

Analýzy fyzické zátěže při digitálním návrhu pracoviště



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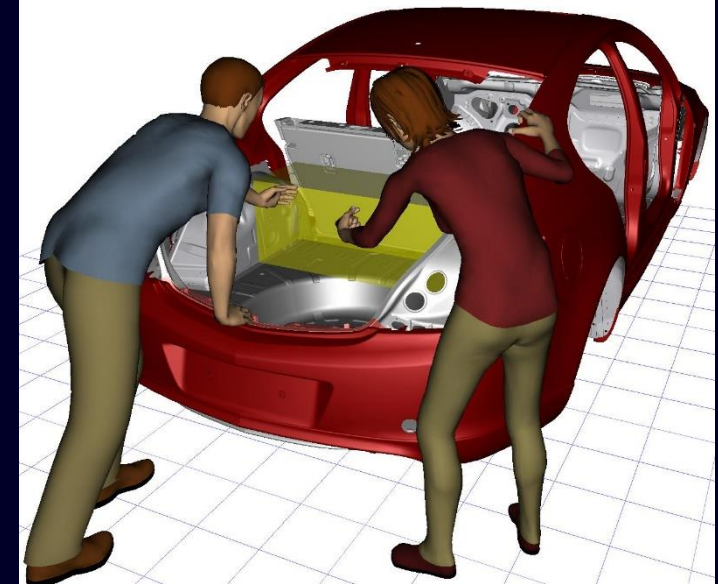
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Proč pro-aktivní ergonomie?

- Zjištění problémů až při náběhu výroby vede k časově náročným a nákladným změnám.
- Simulace umožní analyzovat výrobní procese už v rané fázi plánování.
- Cílem je „ušít“ techniku na míru lidem (neohýbat člověka, ohnout techniku).



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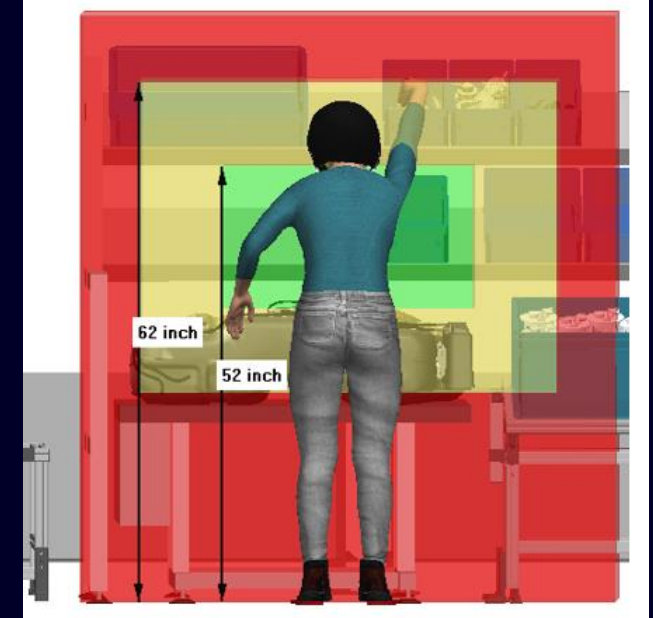
Vyhodnocení lidského faktoru a ergonomie na základě počítačové simulace

