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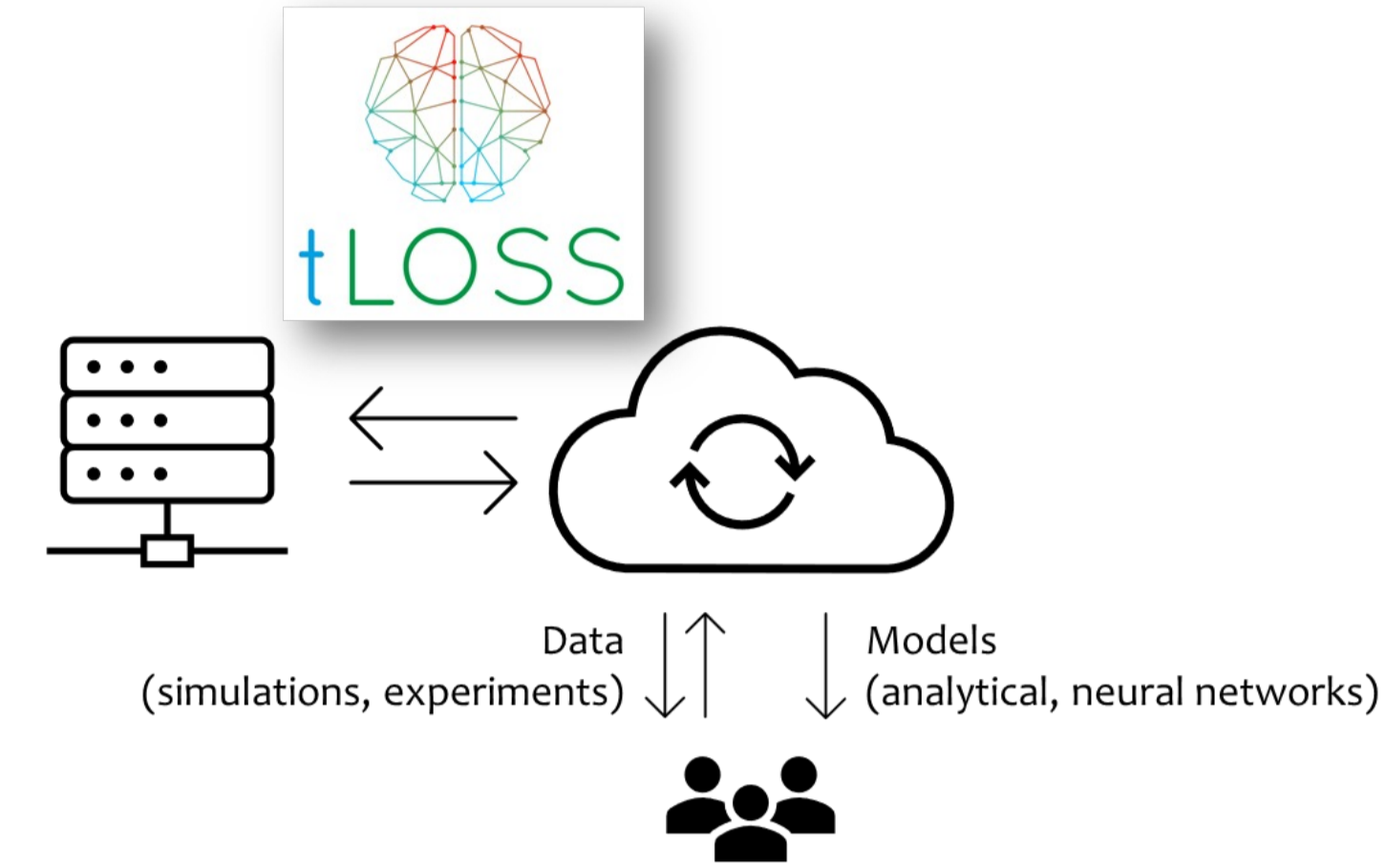
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