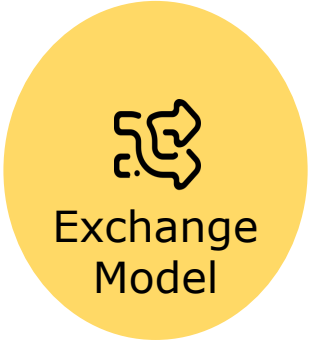
Data Validation

# Data Validation





# Exchange Model is Information Dissemination



# Data Format

## Obstacle Data



AIXM 5.1



GIS



Spread Sheet

## Terrain Data



3D DEM



GeoTiff



GIS



```

589     <gml:beginPosition>2023-10-02T00:00:00.000E</gml:beginPosition>
590     <gml:endPosition/>
591   </gml:TimePeriod>
592 </aixm-5.1:featureLifetime>
593 <aixm-5.1:name>Glide Path Antenna</aixm-5.1:name>
594 <aixm-5.1:type>ANTENNA</aixm-5.1:type>
595 <aixm-5.1:lighted>YES</aixm-5.1:lighted>
596 <aixm-5.1:markingICAOStandard>YES</aixm-5.1:markingICAOStandard>
597 <aixm-5.1:group>NO</aixm-5.1:group>
598 <aixm-5.1:radius uom="M">0.1</aixm-5.1:radius>
599 <aixm-5.1:lightingICAOStandard>YES</aixm-5.1:lightingICAOStandard>
600 <aixm-5.1:part>
601   <aixm-5.1:VerticalStructurePart gml:id="gmlIDVSP_2_VPS">
602     <aixm-5.1:verticalExtent uom="M">15.44</aixm-5.1:verticalExtent>
603     <aixm-5.1:designator>CMRK_2A_0155</aixm-5.1:designator>
604     <aixm-5.1:horizontalProjection_location>
605       <aixm-5.1:ElevatedPoint srsName="urn:ogc:def:ogc:1.3:CRS84" gml:id="gmlIDEP_2_VPS">
606         <gml:pos>55.9416479756156 25.5997332640756</gml:pos>
607         <aixm-5.1:horizontalAccuracy uom="M">5</aixm-5.1:horizontalAccuracy>
608         <aixm-5.1:elevation uom="M">42.9434</aixm-5.1:elevation>
609         <aixm-5.1:geoidUndulation uom="M">-30.979</aixm-5.1:geoidUndulation>
610         <aixm-5.1:verticalDatum>EGM_96</aixm-5.1:verticalDatum>
611         <aixm-5.1:verticalAccuracy uom="M">3</aixm-5.1:verticalAccuracy>
612       </aixm-5.1:ElevatedPoint>
613     </aixm-5.1:horizontalProjection_location>
614   </aixm-5.1:VerticalStructurePart>
615 </aixm-5.1:part>
616 </aixm-5.1:VerticalStructureTimeSlice>
617 </aixm-5.1:timeSlice>
618 </aixm-5.1:VerticalStructure>
619 </hasMember>
620 <hasMember>
621 <aixm-5.1:VerticalStructure xmlns:aixm="http://www.aixm.aero/schema/5.1" gml:id="uuid.bda23548-2c7e-4812-b9e1-475c21d14465">

```



Meta Data

```
546 <gml:identifier codeSpace="urn:uuid:">0a17d453-ca52-4ee7-989c-8e1671fa6766</gml:identifier>
547 <aixm-5.1:timeSlice>
548   <aixm-5.1:VerticalStructureTimeSlice gml:id="gmlIDTS_2_VPS">
549     <gml:validTime>
550       <gml:TimePeriod gml:id="gmlIDTP_2_VPS">
551         <gml:beginPosition>2023-10-02T00:00:00.000E</gml:beginPosition>
552         <gml:endPosition indeterminatePosition="unknown"/>
553       </gml:TimePeriod>
554     </gml:validTime>
555     <aixm-5.1:interpretation>BASELINE</aixm-5.1:interpretation>
556     <aixm-5.1:sequenceNumber>1</aixm-5.1:sequenceNumber>
557     <aixm-5.1:correctionNumber>0</aixm-5.1:correctionNumber>
558     <aixm-5.1:timeSliceMetadata>
559       <gmd:MD_Metadata>
560         <gmd:contact/>
561         <gmd:dateStamp>
562           <gco:DateTime>2023-10-02T00:00:00.000E</gco:DateTime>
563         </gmd:dateStamp>
564         <gmd:spatialRepresentationInfo>
565           <gmd:MD_VectorSpatialRepresentation>
566             <gmd:geometricObjects>
567               <gmd:MD_GeometricObjects>
568                 <gmd:geometricObjectType>
569                   <gmd:MD_GeometricObjectTypeCode codeList="http://www.aixm.aero/schema/5.1/ISO_19139_
570                   </gmd:geometricObjectType>
571                 </gmd:MD_GeometricObjects>
572             </gmd:geometricObjects>
573           </gmd:MD_VectorSpatialRepresentation>
574         </gmd:spatialRepresentationInfo>
575         <gmd:identificationInfo>
576           <gmd:MD_DataIdentification>
577             <gmd:citation></gmd:citation>
578             <gmd:abstract></gmd:abstract>
579             <gmd:status>
580               <gmd:MD_ProgressCode codeList="http://www.aixm.aero/schema/5.1/ISO_19139_Schemas/resources/C
581             </gmd:status>
582             <gmd:language/>
583           </gmd:MD_DataIdentification>
584         </gmd:identificationInfo>
585       </gmd:MD_Metadata>
586     </aixm-5.1:timeSliceMetadata>
```



