

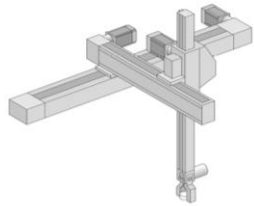
How to dimension & optimize a transmission chain

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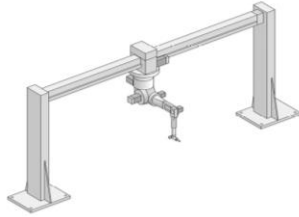


WITTENSTEIN

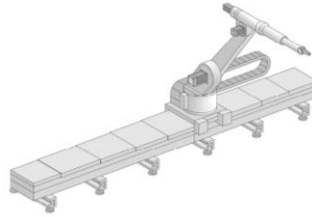
From customer application to kinematic chain dimensioning



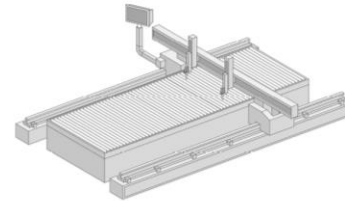
Pick & place robot



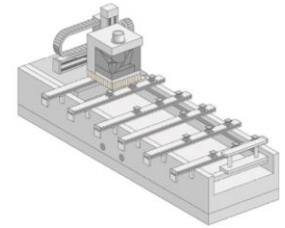
Welding robot



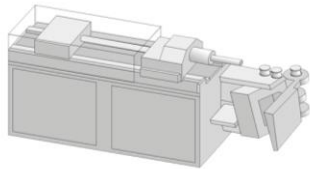
7 th Axis



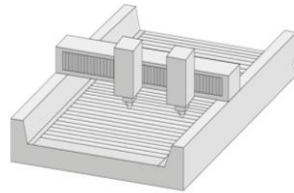
Plasma cutting
system



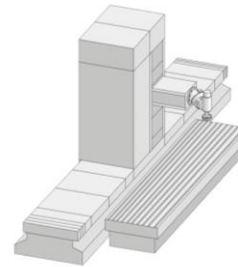
Wood-working



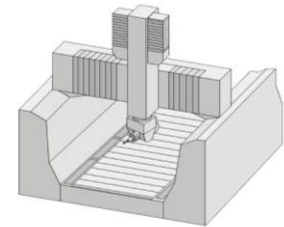
Pipe bending
machine



Flatbed laser



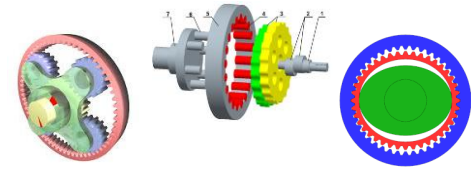
Travelling column
milling machine



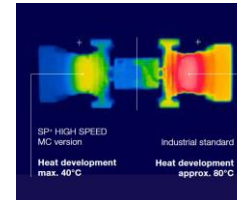
Portal milling
machine

Step 1 - Define requested OEM specifications :

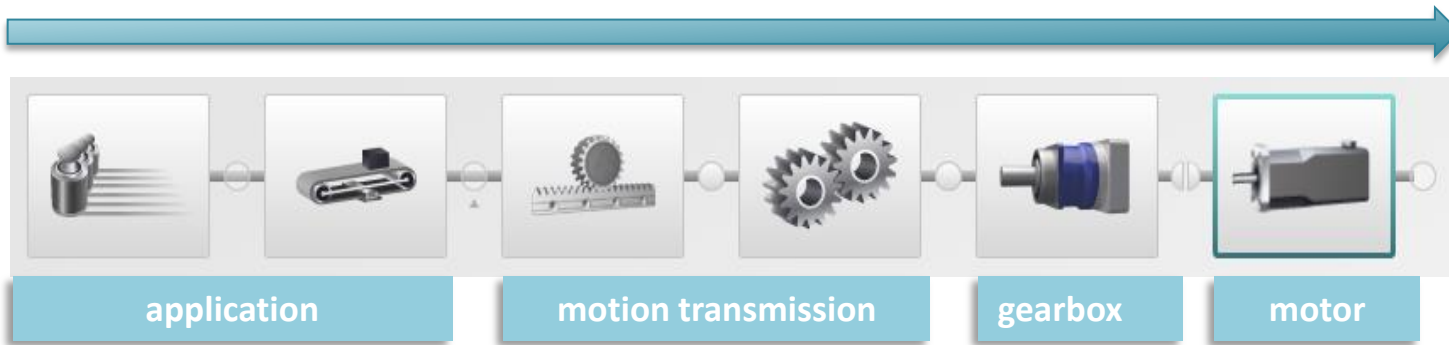
- **Performance:** functioning principle (planetary, worm, cycloid, hypoid, harmonic); precision, speed limit, torque, bearing capacity, torsional rigidity, smooth running
- **Geometry:** dimension of gearbox housing; input/output interface (shaft, flange, pulley, pinion); coaxial or right-angle; machine 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**