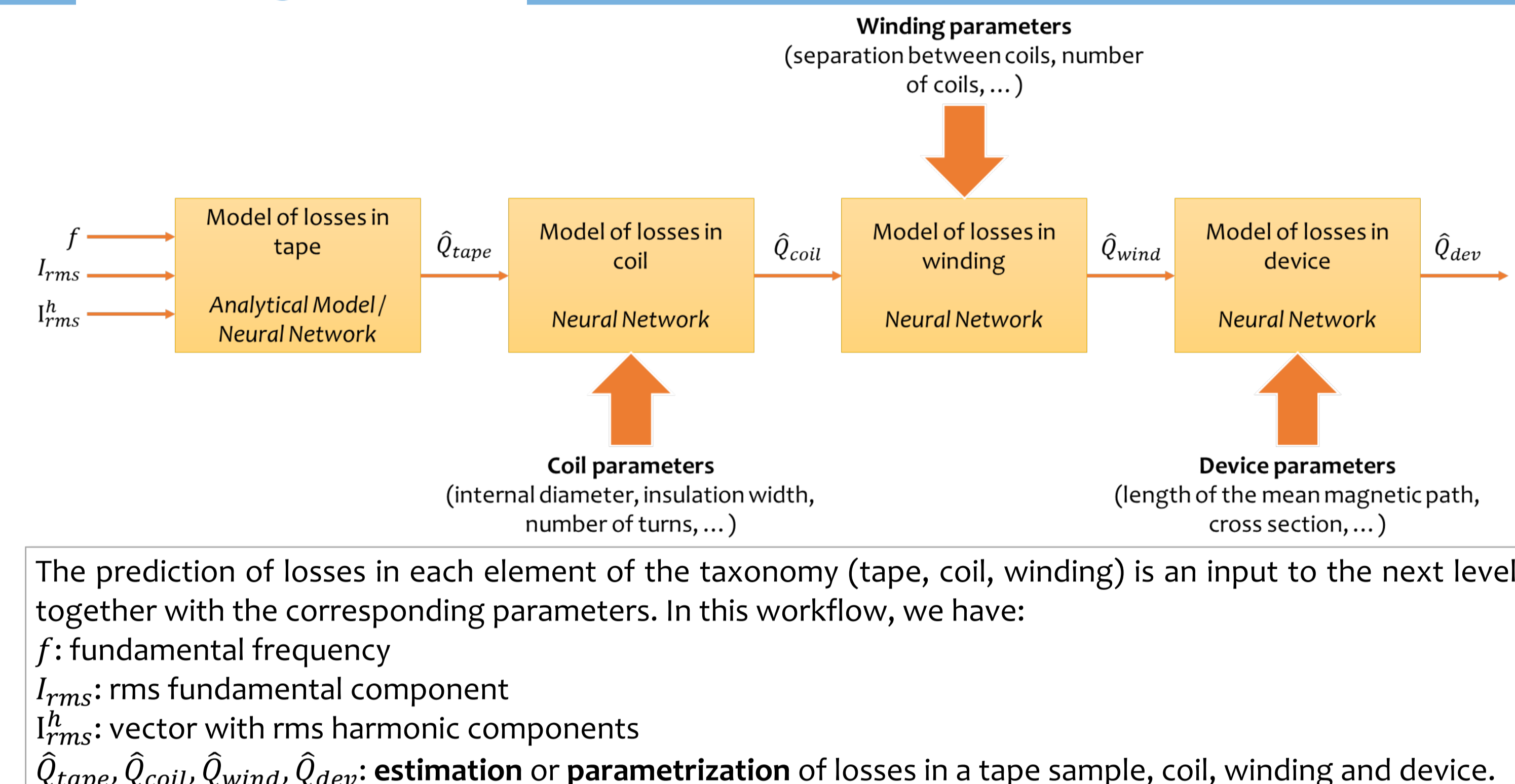
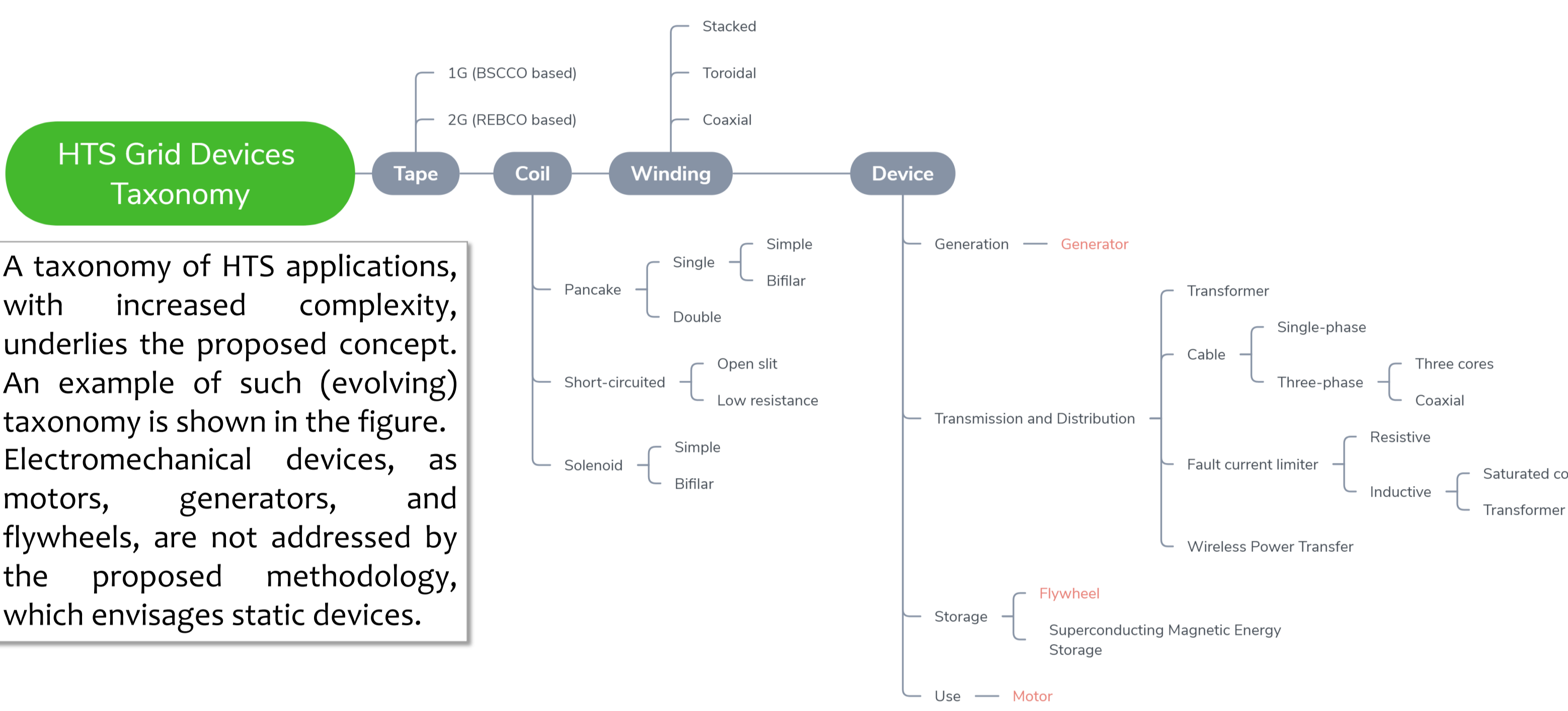
## Abstract

