



PACKAGING MACHINERY

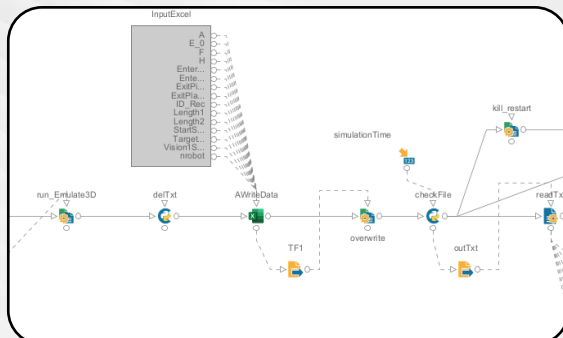
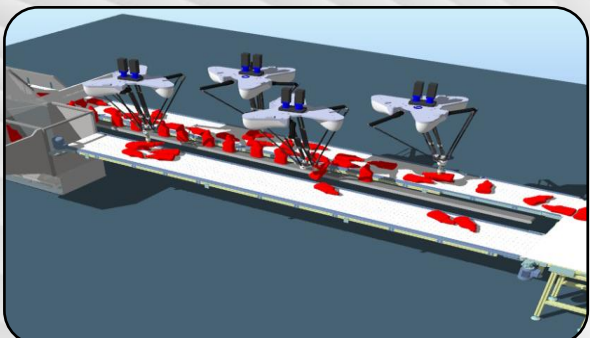
# Optimize the Design of a Robotic Unscrambler Using a Parametric Digital Twin

Alberto Zilio, R&D Engineer, Ronchi Packaging

# AGENDA

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*Betel*

*Parametric Digital Twin*

*Optimized Digital Twin*

*Smart tool for  
machine design  
and management*

*Automatization of  
virtual commisiong  
process*





# INTRODUCTION

## RONCHI MARIO S.P.A



*Company operating in packaging industry since 1966*



*A industry leader in production of Unscramblers, Orienters, Filling Machines and Capping machines.*



*200 employees*



*2 year experience with Emulate3D and digital twin*



# BETEL

## Characteristics

- ▶▶ *High production velocities (400 BPM)*





# BETEL

## Characteristics

▶▶ *High production velocities (400 BPM)*

▶● *Handling of different bottles (high flexibility and agility)*



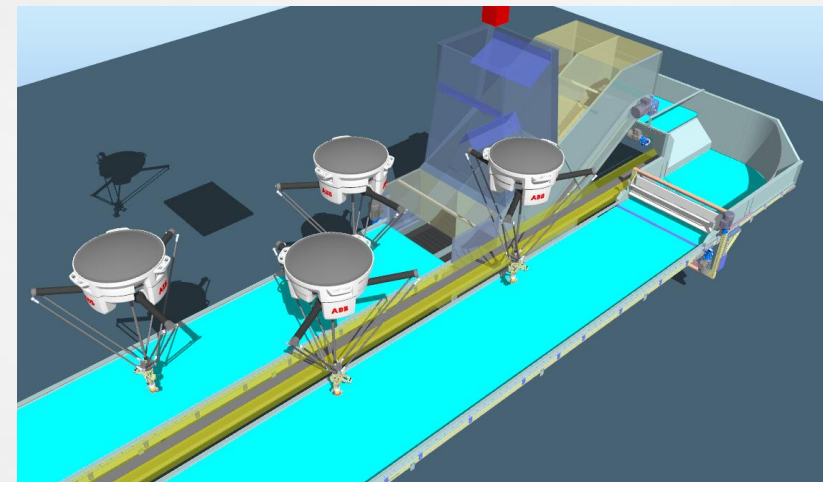
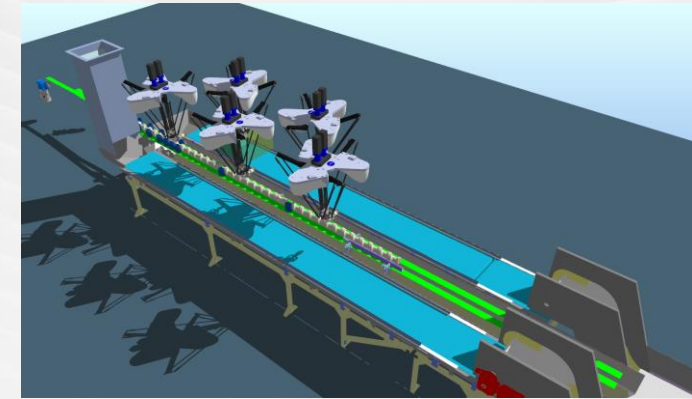
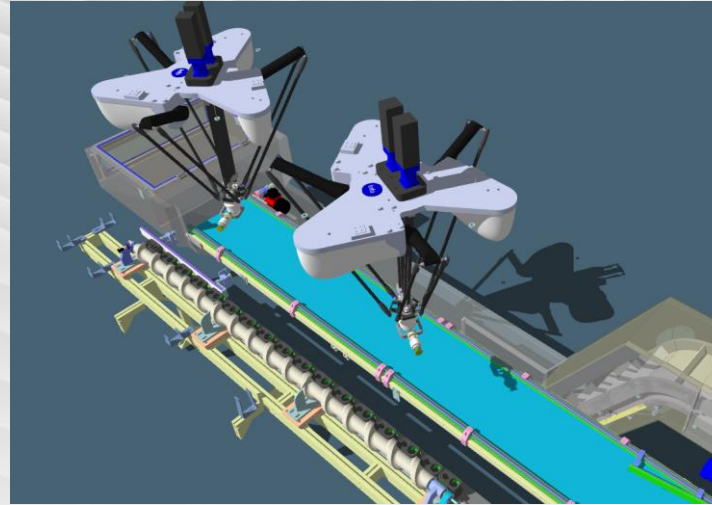
# BETEL

