

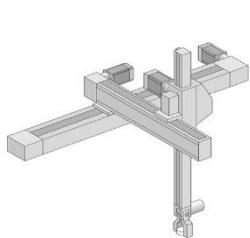
# How to dimension & optimize a transmission chain

Pietro Cattoretti

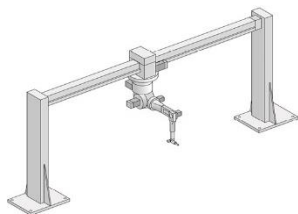


WITTENSTEIN

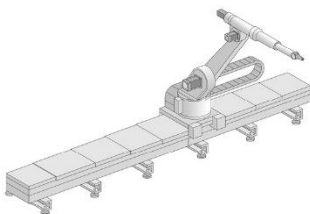
# From customer application to kinematic chain dimensioning



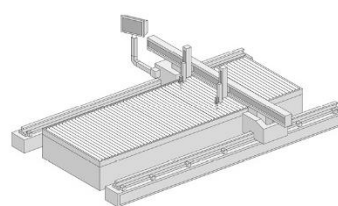
Pick & place  
robot



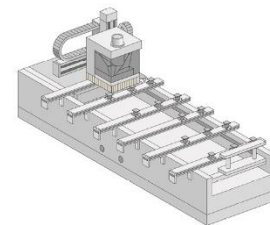
Welding robot



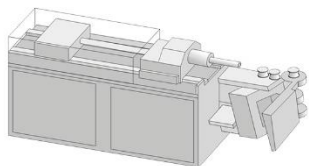
7th Axis



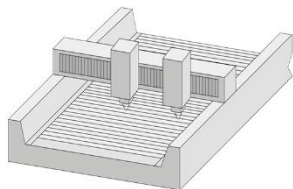
Plasma cutting  
system



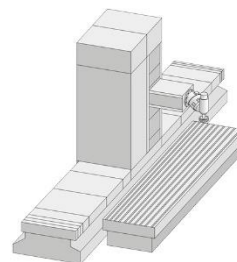
Wood-working



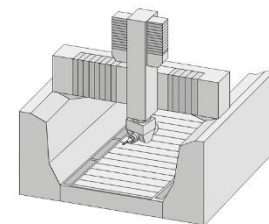
Pipe bending  
machine



Flatbed laser

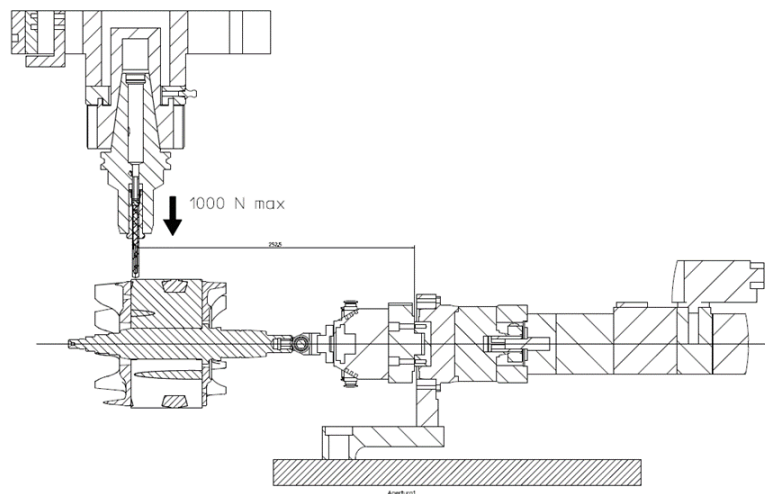
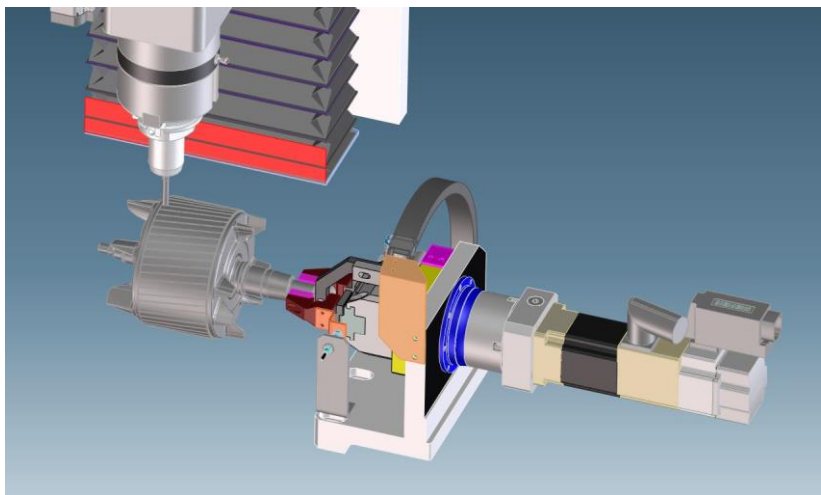


