Proposal to add Environmental Consideration Information to CycloneDX v1.6 Model Cards data

Matt Rutkowski
IBM, STSM Open Source Supply Chain Security

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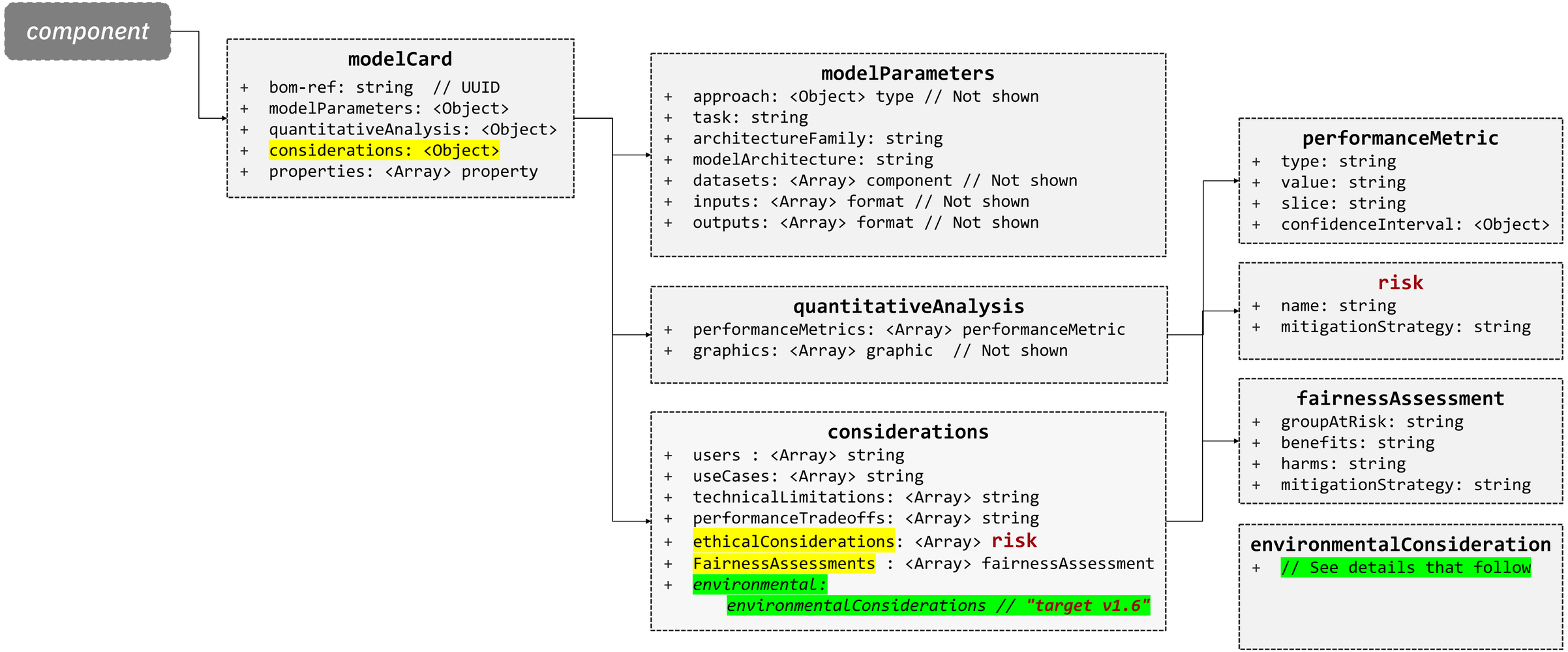
IBM

OWASP CycloneDX Machine Learning BOM (ML-BOM)