## Characteristics

▶▶ *High production velocities (400 BPM)*

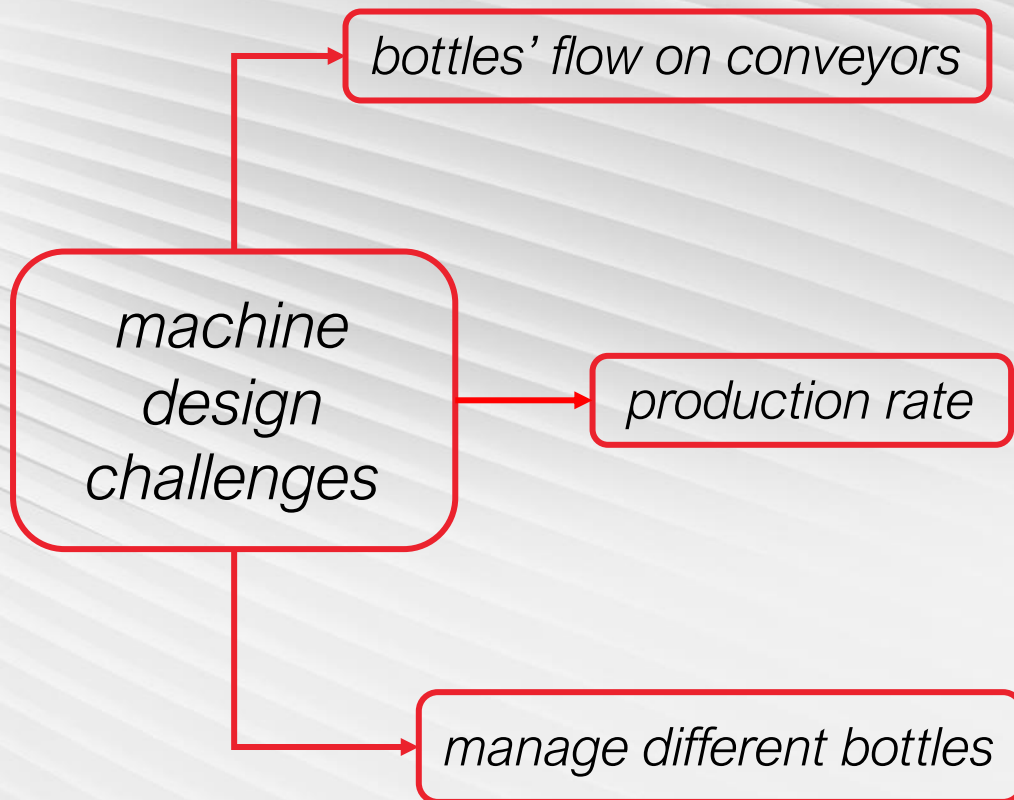
◼▶ *Handling of different bottles (high flexibility and agility)*

🗨️ *Multiple configuration to satisfy different customers' requirements*






# PARAMETRIC DIGITAL TWIN

## Aim



*We need a tool capable of:*

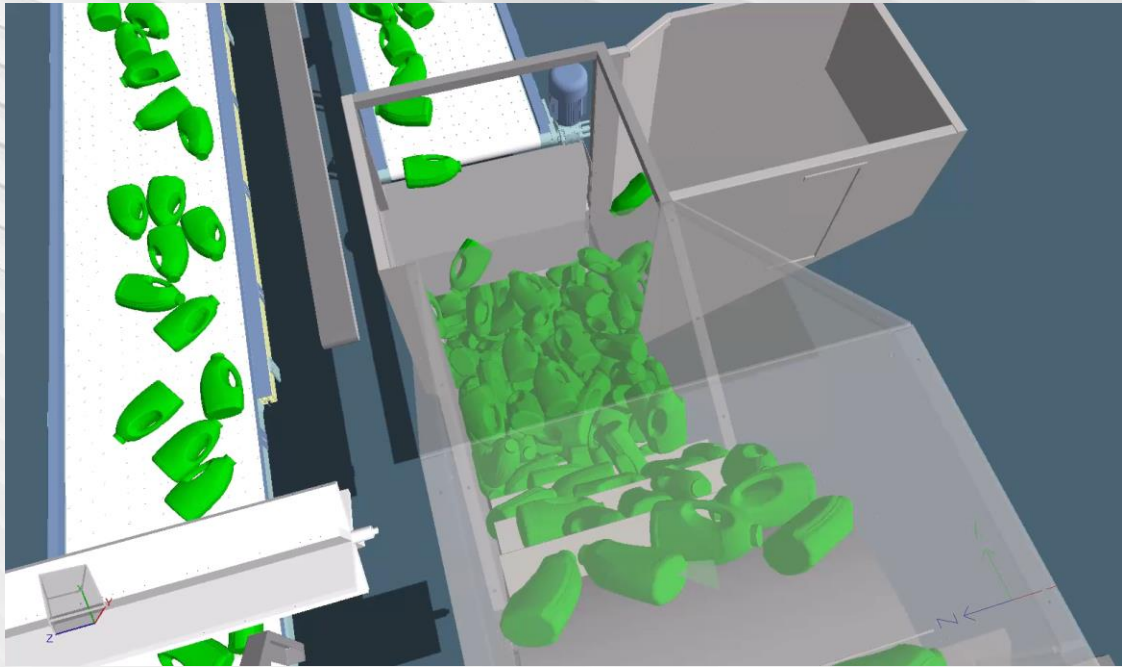
-  *Testing different machine configurations*
-  *Predicting the production speed*
-  *Support electrical and mechanical design*

