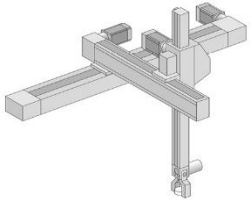
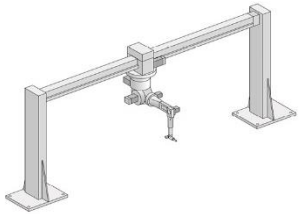
How to dimension & optimize a transmission chain

Pietro Cattoretti

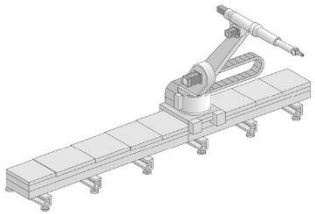
From customer application to kinematic chain dimensioning



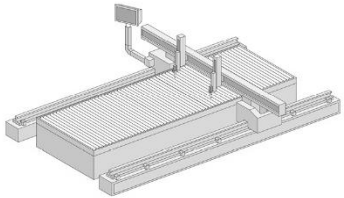
Pick & place robot



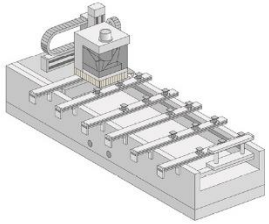
Welding robot



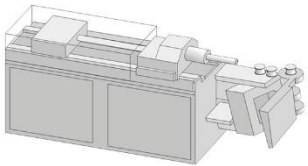
7th Axis



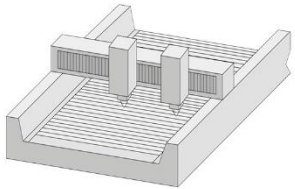
Plasma cutting system



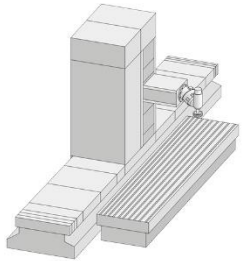
Wood-working



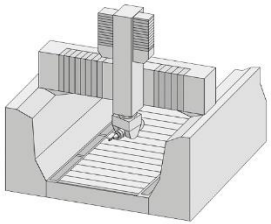
Pipe bending machine



Flatbed laser

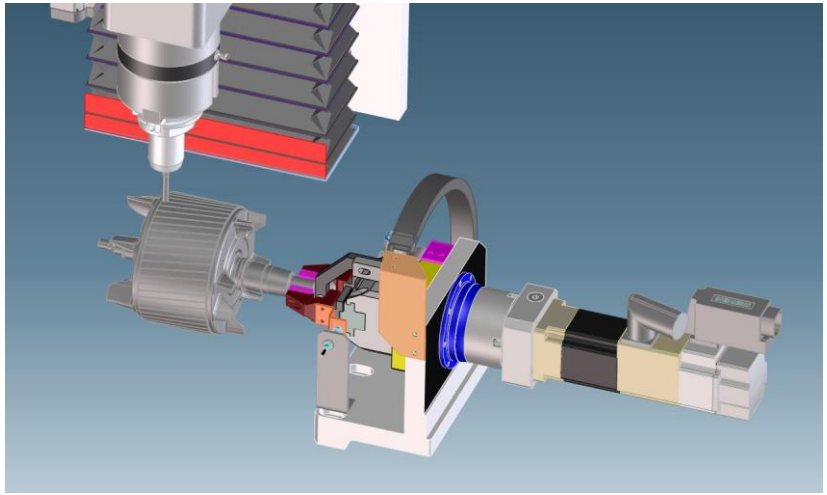


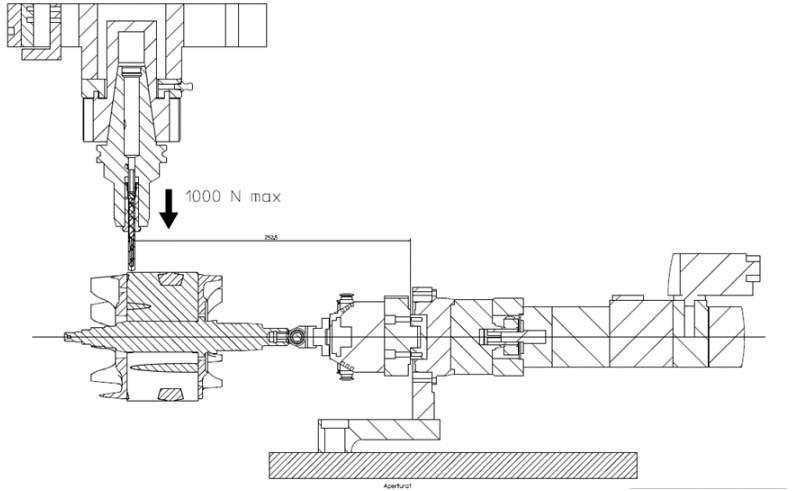
Travelling column milling machine



Portal milling machine

From customer application to kinematic chain dimensioning





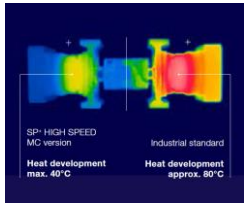