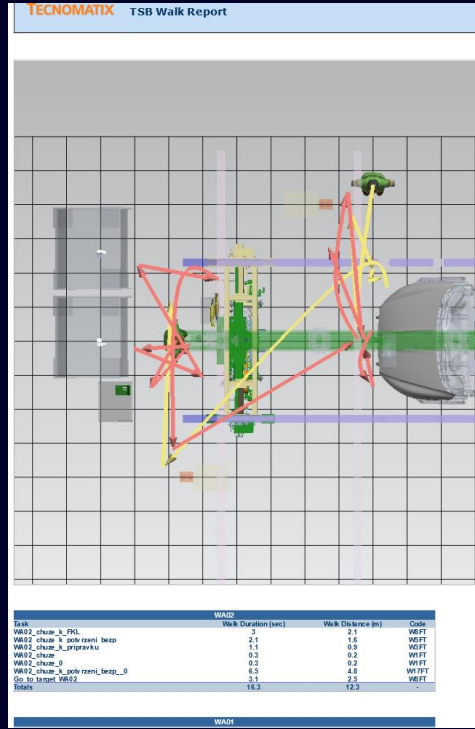
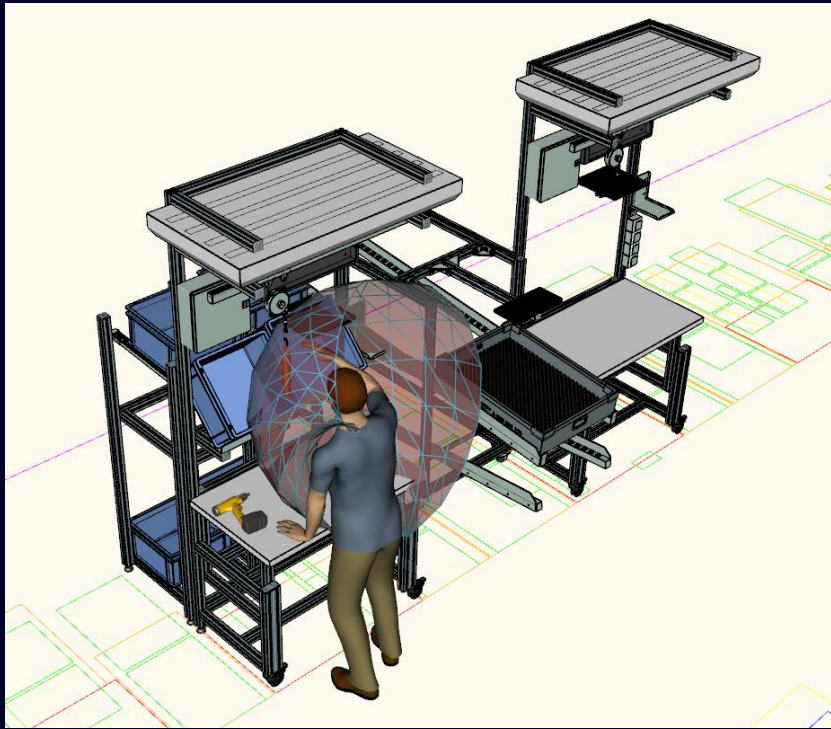
Pro nové pracoviště:

- Vyhodnocení proveditelnosti manuálních operací (prostor, dosah, výhled, čas, technologický a materiálový layout, mikrologistika pracoviště, ...) a ergonomie dle podnikových a národních metod pomocí digitálního modelu a simulace pracovníků již v rané fázi projektování pracoviště.
- Změny na počítačovém modelu jsou mnohem méně nákladné a časově náročné než změny na postaveném pracovišti.

Pro běžící výrobu:

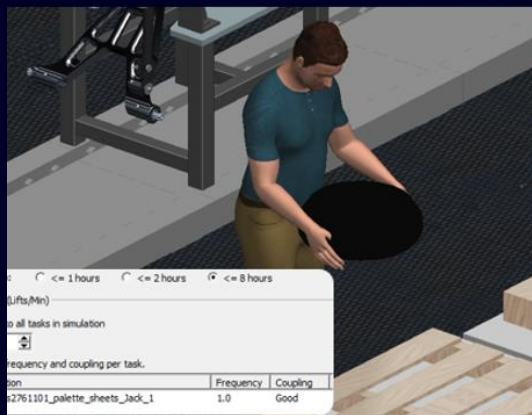
- Analýza současného stavu, digitální návrh změn a optimalizace.
- Porovnání a ověření různých alternativních scénářů.
- Vyhodnocení přínosů z pohledu ergonomie versus investice, ještě před vlastní realizací.