# PARAMETRIC DIGITAL TWIN

E3D pros

E3D

*reproduce correctly the bottles behavior*





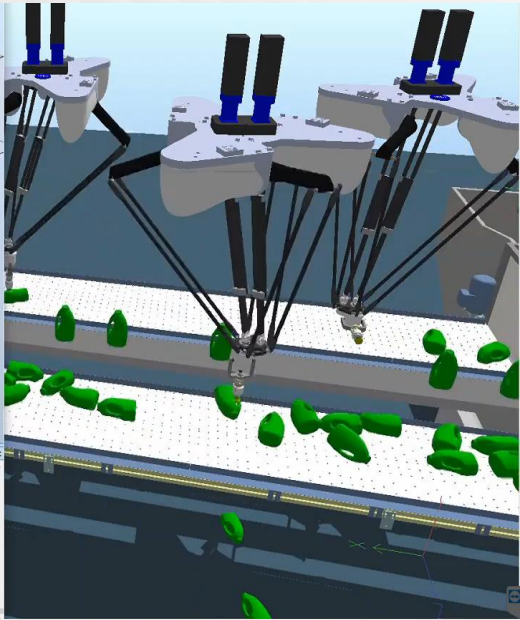
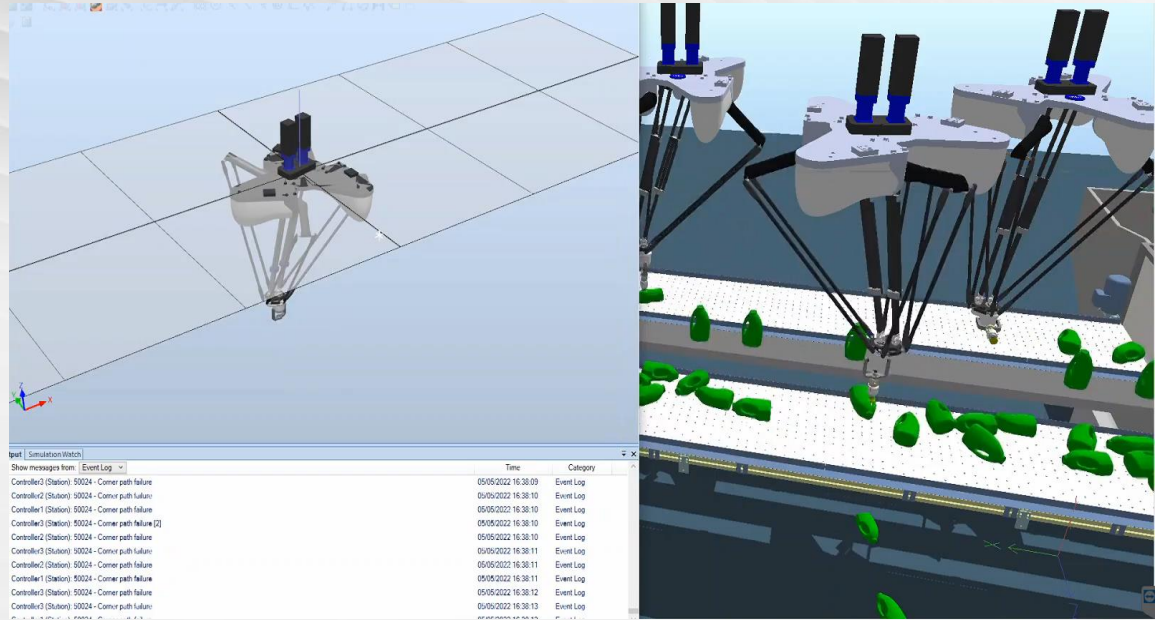
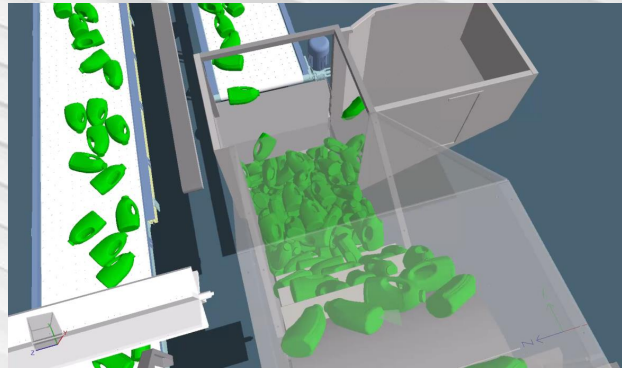
# PARAMETRIC DIGITAL TWIN