National Sanitation Foundation

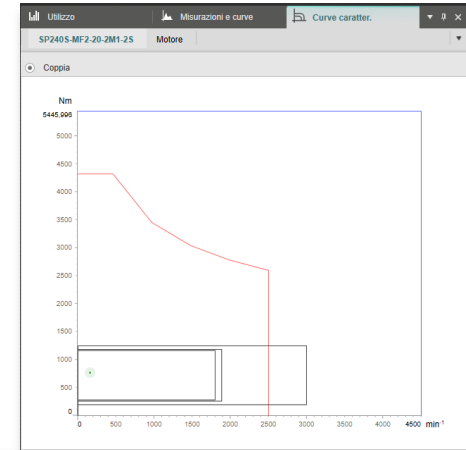


Step 2 – Follow the right sizing sequence

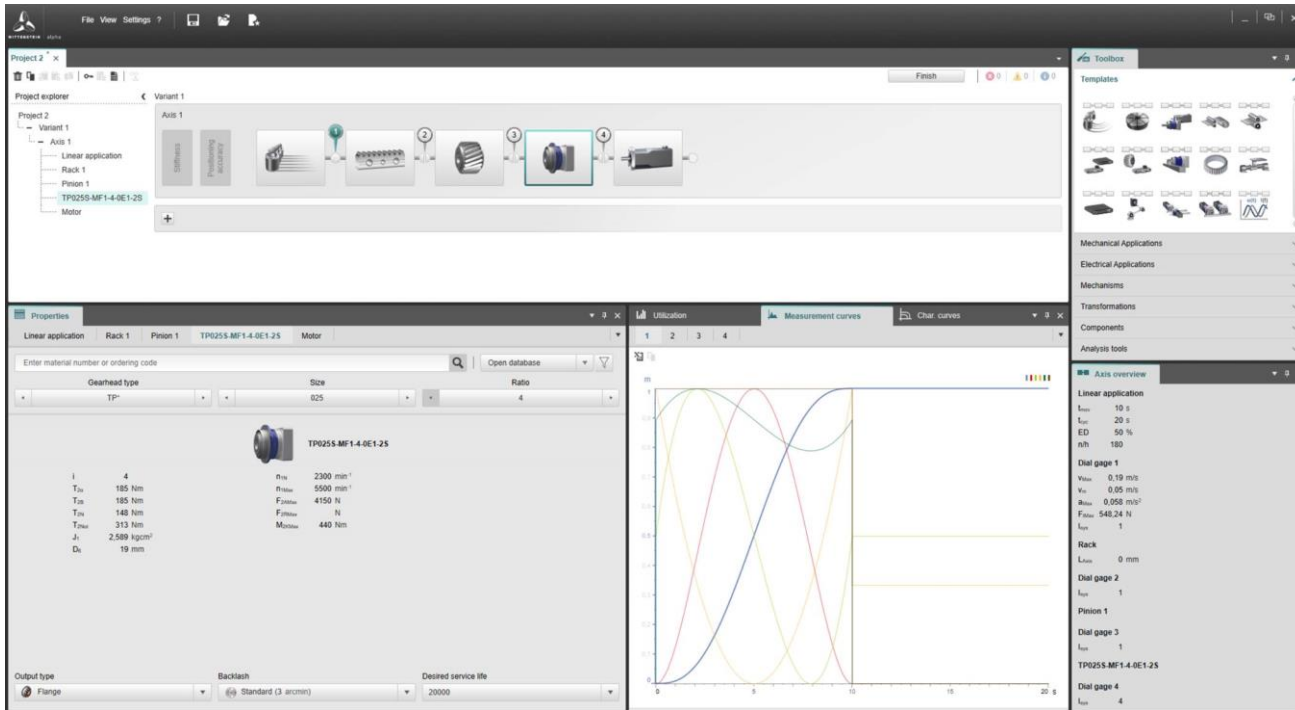


Mechatronic approach to sizing :

Gearbox is now calculated with a complete analysis of working conditions and measurement curves, likewise motors, actuators, etc.



