

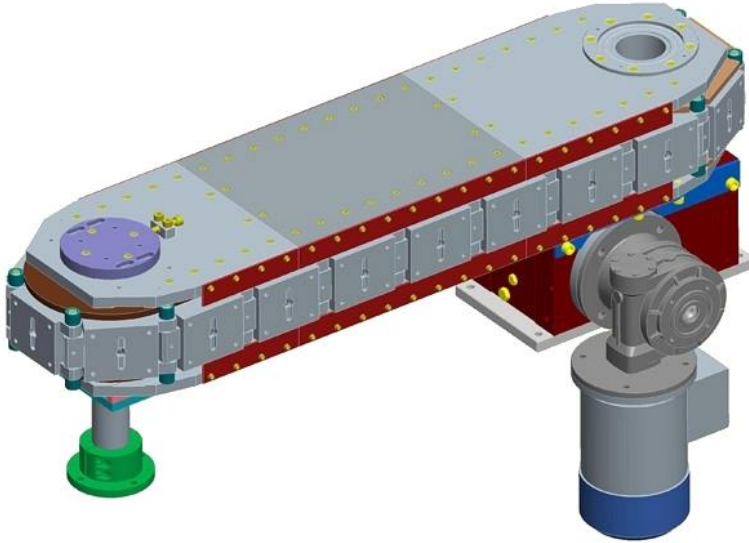
# Flexible transportation systems

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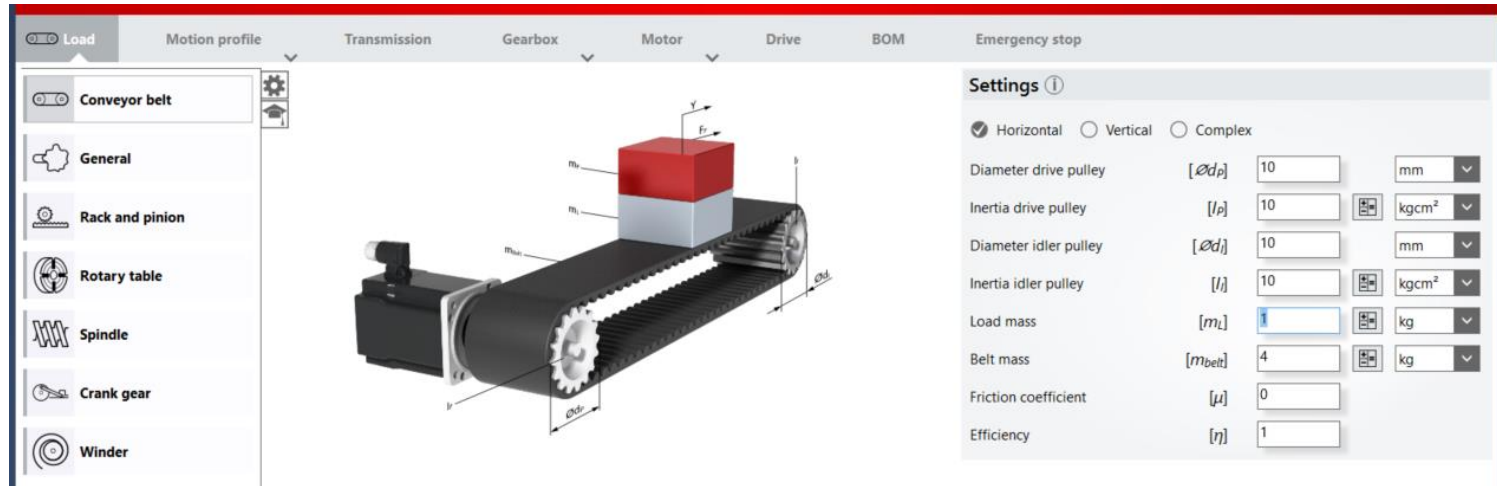
**BECKHOFF**

## Transportation systems – Standard solution



- Motor (asynchronous or brushless)
- Gearbox
- Pallets with fixed steps
- Station to station movements