Travelling  
column milling  
machine



Portal milling  
machine

# From customer application to kinematic chain dimensioning

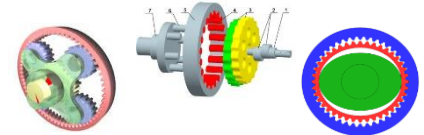


Request: define gearbox and motor in order to drive a specific machine axis

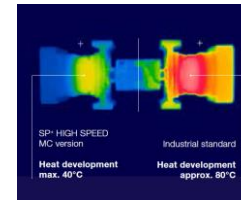
- ➔ Completeness data application check
- ➔ Missing data application check

# Step 1 - Define requested OEM specifications

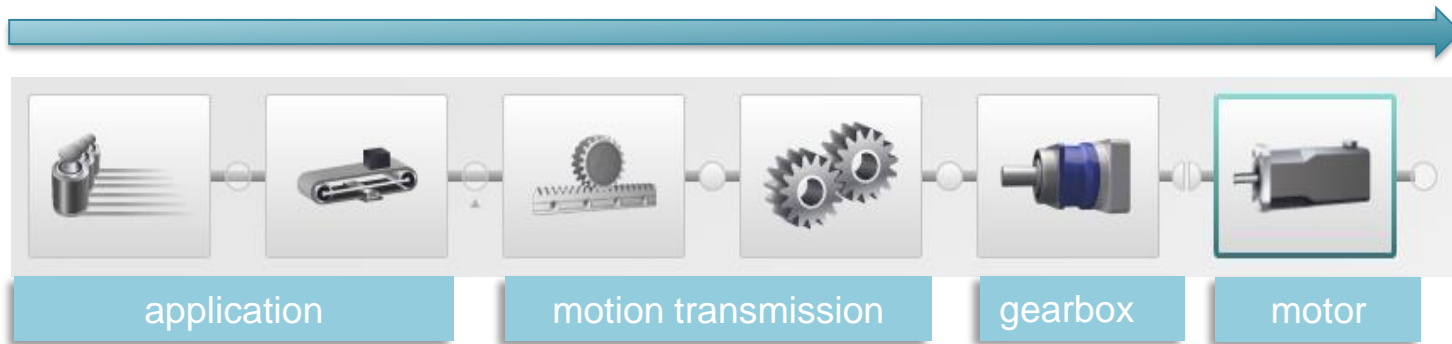
- **Performance:** gearbox type (planetary, worm, hypoid etc.), precision, speed limit, torque, bearing capacity, torsional rigidity, smooth running
- **Geometry:** dimension of gearbox housing; input/output interface (shaft, flange, pulley, pinion); coaxial or right-angle; machine structural constraints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



National Sanitation Foundation

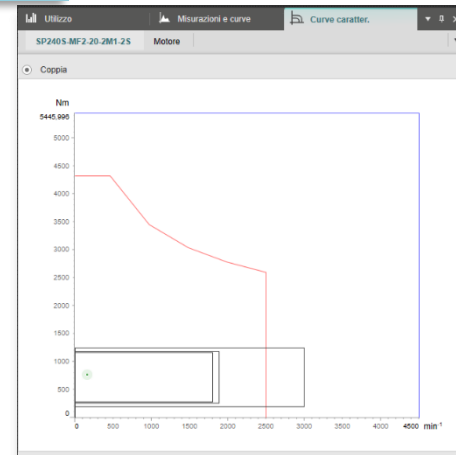


# Step 2 – Follow the right sizing sequence



## Mechatronic approach to sizing :

Gearbox is now selected with a complete analysis of working conditions and matched with motor performances



# Step 3 – Calculate

The screenshot displays the ANIE software interface during the calculation phase. The main window is divided into several panels:

- Project explorer:** Shows a hierarchical view of the project structure, including 'Variant 1', 'Axis 1', 'Linear application', 'Rack 1', 'Pinion 1', and 'TP0255 MF1-4-0E1-25 Motor'.
- Properties:** Displays the configuration for the selected component, 'TP0255 MF1-4-0E1-25'. It includes a search bar for material numbers and a table of gearhead types.
- Measurement curves:** A graph showing the utilization of various components over time (0 to 20 seconds). The y-axis represents utilization from 0.0 to 1.0. Multiple curves represent different parts of the system, showing their respective load profiles.
- Axis overview:** A summary of the system parameters for the 'Linear application'.