E3D pros

**E3D**

*reproduce correctly the bottles behavior*

*link with PLC and robot's virtual controller*



# PARAMETRIC DIGITAL TWIN

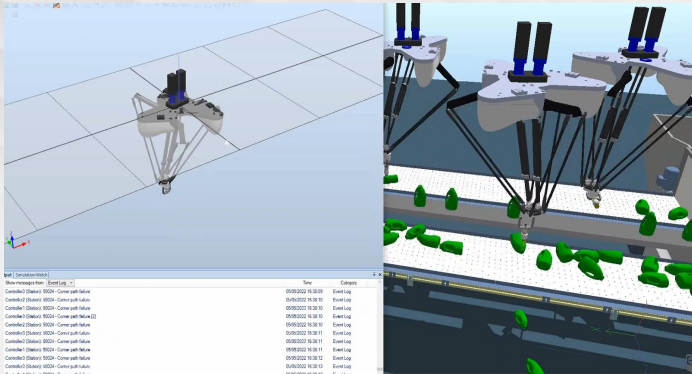
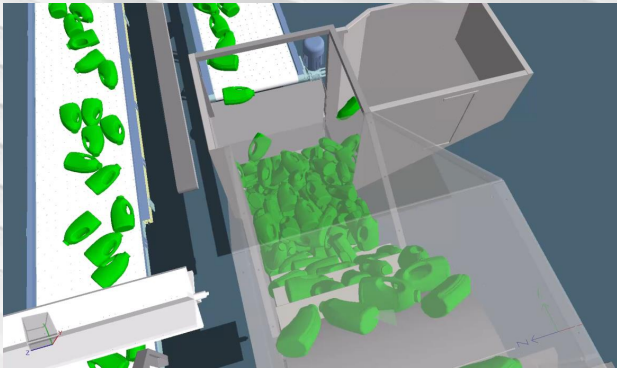
E3D pros

**E3D**

*reproduce correctly the bottles behavior*

*link with PLC and robot's virtual controller*

*catalogues and scripts allow the model to get self-generated*



# PARAMETRIC DIGITAL TWIN

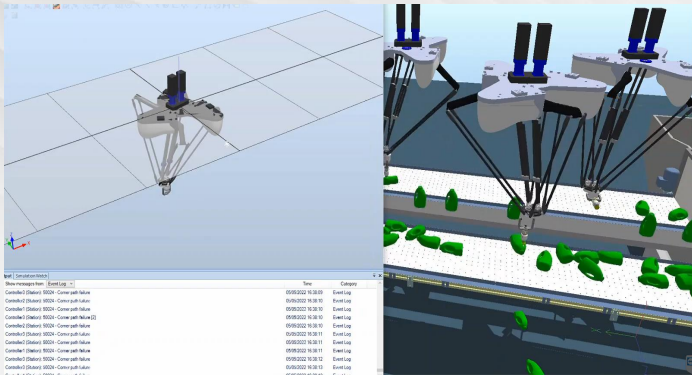
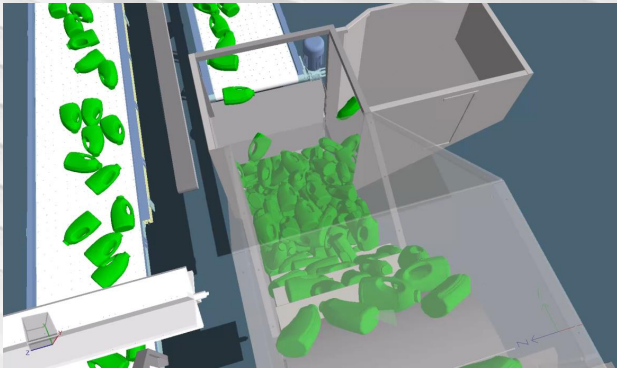
E3D pros

**E3D**

*reproduce correctly the bottles behavior*

*link with PLC and robot's virtual controller*

*catalogues and scripts allow the model to get self-generated*



*quick analysis of different layouts*





# PARAMETRIC DIGITAL TWIN

## Model parameters

*bottle parameter*

*model creation*

*Location*

*Dimension*

*sensor and actuator*

*Motor speed*

*Robot trajectory*

*Camera parameters*

y	z	orientation	Length	Width	nConc	Column	BackLight	Type	Index of convey	Distance from start of con	nBackligh	Column#	Robot	Type (2)	Distance y from B	Distance x from B	Distance z from B	nRobot	Column2	IntDutFeedCont	Column2	Elevatol	Column2	Coordinate Load Creat	s (2)
1140	400	z	110	800	7			BackLight500/500	5	2265					300	1500	1500								
1140	550	z	2234	800	7			BackLight500/500	6	2265			2	Codan100	ERS	-300	1500								
1140	550	z	2300	800	7			BackLight500/500	5	2265			3	Codan100	ERS	-300	1500								
1140	550	z	1100	800	7			BackLight500/500	5	4332			4	Codan100	ERS	-300	1500								
1140	550	z	600	800	7			BackLight500/500	5	4332			5	Codan100	ERS	-300	1500								
1140	550	z	3500	800	7			BackLight500/500	6	8287			6	Codan100	ERS	-300	1500								
1100	0	z	2900	80									7												
0	0	z	0	0									8												
0	0	z	0	0									9												