# Transportation systems – Standard solution



**Settings**

- Horizontal  Vertical  Complex
- Diameter drive pulley [ $d_p$ ] 10 mm
- Inertia drive pulley [ $I_p$ ] 10 kgcm<sup>2</sup>
- Diameter idler pulley [ $d_i$ ] 10 mm
- Inertia idler pulley [ $I_i$ ] 10 kgcm<sup>2</sup>
- Load mass [ $m_l$ ] 1 kg
- Belt mass [ $m_{belt}$ ] 4 kg
- Friction coefficient [ $\mu$ ] 0
- Efficiency [ $\eta$ ] 1

Simple mathematical models



## Transportation systems – Standard solution

Motion profile definition :

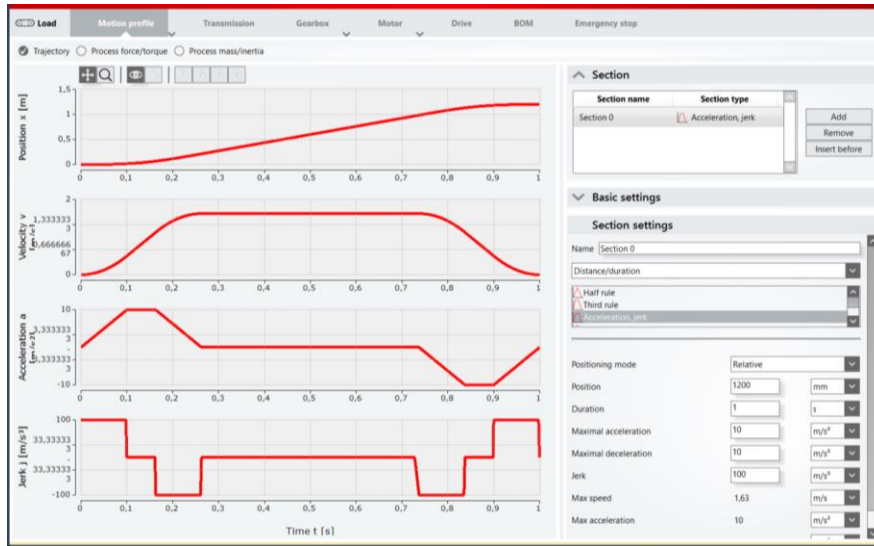
- Few calculation needed
- Limited interaction between mechanical and electrical components

Application field:

- Packaging
- Assembly
- Pharmaceutical

# Transportation systems – Standard solution

Define motion profile:



- Dynamics (position, velocity, acceleration)
- Center of gravity, Inertia, material
- Cycle profile (movement time, rest time)



# Transportation systems – Standard solution

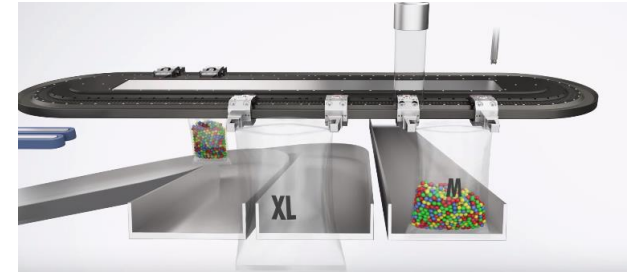
- Long downtimes due to changeovers
- Not flexible
- Maintenance