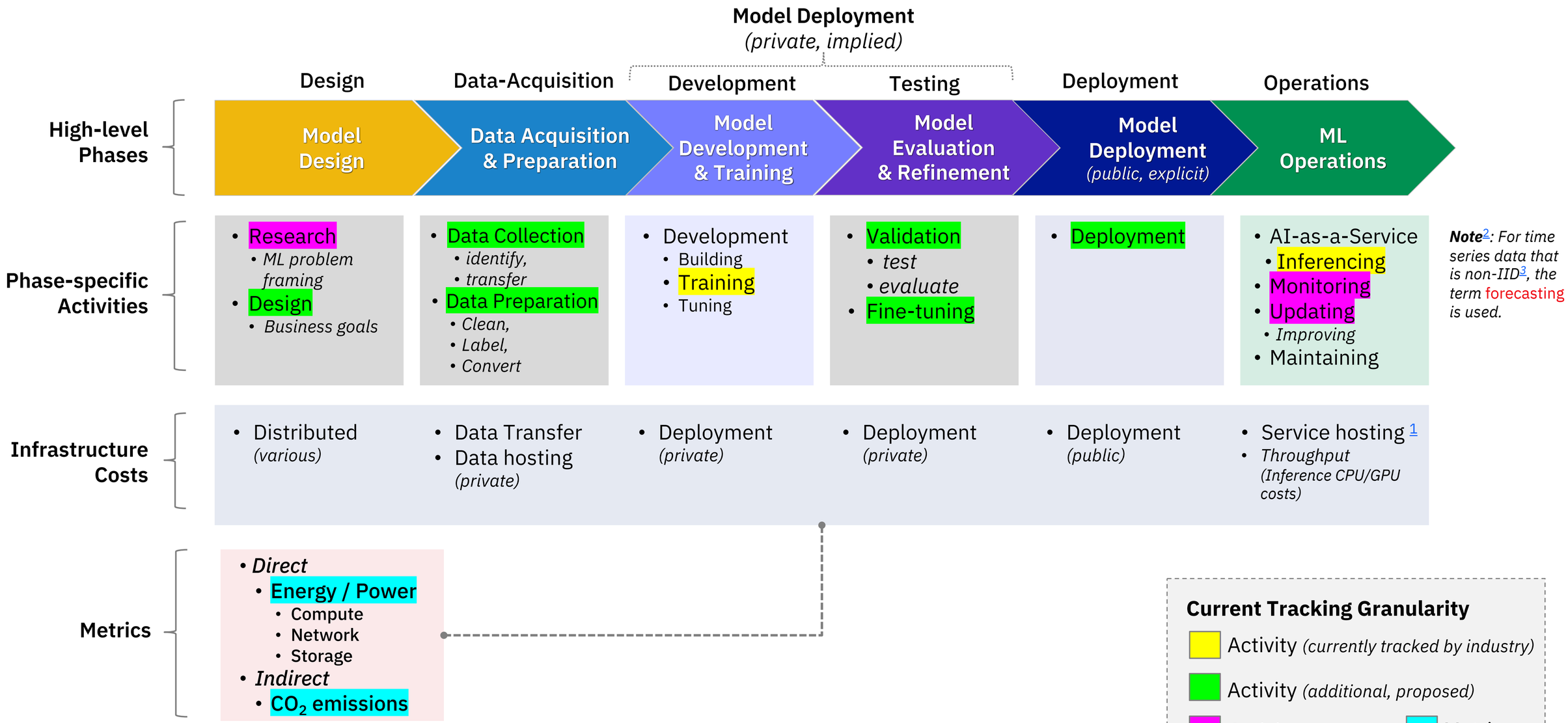
CycloneDX
https://cyclonedx.org/

Model Card Schema overview (not exhaustive)



https://cyclonedx.org/docs/1.5/json/#metadata_component_modelCard

AI CI/CD Lifecycle – Environmental Considerations / Impacts *(costs)*



Datatype: "environmentalConsiderations"

```
"environmentalConsiderations": {
  "type": "object",
  "title": "Environmental Consideration",
  "description": "Describes various environmental impact metrics the corresponding model has exhibited across its lifecycle.",
  "properties": {
    "energyConsumptions": {
      "title": "Energy Consumptions",
      "description": "Describes energy consumption information incurred for specified model lifecycle activities.",
      "type": "array",
      "items": {
        "$ref": "#/definitions/energyConsumption" // See next slide for type properties
      }
    } // FUTURE: Potential to add more consideration "types" each with different metric structures...
  }
},
```

Note: Allows room to add more kinds (types) of environmental considerations apart from energy (and/or its corresponding CO2 footprint) information

Datatype: "environmentalConsideration"

```
"energyConsumption": {
  "title": "Energy Consumption",
  "description": "Describes energy consumption information incurred for the specified model lifecycle activity.",
  "type": "array",
  "items": {
    "type": "object",
    "properties": {
      "activity": {
        "type": "string",
        "title": "Activity",
        "description": "An activity that is part of a machine learning model development or operational lifecycle.",
        "enum": [ "design", "data-collection", "data-preparation", "training", "fine-tuning", "deployment", "inference" ]
      },
      "energySources": {  // Note: multiple energy providers per-activity, For example, multiple cloud data centers.
        "title": "Energy Sources",
        "description": "The provider(s) of the energy consumed by the associated model development lifecycle activity.",
        "type": "array",
        "items": { "$ref": "#/definitions/energyProvider" }
       },
       "energyCost": {
         "title": "Energy Cost",
         "description": "The total energy cost associated with the model lifecycle activity.",
         "$ref": "#/definitions/energyMeasure"
       },
       "CO2CostEquivalent": {
         "title": "CO2 Equivalent Cost",
         "description": "The CO2 cost (debit) equivalent to the total energy cost.",
         "$ref": "#/definitions/co2Measure"
       },
       "CO2CostOffset": {
         "title": "CO2 Cost Offset",
         "description": "The CO2 offset (credit) for the CO2 equivalent cost.",
         "$ref": "#/definitions/co2Measure"
       }
    }
  }
},
```