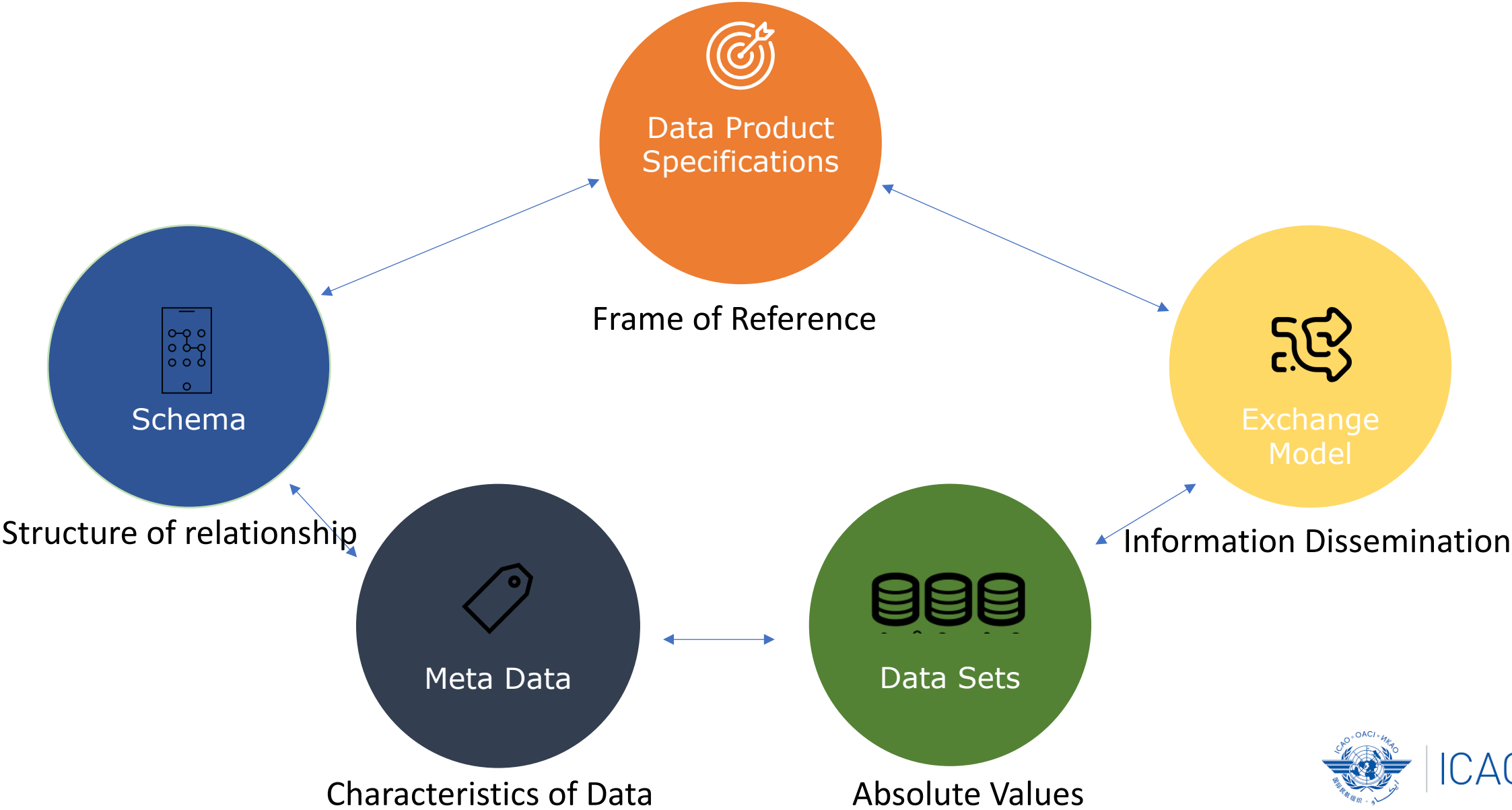
# Delivery Specification

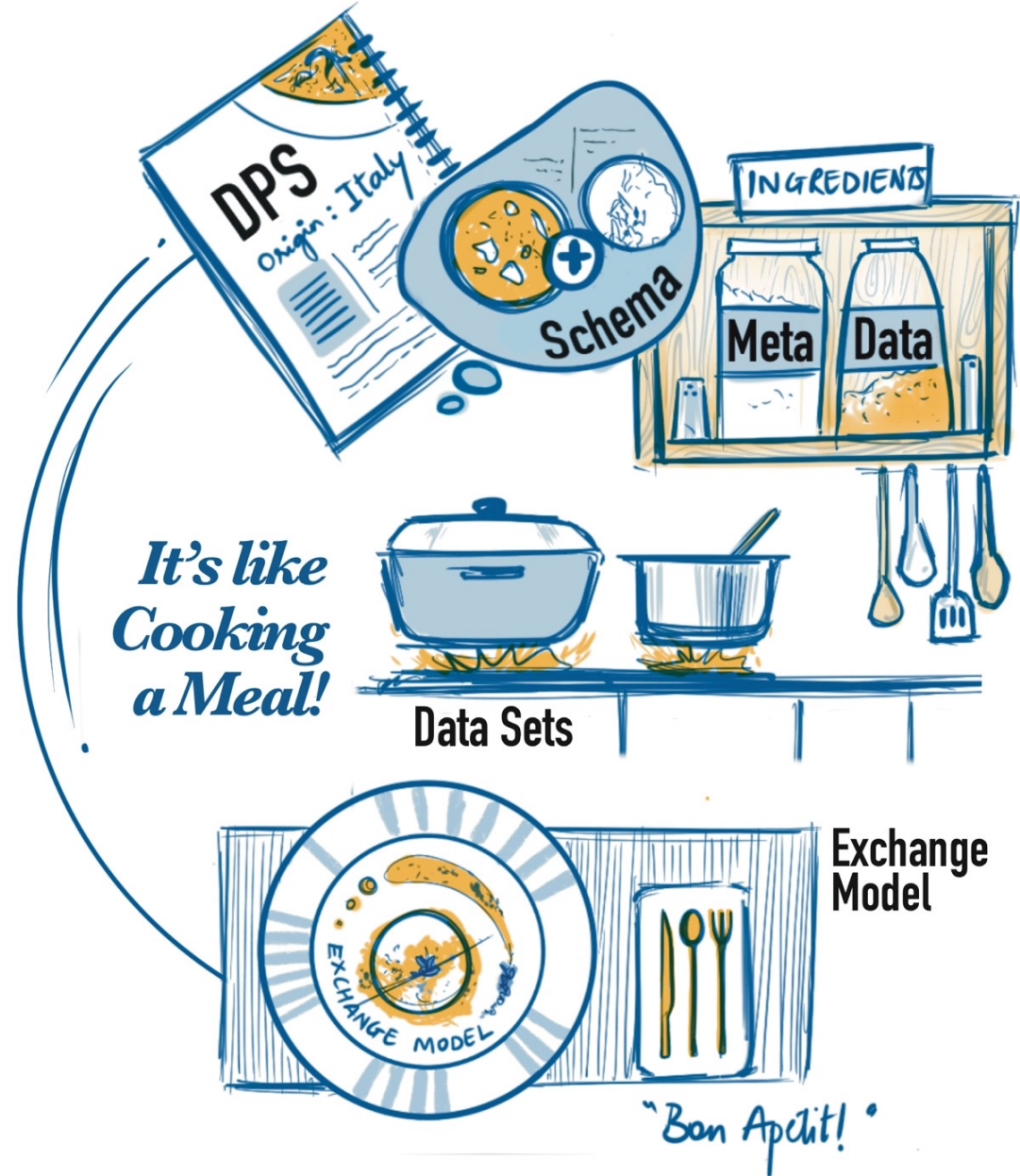
Specifications
Format Name
Version
Specifications
File Structure
Language
Units of Delivery
Transfer Size
Medium Name