Request: define gearbox and motor in order to drive a specific machine axis

➔ Completeness data application check

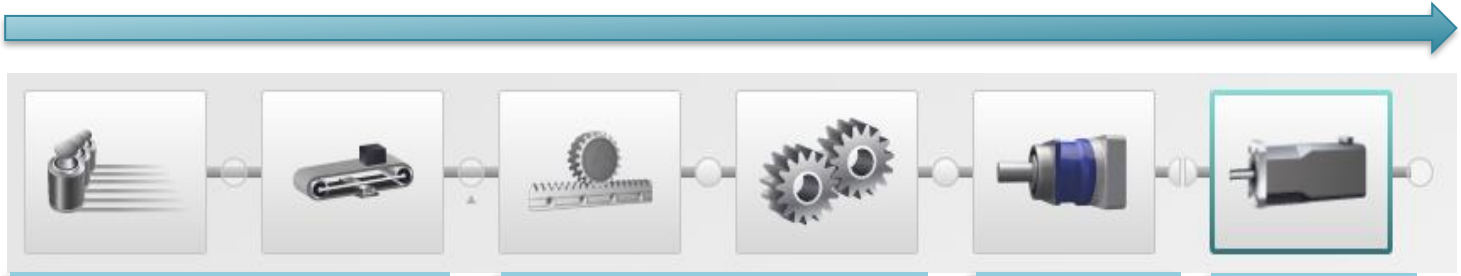
➔ Missing data application check

Step 1 - Define requested OEM specifications

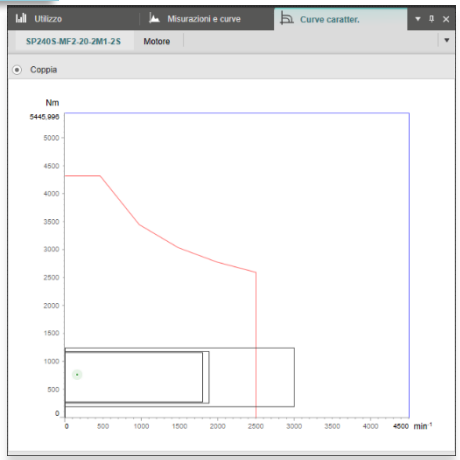
- **Performance**: gearbox type (planetary, worm, hypoid etc.), precision, speed limit, torque, bearing capacity, torsional rigidity, smooth running
- **Geometry**: dimension of gearbox housing; input/output interface (shaft, flange, pulley, pinion); coaxial or right-angle; machine structural constraints (integration/machine footprint)
- **Environmental conditions:** (temperature, IP-protection class, corrosion resistance, hygienic cleaning requirements, operating noise, lubrication, special certifications (ATEX, EHEDG, etc..)
- **Efficiency** (energy saving)
- **Digitalization**
- **Costs**