R2	R3	R4	SpeedRleCpe	Conveyors B\ R1	R2	R3	R4	CAD_Name	robotigle
0	0	0	200	Position	0	1	1	ND	400
0	0	0	700	PickX	475	475	475		
0	0	0	200	PickY	-350	350	350		
100	100	100	190	PickZ	-1500	-1500	-1500		
100	100	100	300	YBLAbs	818	782	782	-1282	41701
0	0	0	300	YBLAbs	550	-550	-550	-550	
0	0	0	700	YRBAbs	2432	167	167	-1517	41701
0	0	0	700	YRBAbs	200	-200	-200	-200	
0	0	0	800	PlaceX	567	-2833	-2833	4887	41701
0	0	0	400	PlaceY	-200	200	200	200	
0	0	0	400	PlaceZ	-1440	-1440	-1440	-1440	

Input	valore	uom	tipo	range	costanti
A	200	mm	step (50mm)	200/400	
L1	600	mm	step (100mm)	300/1000	M2
L2	500	mm	step (100mm)	300/1000	Q
E	600	mm	standard	204-847.2-608.6-914-1218.2	K
F	40	mm	step (20mm)	-100/900	
H	1500	mm	step (20mm)	900/6500	
nrobot	1		step(1)		

Formato	ID ricetta	TargetVelocity	step(1)	numero di formati da simulare	Parametri dipendenti da input
	1	100	EPFM	1	M1
					B
					G1
					G2

Conveyor Speed	Value	Step	Range
Conveyor Speed 1	200	mm/s	step (100 mm/s)
Conveyor Speed 2	700	mm/s	step (100 mm/s)
Conveyor Speed 3	300	mm/s	step (50 mm/s)
Conveyor Speed 4	190	mm/s	step (100 mm/s)
Conveyor Speed 5	190	mm/s	step (100 mm/s)
Conveyor Speed 6	300	mm/s	step (50 mm/s)
Elevator Speed 1	400	mm/s	step (100 mm/s)
Enter Area Pick 1	-600	mm	Step (10 mm)
Enter Area Pick 2	-100	mm	Step (10 mm)
Enter Area Pick 3	-100	mm	Step (10 mm)
Enter Area Pick 4	-100	mm	Step (10 mm)
Enter Area Pick 5	-100	mm	Step (10 mm)
Enter Area Pick 6	-100	mm	Step (10 mm)
Length Area Pick 1	100	mm	Step (10 mm)
Length Area Pick 2	100	mm	Step (10 mm)
Length Area Pick 3	100	mm	Step (10 mm)
Length Area Pick 4	100	mm	Step (10 mm)
Length Area Pick 5	100	mm	Step (10 mm)
Length Area Pick 6	100	mm	Step (10 mm)
Enter Area Place 1	430	mm	Step (10 mm)
Enter Area Place 2	-200	mm	Step (10 mm)
Enter Area Place 3	-200	mm	Step (10 mm)
Enter Area Place 4	-200	mm	Step (10 mm)
Enter Area Place 5	-200	mm	Step (10 mm)
Enter Area Place 6	-200	mm	Step (10 mm)
Length Area Place 1	100	mm	Step (10 mm)
Length Area Place 2	100	mm	Step (10 mm)
Length Area Place 3	100	mm	Step (10 mm)
Length Area Place 4	100	mm	Step (10 mm)
Length Area Place 5	100	mm	Step (10 mm)
Length Area Place 6	100	mm	Step (10 mm)

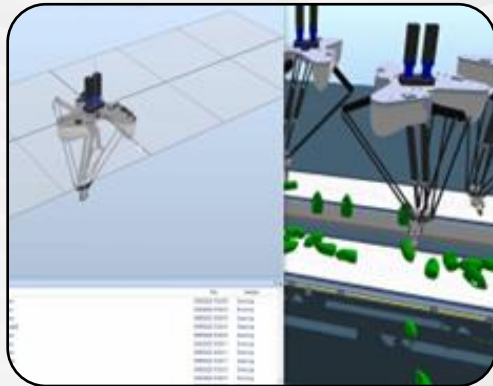
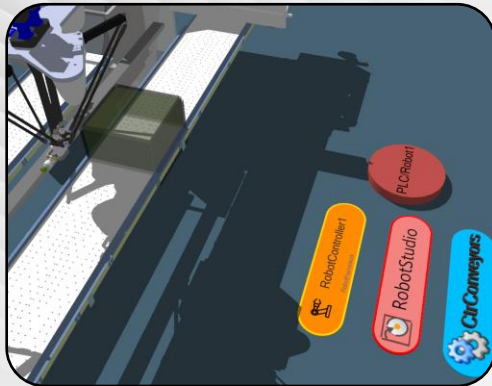
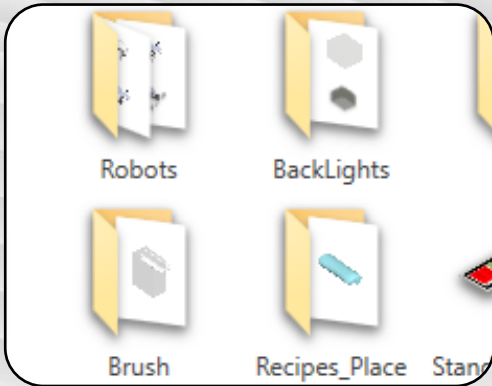
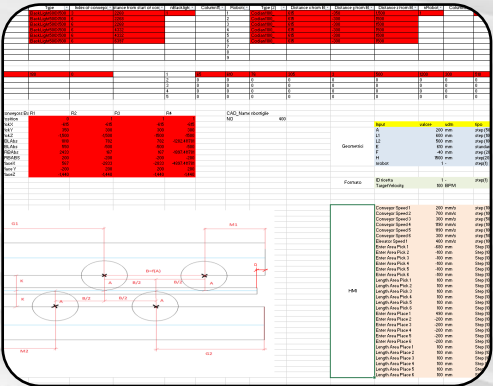
  