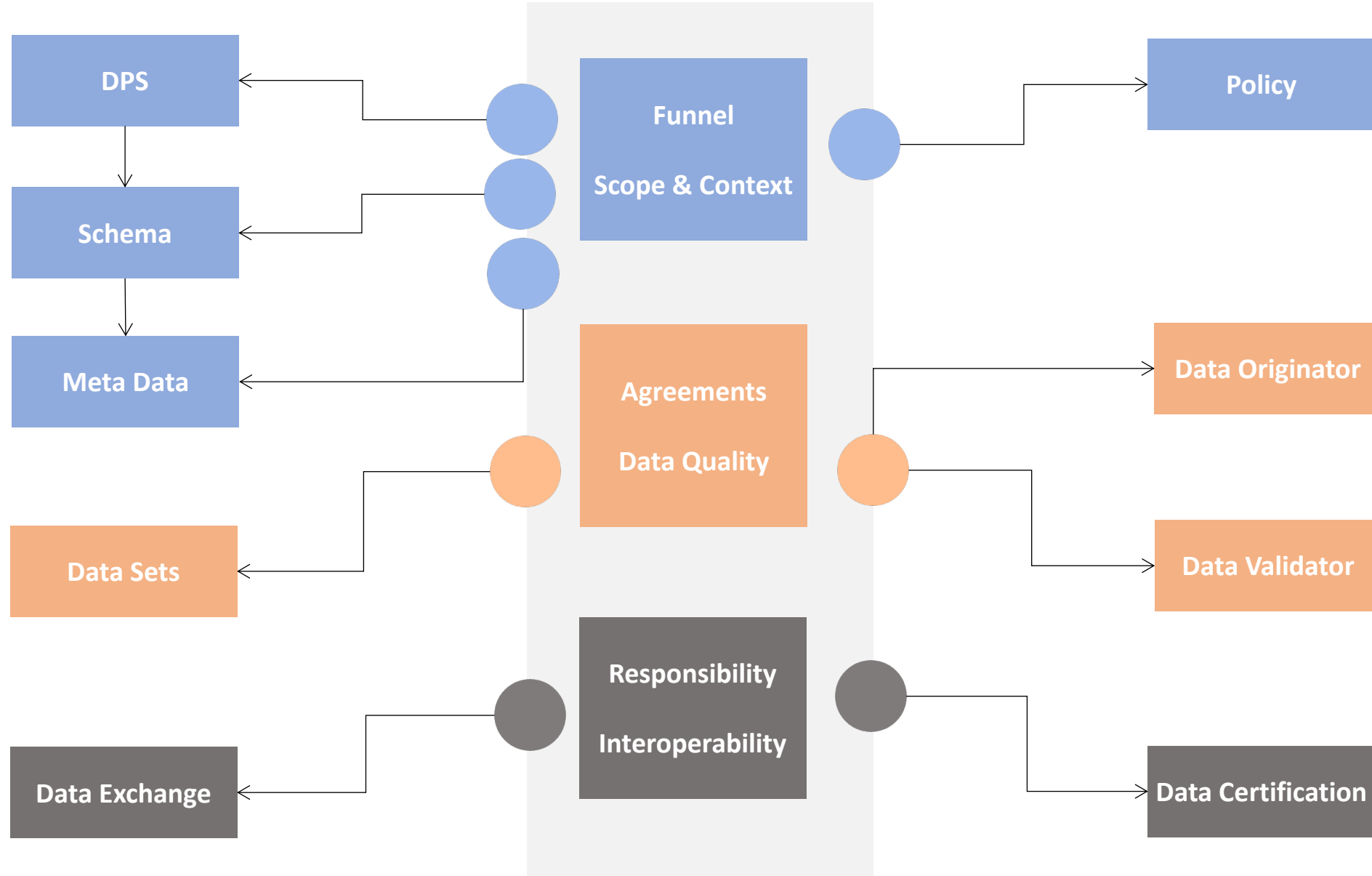
# Making eTOD happen !!