Gearhead type	Size	Ratio
TP	025	4

Parameter	Value
$i$	4
$T_{in}$	185 Nm
$T_{out}$	185 Nm
$T_{in}$	148 Nm
$T_{out}$	313 Nm
$J$	2.589 kgcm <sup>2</sup>
$D_s$	19 mm
$n_{in}$	2300 min <sup>-1</sup>
$n_{out}$	560 min <sup>-1</sup>
$F_{in}$	4150 N
$F_{out}$	N
$M_{in}$	440 Nm

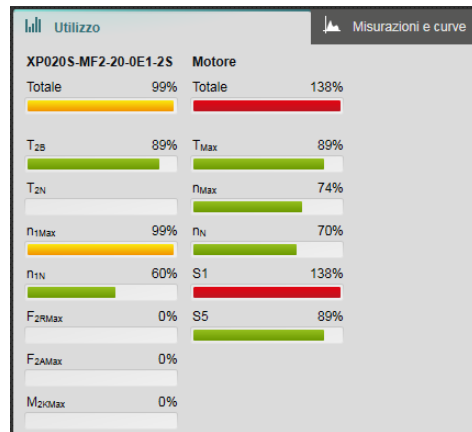
Component	Parameter	Value
Linear application	$L_{in}$	18 s
	$L_{out}$	20 s
	ED	50 %
	$n_h$	180
Dial gage 1	$V_{max}$	0.19 m/s
	$V_c$	0.05 m/s
Rack	$L_{in}$	0 mm
	$L_{out}$	0 mm
Dial gage 2	$f_{in}$	1
	$f_{out}$	1
Pinion 1	$f_{in}$	1
	$f_{out}$	1
Dial gage 3	$f_{in}$	1
	$f_{out}$	1
Dial gage 4	$f_{in}$	4
	$f_{out}$	4



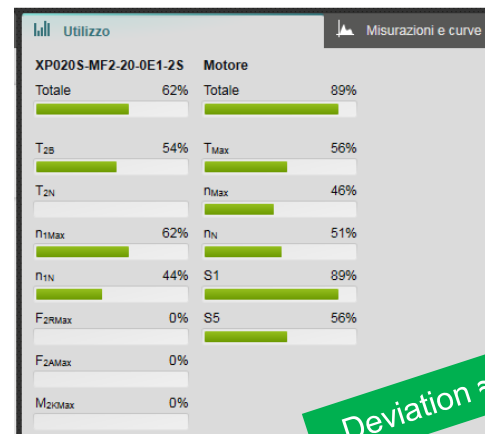
## From dimensioning to reality.... what really happens in the machine?

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

calculation



real situation

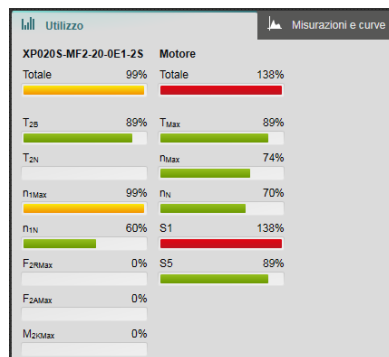
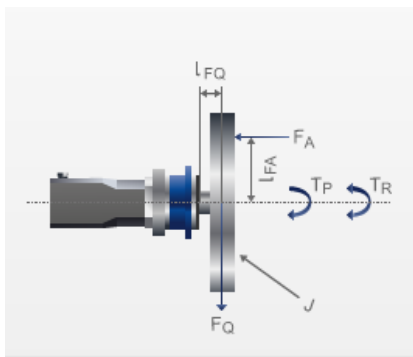


Deviation ≈ 5 % !!

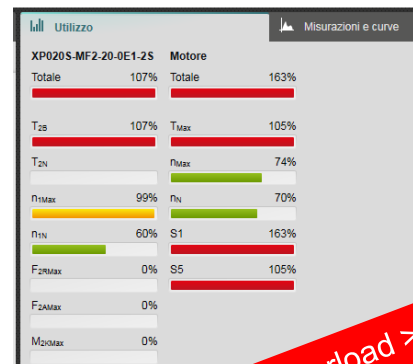
# Step 4 – Performance check (deviations)

