Digital twins

A modern time machine improving operational processes

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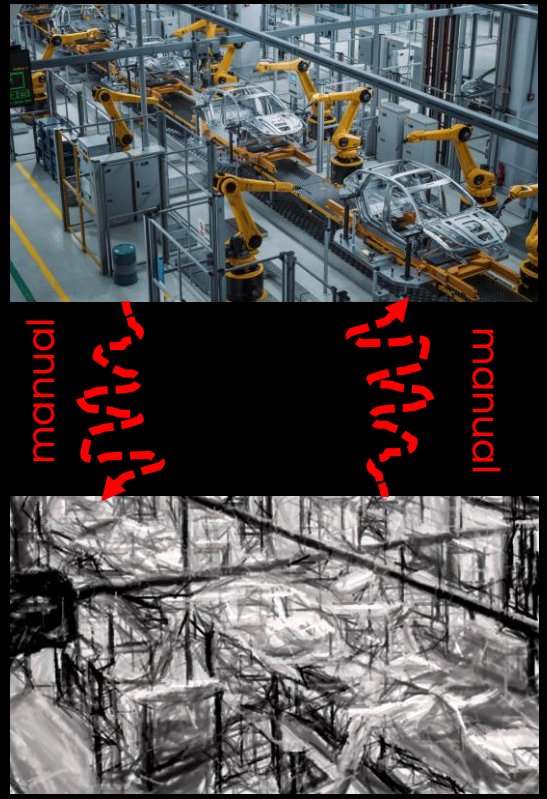
Digital Model



Digital Model, Digital Shadow

automated

manual

Digital Model

Digital Shadow

Digital Model, Digital Shadow, Digital Twin

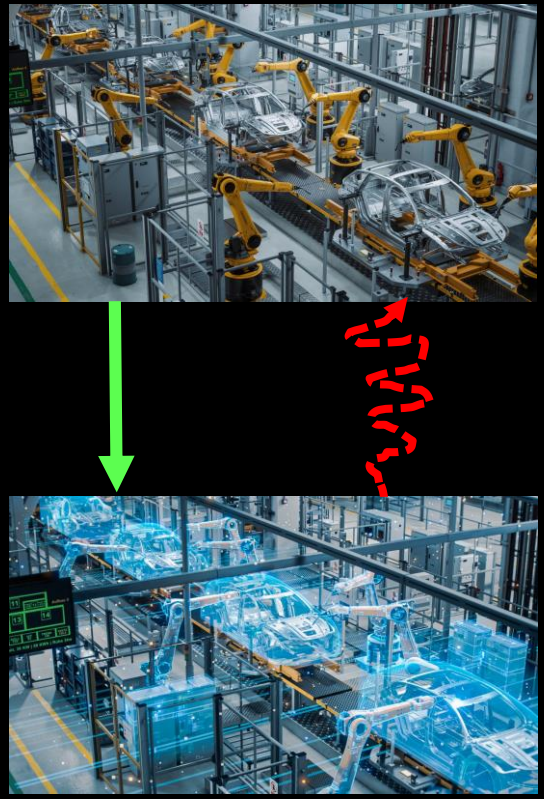
automated in
both directions

Digital Model

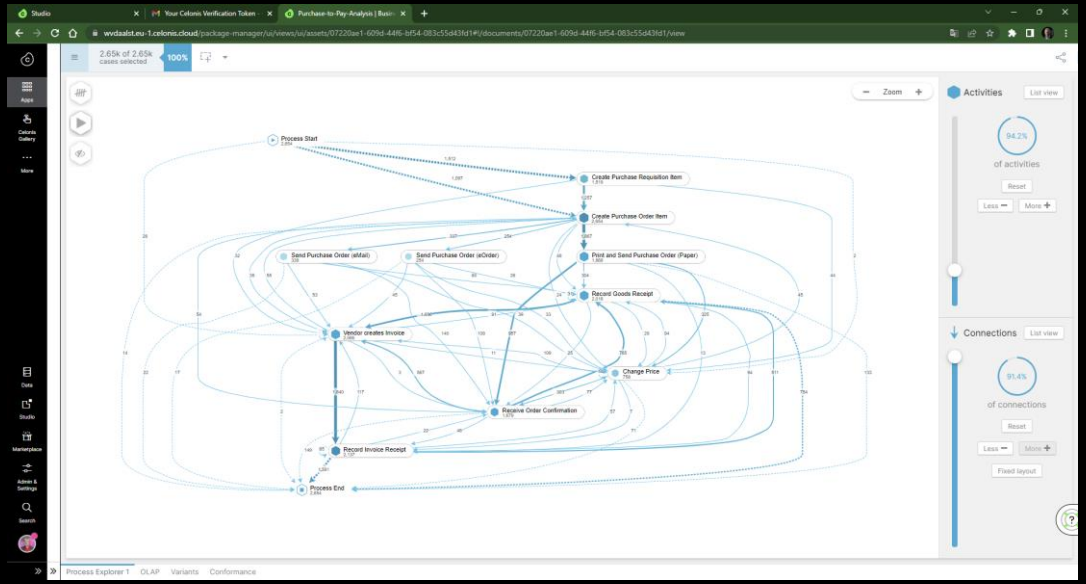
Digital Shadow

Digital Twin

The first digital shadows of operational processes are a reality thanks to process mining!



Digital Shadow



Recent developments in object-centric process mining will help to create more realistic digital shadows (2D to 3D).

…, but Digital Twins require Hybrid Intelligence!

Digital Twin

Human Intelligence
people and experiences

flexible
creative
emphatic
instinctive
commonsensical

Hybrid Intelligence

fast
efficient
cheap
scalable
consistent

data and algorithms
Machine Intelligence

The Covid pandemic, Ukraine war, and supply chain disruptions show that fully autonomous digital twins are still a dream rather than a reality.

Compare to autonomous driving

	SAE LEVEL 0	SAE LEVEL 1	SAE LEVEL 2	SAE LEVEL 3	SAE LEVEL 4	SAE LEVEL 5
What does the human in the driver's seat have to do?	**You are driving** whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering			**You are not driving** when these automated driving features are engaged – even if you are seated in "the driver's seat"		
	You must constantly supervise these support features; you must steer, brake or accelerate as needed to maintain safety			When the feature requests, you must drive	These automated driving features will not require you to take over driving	
	These are driver support features			These are automated driving features		
What do these features do?	These features are limited to providing warnings and momentary assistance	These features provide steering **OR** brake/ acceleration support to the driver	These features provide steering **AND** brake/ acceleration support to the driver	These features can drive the vehicle under limited conditions and will not operate unless all required conditions are met		This feature can drive the vehicle under all conditions
Example Features	• automatic emergency braking • blind spot warning • lane departure warning	• lane centering **OR** • adaptive cruise control	• lane centering **AND** • adaptive cruise control at the same time	• traffic jam chauffeur	• local driverless taxi • pedals/ steering wheel may or may not be installed	• same as level 4, but feature can drive everywhere in all conditions

Levels defined by the Society of Automotive Engineers (SAE) https://www.sae.org/

Mercedes-Benz S-class and EQS: First level 3 internationally certified car on sale since May 2022.

Process automation and management will show a similar gradual development.