This work describes an **open access platform for collaborative data-driven modelling of AC losses in high-temperature superconducting (HTS) devices**, as opposed to computationally intensive, time-consuming numerical methods. The platform is being developed in the frame of the **Portuguese project tLOSS**. HTS devices are usually modelled and simulated by the Finite Element Method (FEM), due to its accuracy and ability to address multiphysics problems. Yet, the non-linearity of HTS properties or huge width-to-thickness ratios, makes FEM extremely computationally intensive, leading to unreasonable processing times in the optimization of devices, when, e.g., thousands of configurations need to be simulated and assessed. This is still a major impediment to HTS technologies dissemination. There is an opportunity for the **development of data-driven based approaches, from the field of Artificial Intelligence (AI)**, for modelling and simulating the behaviour of HTS devices. Data-driven approaches use data (from experiments and/or simulation) to learn patterns in it. The built computational models can be used for obtaining predictions of distinct conditions instantly. The ability of these approaches to build generalised models with adequate accuracy depends on the availability of large amounts of data from diverse devices and operating conditions.



## Taxonomy of applications

## Modelling workflow



## The platform

## Example: upload data of AC losses in tapes

**Upload Data**

Selecting the component of the modelling workflow

The files supported are .xlsx, .xls, .ods, .slk, .xml and .csv.  
Before uploading be sure there are no empty attributes or empty attribute values.  
You can see an example file below.

Example file

Upload Your File

Escolher ficheiro Nenhum ficheiro selecionado

Or Drag It Here.