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

calculation



real situation



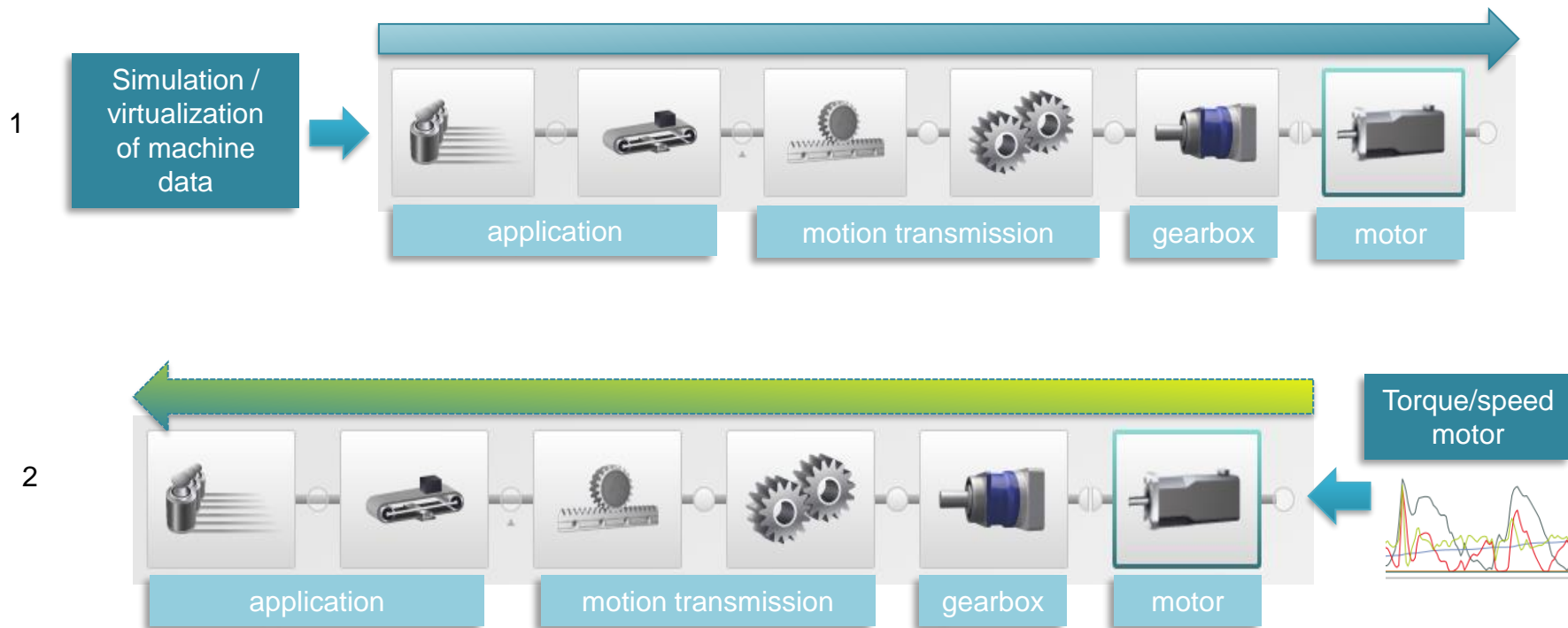
Overload > 30% !!

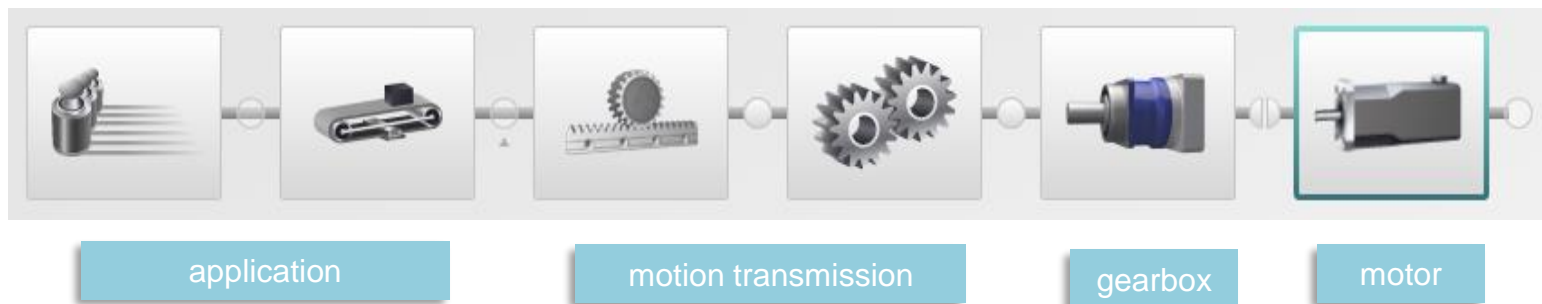


Main reasons for deviation :

- 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)







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

Thanks for your attention and enjoy the next presentations!