Summary of NIOSH 91/81

LI	Operation	Object Weight (kg)	Frequency (1/min)	Origin	Destination	NIOSH91 RWL	LI	NIOSH81 AL
1	WB021101_palette_sheets_Jack_1	18	1	Origin	Destination	4.26	3.52	4.83
2	WB021101_palette_sheets_Jack_1	18	1	Destination	Origin	7.62	1.97	8.77

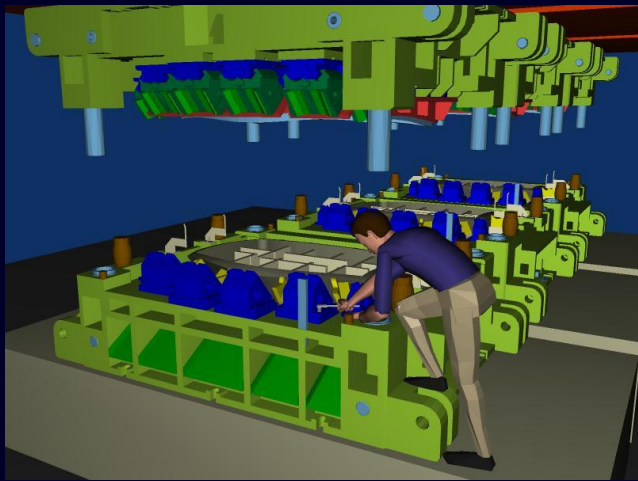


Capability Summary Chart

	Left					Right					
	Moment (Nm)	Muscle Effect	Mean (Nm)	SD (Nm)	Cap (%)	Moment (Nm)	Muscle Effect	Mean (Nm)	SD (Nm)	Cap (%)	
Wrist	Flex/Ext	0.7	EXT	5.5	1.8	99.7	0.7	EXT	5.5	1.8	99.7
	Rad/Ulnar dev	-3.5	RAD	7.8	2.4	99.2	-3.5	RAD	7.8	2.4	99.2
	Supp/Pro	0.7	SUP	6.5	2.2	99.6	0.7	SUP	7.4	2.4	99.6
Elbow		-18.4	FLEXION	32.6	8.6	95.1	-18.1	FLEXION	35.5	9.3	95.9
	Abduc/Adduc	-39.2	ABDUCT	37.4	9.8	42.7	-38.8	ABDUCT	39.7	10.4	53.0
Shoulder	Rotation S&P d	-5.8	FORWARD	41.1	14	99.4	-5.8	FORWARD	44.1	15	99.9
	Humeral Rot	-6.6	LATERAL	23.6	6.2	99.7	-6.6	LATERAL	25.3	6.6	99.9
Trunk	Flex/Ext	-85.3	EXTEN	160.2	55.3	91.2					
	Lateral Bending	0		0	0	100					
Hip	Rotation	0		0	0	100					
		-43.4	EXTEN	103.5	39.1	93.8	-43.5	EXTEN	103.5	39.1	93.7
Knee		-23.5	FLEXION	77.6	24.9	90.5	-24.9	FLEXION	77.6	24.9	90.3
		-42.8	EXTEN	91.5	25.1	97.4	-43	EXTEN	91.5	25.1	97.4

Force Solver - Jack

Joint/Axis	Capable (%)	Use	Moment (Nm)	Muscle Effect	Angle (Deg)	Strength Mean (Nm)	Strength SD (Nm)
Forces							
Left hand							
Site: palm/center	100.0	N, 0.0 kg					
X: 0	100.0	Z: 500.0					
Right hand							
Site: palm/center	100.0	N, 14.0 kg					
X: 5	100.0	Z: 19					
Clear All Loads							
Support							
Force distribution strategy	Two Feet						
Supporting hand:	None						





Ověření souladu s ergonomickými standardy a limity již při návrhu operace / pracoviště

Příklad dostupných analýz v Process Simulate Human (Jack):

- NIOSH (ČSN EN 1005-2)
- OWAS
- RULA
- Fatigue
- Static Strength
- Lower Back
- Cumulative Back Load
- EAWS
- Ergonomics Metrics
- Force Solver
- Energy Expenditure
- Arm Strength Evaluation (Arm Force Field)
- Strain Index
- Normy času (MTM, ...)