Optimize the Design of a Robotic Unscrambler Using a Parametric Digital Twin



# PARAMETRIC DIGITAL TWIN

## E3D model



*Parameters are read and saved*

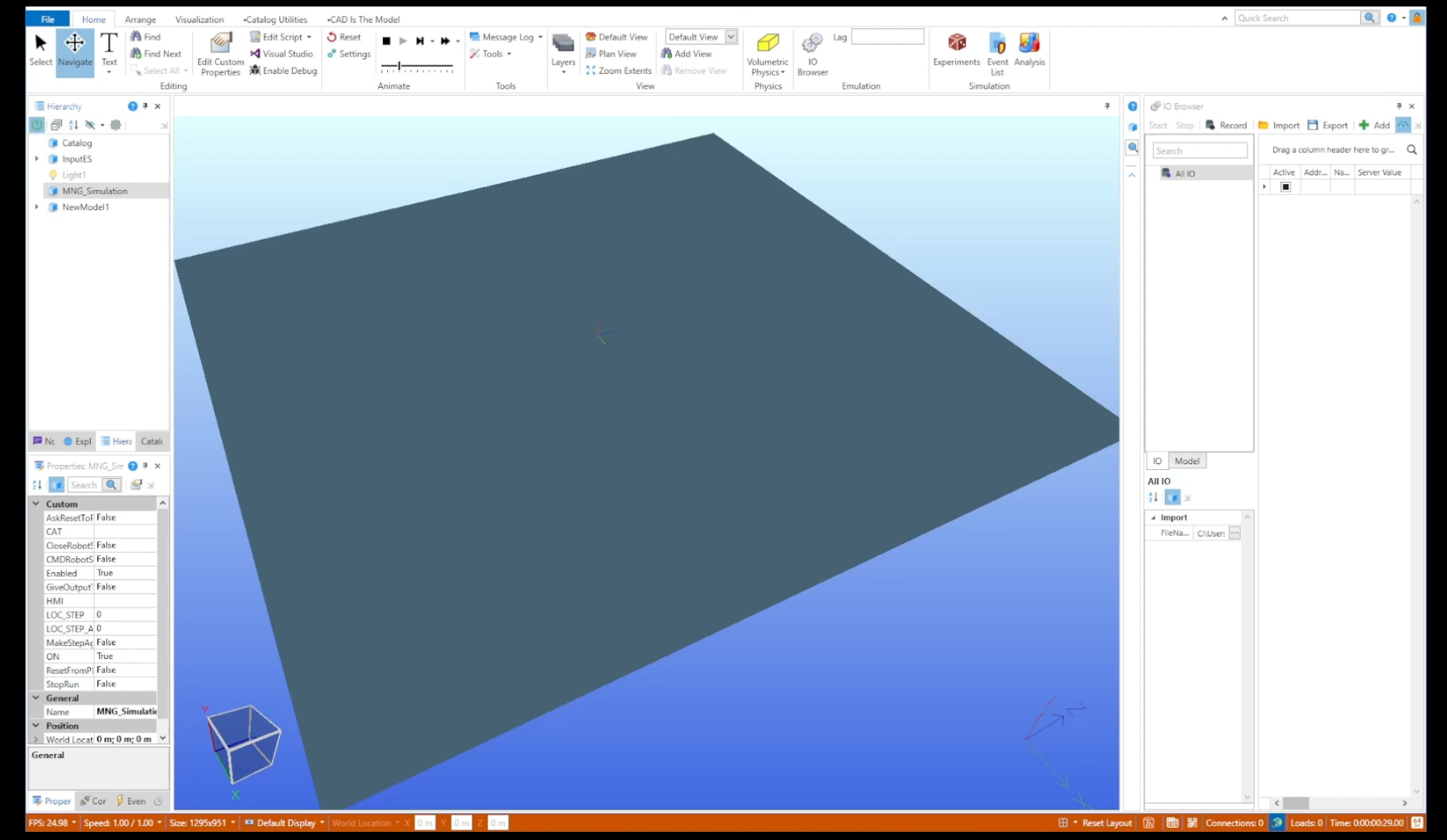
*Model components are loaded from catalogues*