Datatype for Model Lifecycle: "activity"

```
"activity": {
  "type": "string",
  "title": "Activity",
  "description": "An activity that is part of a machine learning model development or operational lifecycle.",
  "enum": [ "design", "data-collection", "data-preparation", "training", "fine-tuning", "validation", "deployment",
"inference" ],
  "meta:enum": {
    "design": "model design including problem framing, goal definition and algorithm selection.",
    "data-collection": "model data acquisition including search, selection and transfer.",
    "data-preparation": "model data preparation including data cleaning, labeling and conversion.",
    "training": "model building, training and generalized tuning.",
    "fine-tuning": "refining a trained model to produce desired outputs for a given problem space.",
    "validation": "model validation including model output evaluation and testing.",
    "deployment": "explicit model deployment to a target hosting infrastructure.",
    "inference": "generating an output response from a hosted model from a set of inputs."
  }
},
```

Datatypes for Datacenter: "energyProvider"

```
"energyProvider": {
  "type": "object",
  "title": "Energy Provider",
  "description": "Describes the physical provider of energy used for model development or operations.",
  "properties": {
    "name": {
      "type": "string",
      "title": "Name",
      "description": "The name of the energy provider."
    },
    "description": {
      "type": "string",
      "title": "Description",
      "description": "A description of the energy provider."
    },
    "address": {
      "$ref": "#/definitions/postalAddress", // See in later slide
      "title": "Address",
      "description": "The physical address (location) of the energy provider."
    },
    "energySource": {
      "type": "string",
      "enum": [ "coal", "oil", "natural-gas", "propane", "nuclear", "wind", "solar", "geothermal", "hydropower", "other" ],
      "title": "Energy Source",
      "description": "The energy source for the energy provider."
    },
    "energyProvided": {
      "$ref": "#/definitions/CO2Measure"
      "title": "Energy Provided",
      "description": "The energy provided by the energy source for the activity."
    }
  }
},
```

https://www.energy.gov/energy-sources

Datatype: "co2Measure"

```
"co2Measure": {
  "type": "object",
  "title": "CO2 Measure",
  "description": "A measure of carbon dioxide (CO2).",
  "properties": {
    "value": {
      "type": "number",
      "title": "Value",
      "description": "Quantity of carbon dioxide (CO2)."
    },
    "unit": {
      "type": "string",
      "enum": [ "tCO2eq" ],
      "title": "Unit",
      "description": "Unit of carbon dioxide (CO2).",
      "meta:enum": {
        "tCO2eq": "Tonnes (t) of carbon dioxide (CO2) equivalent (eq)."
      }
    }
  }
},
```

Datatype: "energyMeasure"

```
"energyMeasure": {
  "type": "object",
  "title": "Energy Measure",
  "description": "A measure of energy.",
  "properties": {
    "value": {
      "type": "string",
      "title": "Value",
      "description": "Quantity of energy."
    },
    "unit": {
      "type": "string",
      "enum": [ "kWh" ],
      "title": "Unit",
      "description": "Unit of energy.",
      "meta:enum": {
        "kWh": "kilowatt-hour (kWh) is the energy delivered by one kilowatt (kW) of power for one hour (h)."
      }
    }
  }
},
```

Datatypes for Datacenter: "postalAddress"

```
"postalAddress": {
  "type": "object",
  "title": "Postal address",
  "description": "An address used to identify a contactable location.",
  "properties": {
    "country": {
      "type": "string",
      "title": "Country",
      "description": "The country name or the two-letter ISO 3166-1 alpha-2 country code."
    },
    "region": {
      "type": "string",
      "title": "Region",
      "description": "The region or state in the country. For example, Texas."
    },
    "locality": {
      "type": "string",
      "title": "Locality",
      "description": "The locality or city within the country. For example, Austin."
    },
    "postOfficeBoxNumber ": {
      "type": "string",
      "title": "Post Office Box Number",
      "description": "The post office box number. For example, 901."
    },
    "postalCode": {
      "type": "string",
      "title": "Postal Code",
      "description": "The postal code. For example, 78758."
    },
    "streetAddress": {
      "type": "string",
      "title": "Street Address",
      "description": "The street address. For example, 100 Main Street."
    }
  }
}
```

Note: Can add a schema.org "contact point" in the future.
See: https://schema.org/ContactPoint