# Transportation systems – Flexible solution



## Transportation systems – Flexible solution

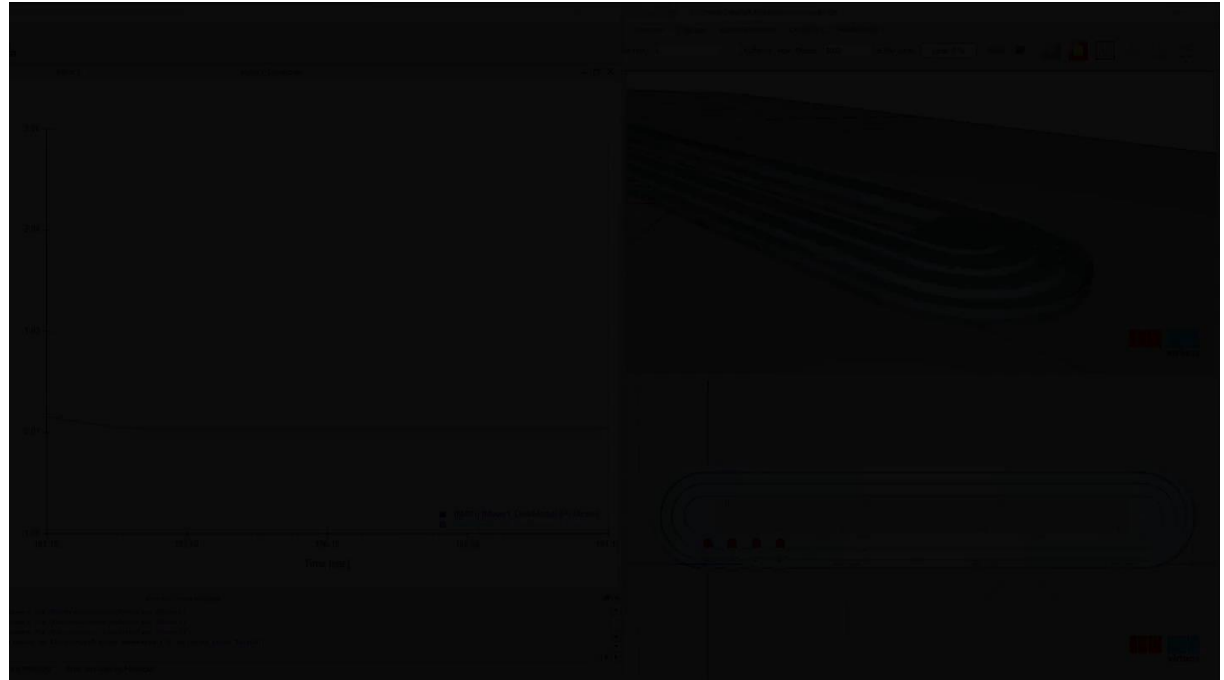
- Changeovers by recipe
  - Customization of production
- Extreme flexibility «on the run»
  - Flexible flow according to working station status
- Low maintenance
  - No moving mechanical parts, only bearings on rail





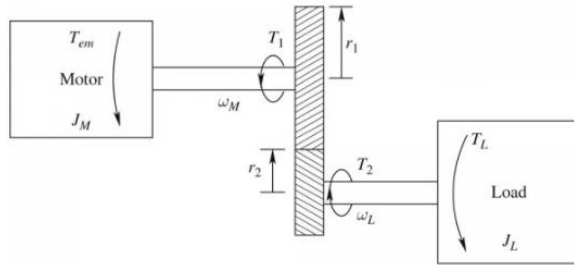
# Transportation systems – Flexible solution

- Complex profile
- Contemporaneity
- Strong interaction between mechanical, electronic and even programming part
- Mechatronic skills are required



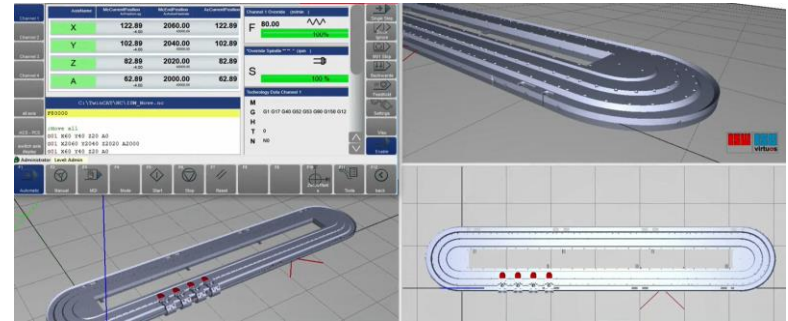
# Transportation systems – Kinematic analysis

## Standard systems



1. Standard mathematical model
2. Standard dynamic profile

## Flexible systems



1. Improved model required
2. Flexible dynamic profile to optimize speed, current consumption, position profile
3. Improved tools and skills