*Parameters are assigned to the corresponding visual/controller*

*A custom simulation manager starts the communications*

# PARAMETRIC DIGITAL TWIN

## E3D model



Optimize the Design of a Robotic Unscrambler Using a Parametric Digital Twin





# OPTIMIZED DIGITAL TWIN

## Aim




challenges of  
finding the  
optimal solution

large amount of  
parameters

long simulation time



*We need a tool capable of:*

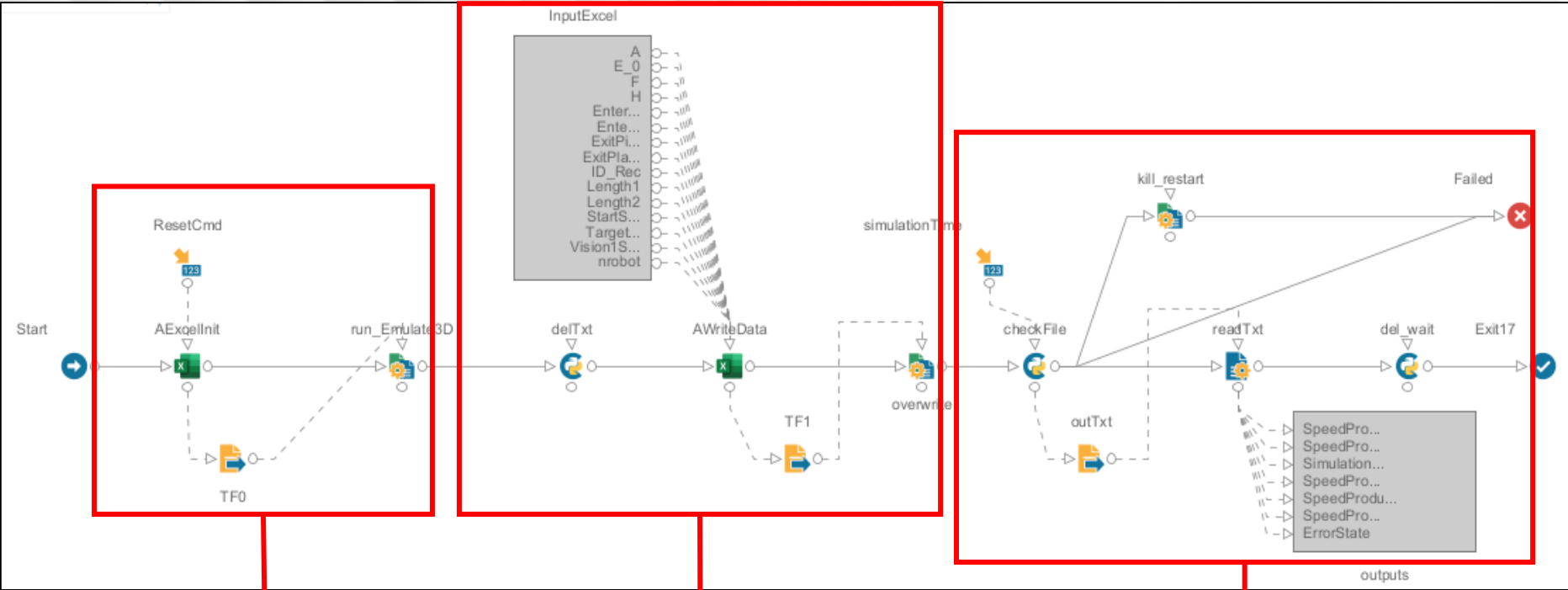
-  Set different parameter in the configuration file
-  Run E3D model
-  Evaluates the results

