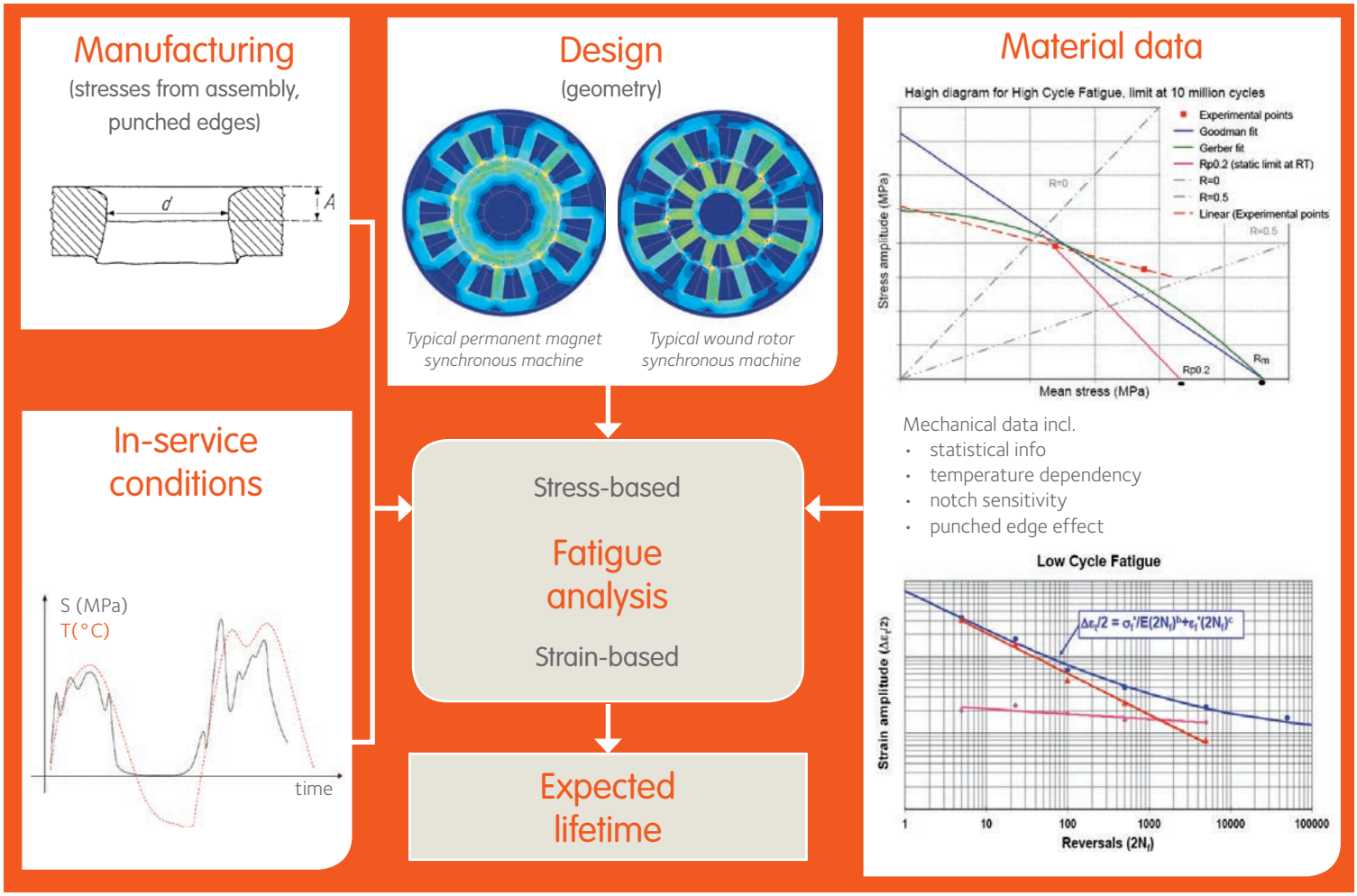
Advanced mechanical characterisation for iCARe®

Mechanical design aspects

Our customers' mechanical design departments need to be able to predict the structural integrity of the rotor and stator based on in-service loads, manufacturing aspects, component geometry and statistical material data obtained using laboratory samples.
The main aspects are summarised in the figure below:

- In-service conditions
  - Load/deformation during rotation, acceleration and deceleration (centrifugal, electromagnetic)
  - Temperature (e.g. as a function of load and ambient temperature)
  - Etc
- Manufacturing aspects such as punched edges and stresses introduced during assembly of the electrical motor parts
- Design, mainly the radii used and the amount of material that remains to transmit the load
- Material properties (statistical variation, temperature dependency, notch sensitivity, punched edge effect etc)

Fatigue design and analysis: different aspects



Static material properties

The yield stress is an important parameter for the design of electrical machines. In the simple case of a constantly spinning rotor, the magnitude of the yield strength determines the maximum rotation speed at which the material can withstand centrifugal forces without plastic deformation. The iCARe® Speed grade is specifically developed for high-speed rotors for the automotive market.
ArcelorMittal can supply elevated temperature tensile data to correctly assess the mechanical behaviour of e-machines under static loads at operating temperatures.

Dynamic material properties

As a material supplier, ArcelorMittal can provide material fatigue data for its electrical steels for the two existing design and analysis approaches, i.e.:

- Stress-based design and analysis (high cycle fatigue, HCF)
- Strain-based design and analysis (low cycle fatigue, LCF)

This data is based on standardised tests.
On request, specific machine design features can be experimentally assessed using specific laboratory set-ups.