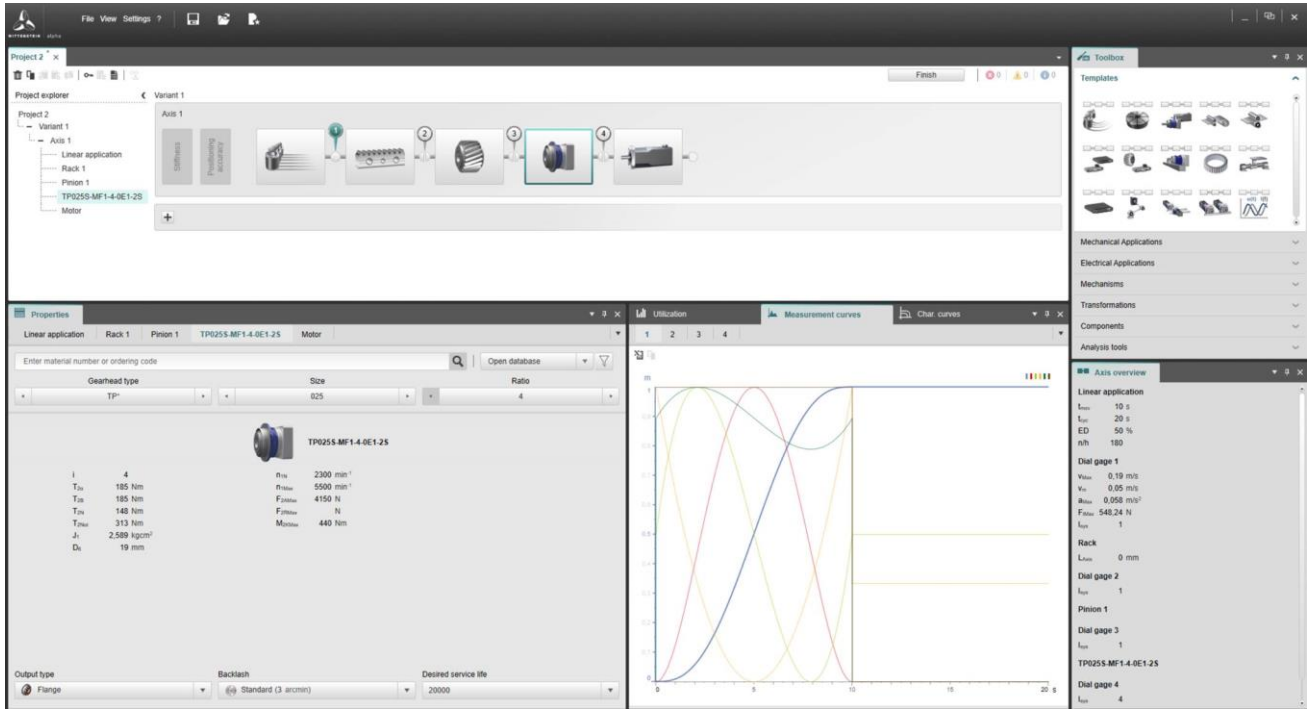
Step 2 – Follow the right sizing sequence



Mechatronic approach to sizing :
Gearbox is now selected with a complete analysis of working conditions and mached with motor perfomances