# OPTIMIZED DIGITAL TWIN

## Model integration

**modeFRONTIER**

- Process Automation
- Exploration and optimization
- Data Analysis



Run E3D

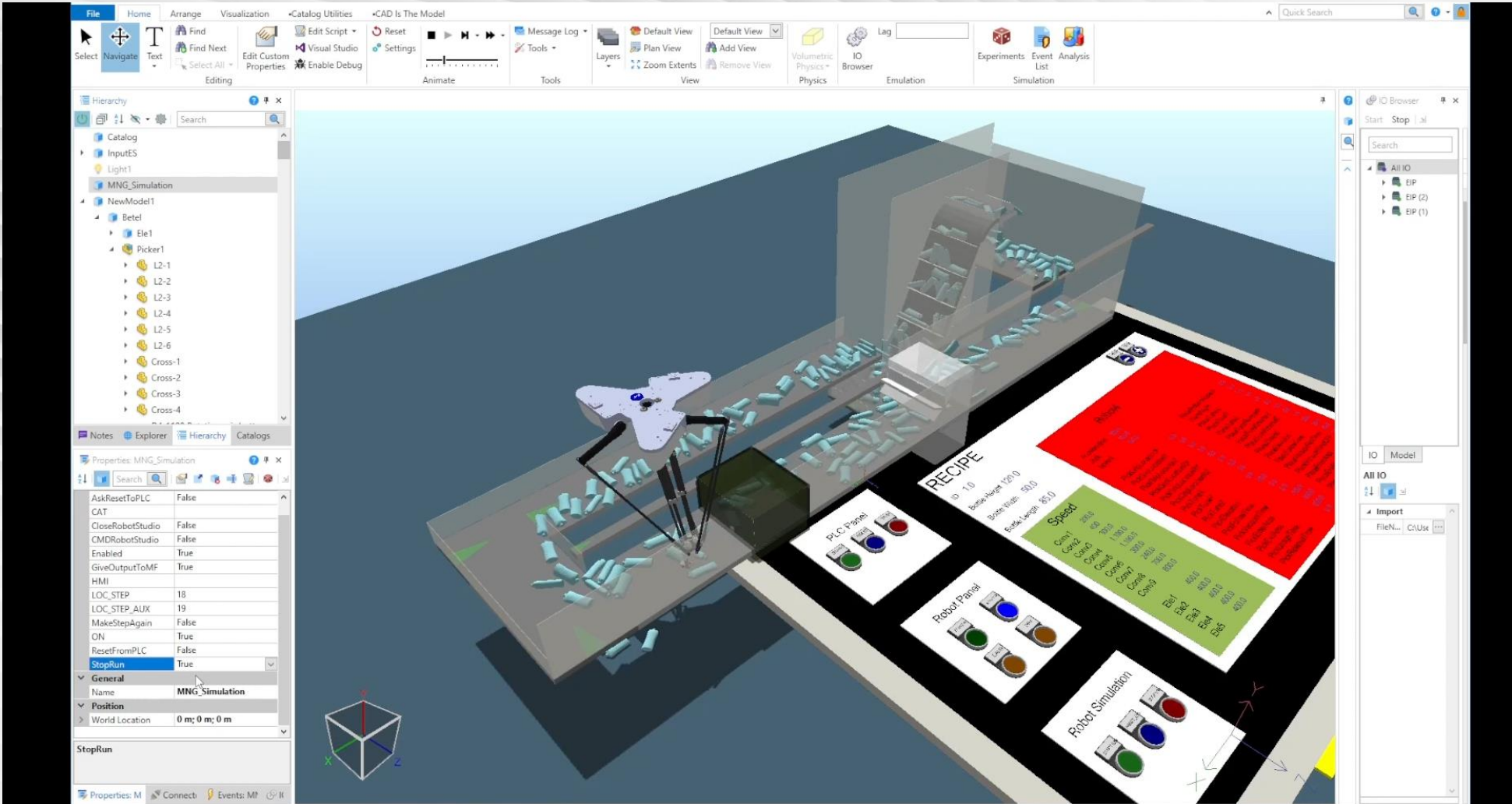
Set input parameters

Read outputs



# OPTIMIZED DIGITAL TWIN

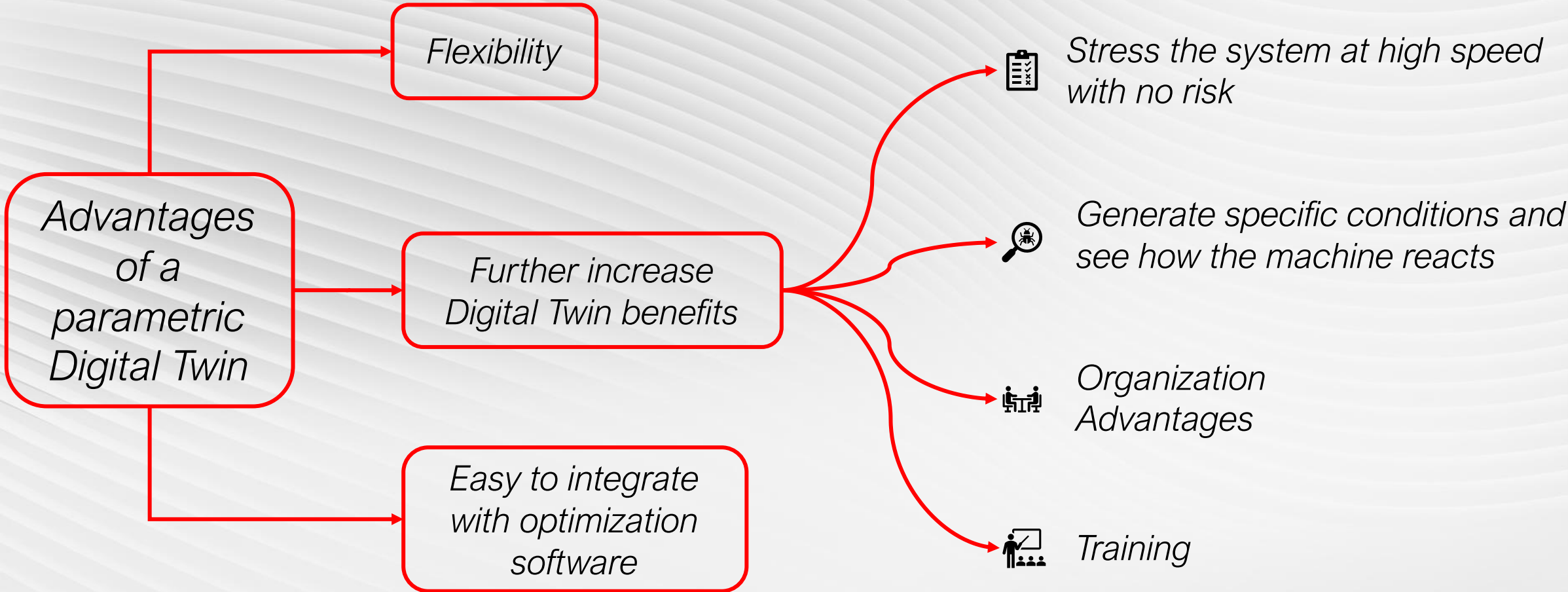
## Model integration



Optimize the Design of a Robotic Unscrambler Using a Parametric Digital Twin









PACKAGING MACHINERY

*Thank you for your attention*