Choose the type of component

Tape Coil  Winding Device

Choose the attributes on your Data Set that correspond to the ones shown

Average critical Current /  $I_{lc}$  Losses Q /  $Q_{(I/m/cycle)}$

Data from: Experience Simulation

Defining the data set

Manufacturer SST Reference SS304

Average Critical Current(A) 275

Frequency (Hz) 50

Tape types

Tape type 2G (REBCO based)

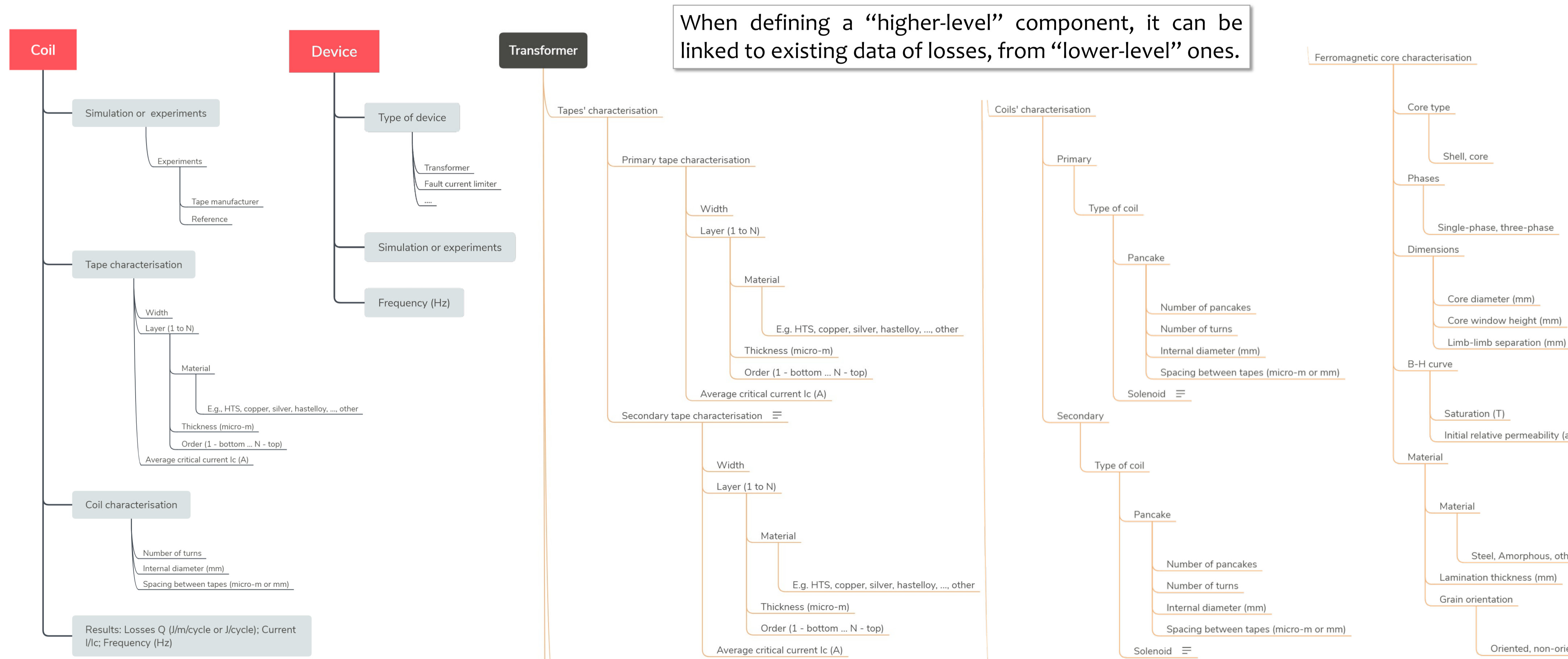
Tape Width (mm) 10

SuperConductor	Layer	Material	Thickness(μm)
	1	Kapton	40
	2	Copper	10
	3	REBCO	1
	4	Hastelloy	50
	5	Copper	10
	6	Kapton	40

Fitted model:  $\hat{Q} = a \left(\frac{I}{I_c}\right)^b$

## Ontology: examples of components and their attributes

## Conclusion, on-going and future work



- A data-driven based methodology and ecosystem is being developed under the national project tLOSS (Transforming Losses Calculation in High Temperature Superconducting Power Systems).
- It envisages a data-driven, collaborative paradigm to accelerate the design of HTS grid devices, concerning the calculation of losses and corresponding cryogenic requirements.
- The modelling workflow allows changing one parameters of the design (e.g., the number of turns of coils) and calculating losses immediately, without having to run whole new numerical simulations.
- The success of the paradigm, i.e., the generalization ability, requires the availability of larges amount of data, to train neural networks, but also to build analytical models, which are generated by researchers worldwide. Thus, the tLOSS collaborative platform is being developed.
- After uploading data, analytical and neural networks models are automatically built.
- Future work includes releasing the platform and developing predictive tools with the existing models.