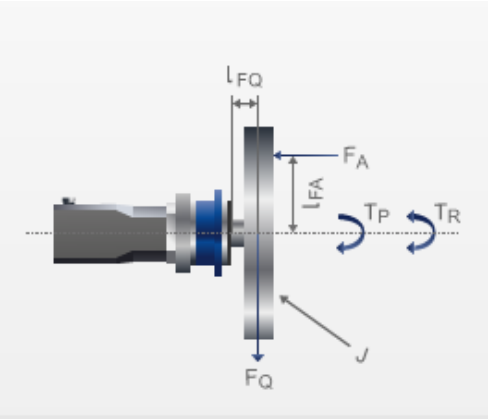
Step 3 – Calculate



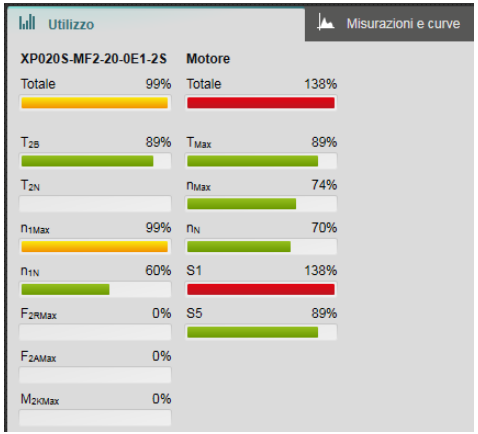
Step 4 – performance check

From dimensioning to reality…. what really happens in the machine?

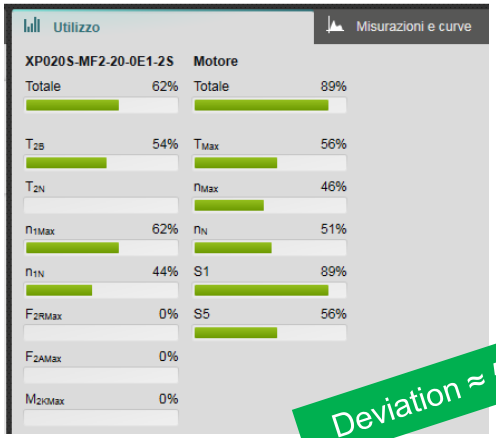
When simulation is correct, deviations between real and theoretical behaviour are very little (**few % points**)



calculation



real situation

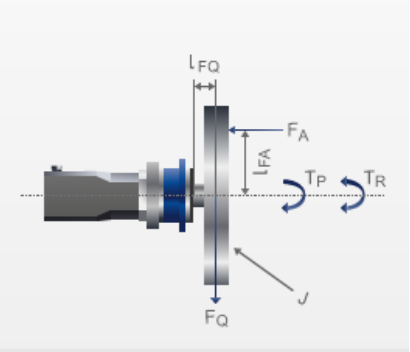


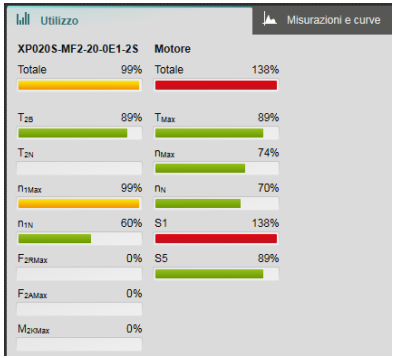
Deviation ≈ 5 % !!

Step 4 – Performance check (deviations)

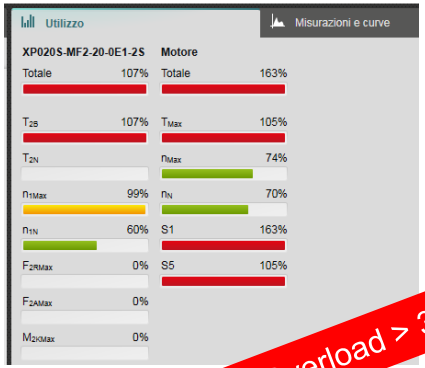
From dimensioning to reality…. what really happens in the machine?

calculation





real situation



Overload > 30% !!