Step 3 – Calculate

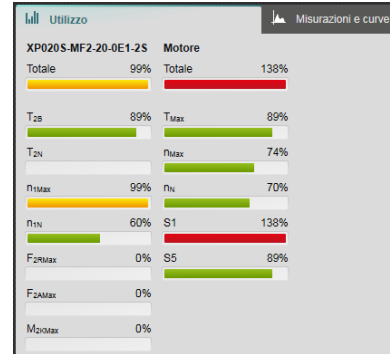
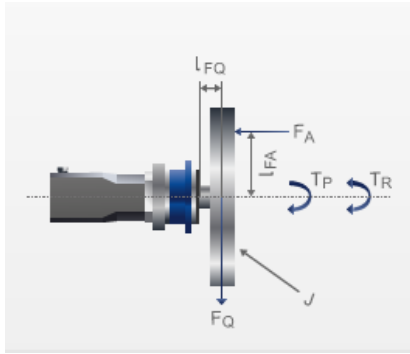


- ✓ Define number of axis
- ✓ Define type of application (rack & pinion, conveyor belt, drive belt, crank, feed roll, etc.)
- ✓ Choose gearbox technology
- ✓ Choose motor from data- base



Step 4 – Result analysis (check deviations)

calculation



real situation



Overload > 30% !!

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

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)

Machine virtualization: how to optimize the sizing approach

Within Industry 4.0 approach it is possible to simulate the whole machine behaviour with a software to avoid an expensive prototyping phase.

Advantages:

reduce time/costs for dimensioning

Limit data cross-check (different components in the machine)

Reduce costs to manufacture prototypes

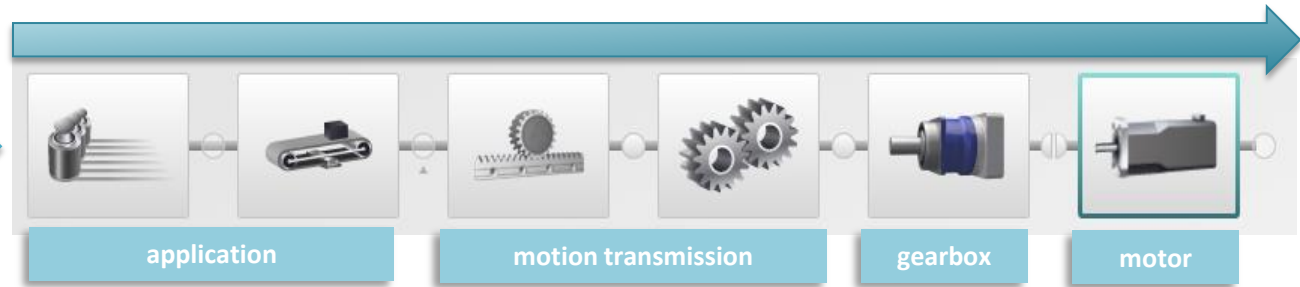
Prototype becomes the first machine of a series

Simulation output data can be easily imported into sizing tools

Optimization

1

Simulation /
virtualization
of machine
data



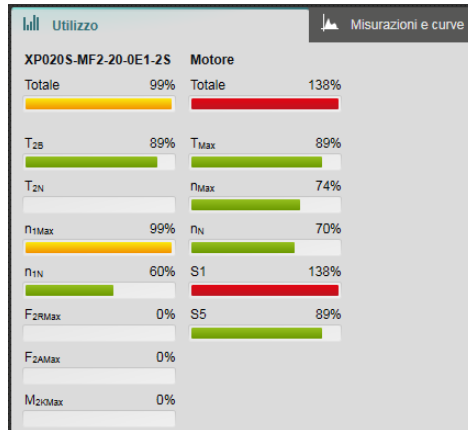
2



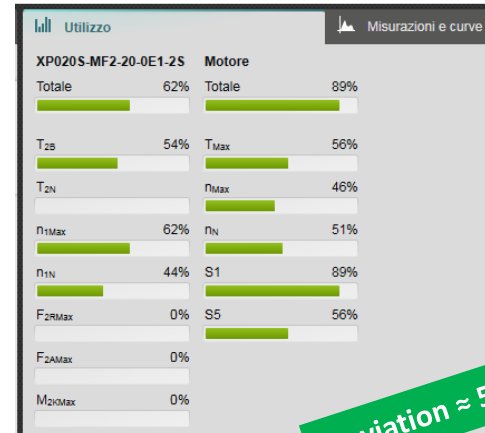
Optimization:

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

calculation



real situation



Deviation ≈ 5 % !!