## Getting it right the first time



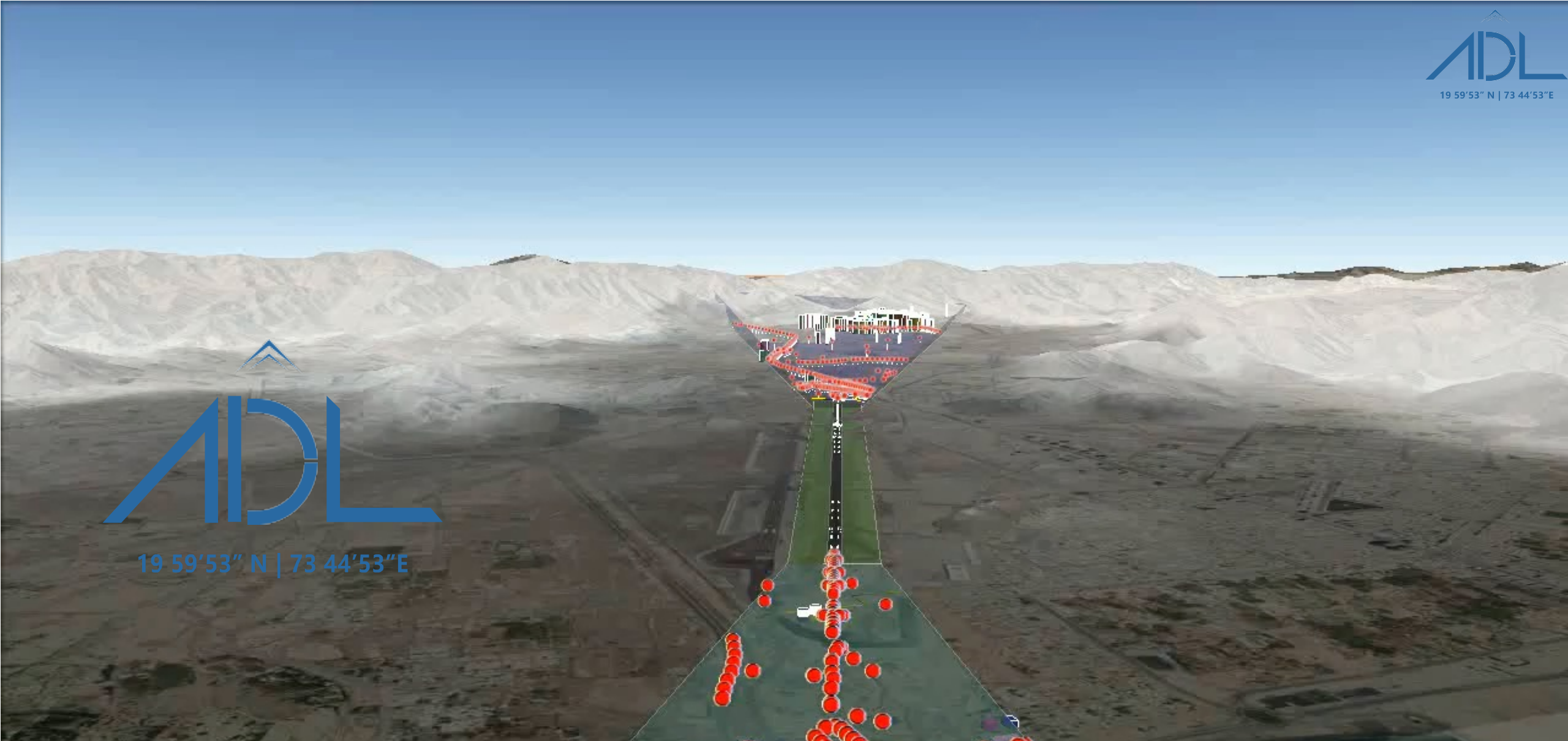


# Hierarchical nature of "Concepts & Roles"



# Non Negotiable Steps

- Missing any one of the elements of the DDS results in incomplete data set
- DPS -> Schema -> Meta Data -> Data Sets -> Exchange Model is necessarily the sequence for TOD implementation
- Temporality attribute must be captured for every obstacle
- Maintenance periodicity of Terrain data is dependent on infrastructure development in that particular State or near to airport



ADL  
19 59'53" N | 73 44'53" E

ADL's eTOD output of existing International Airport

Thank You !!



19 59'53" N | 73 44'53"E

UAE

BC1- GL - FD13, Ground Floor,  
Business Centre 1, Abu Dhabi

India

B 76, NICE Area, MIDC, Satpur,  
Nashik 422007, MH - India

[www.adlcoordinates.com](http://www.adlcoordinates.com)