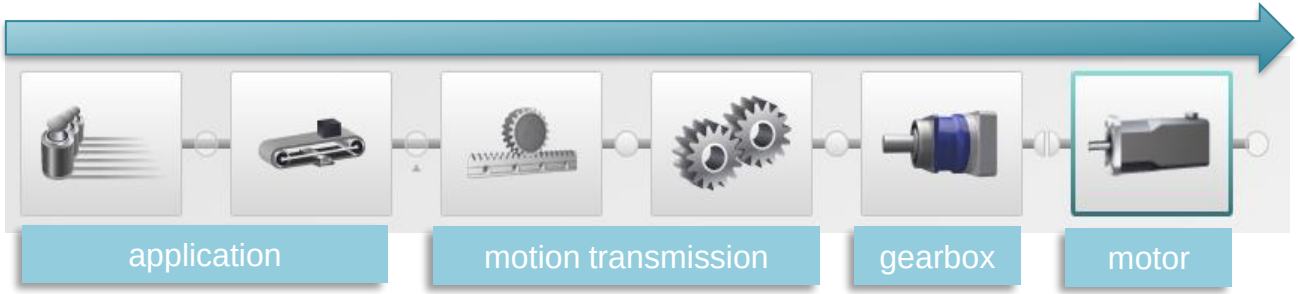
Main reasons for deviation :

- Axis data were estimated without exact data (mass characteristics, motion time, etc…)
- Complex motion profiles were simplified to linear profiles
- Variables of process/product characteristics slightly changed
- Performances needed to be improved
- Boundary conditions were not considered (temperature, assembly)

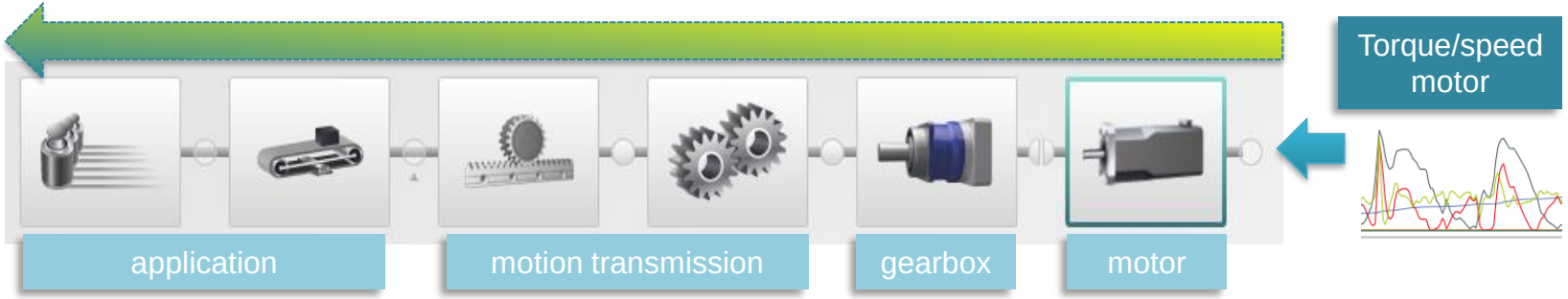
Upgrade / Optimization

1

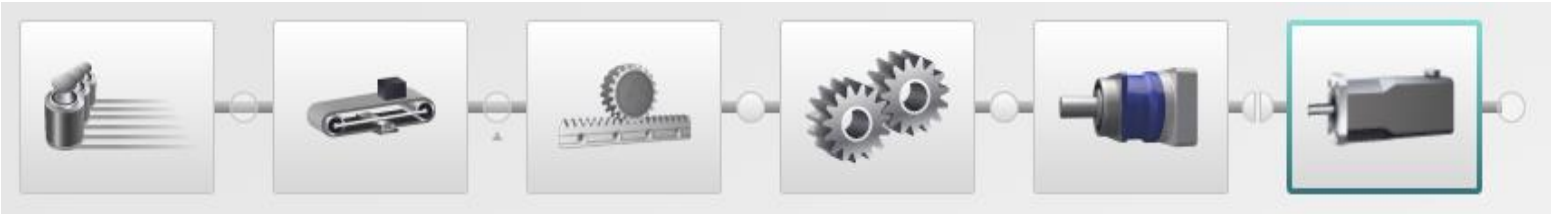
Simulation / virtualization of machine data



2



Conclusion



Precise modeling of the kinematic chain of the application allows us the correct choice of electromechanical components, so:

- Ensure the best performance
- Avoid failures and stop of production
- Guarantee continuity of service and productivity of our company machine or plant

Conclusion

Thanks for your attention and enjoy the next presentations!