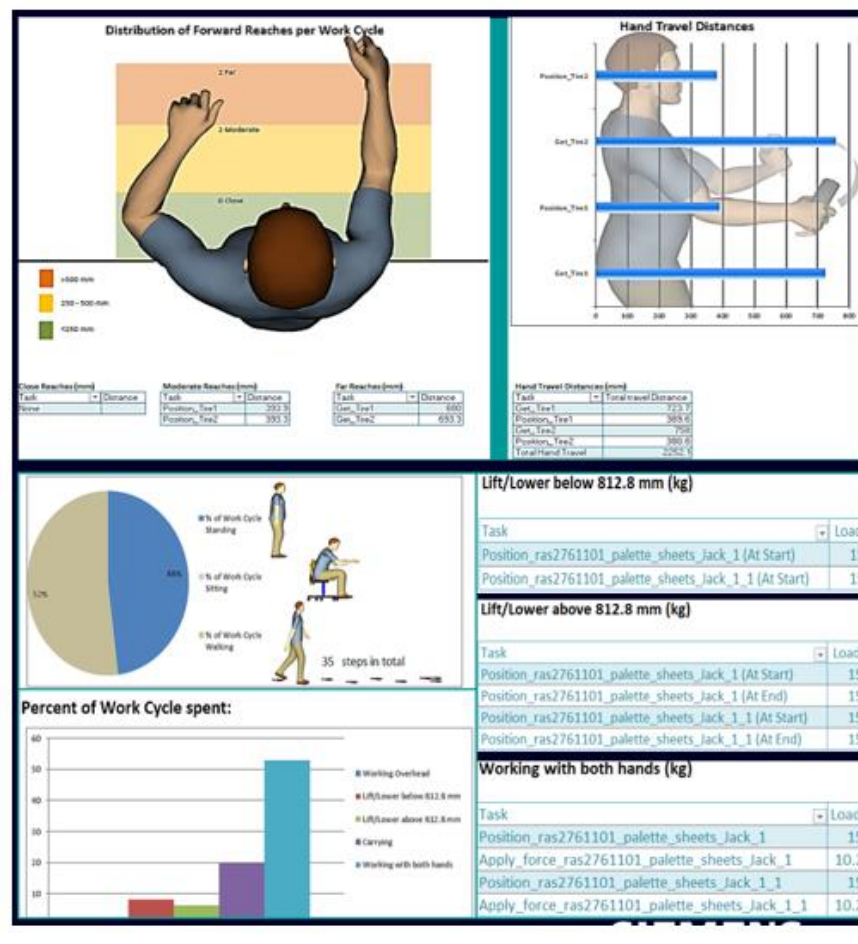
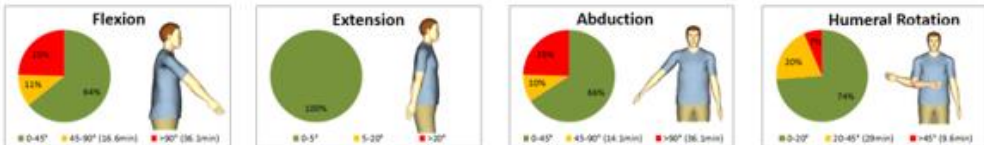
Joint Angle Summary: Time spent per work cycle in each posture range

Mild: 
 Moderate: 
 Significant: 

Left Shoulder:



Right Shoulder:



Analysis Tools

Human: Jack

Simulation:

Notes

Posture Analysis

- Posture Monitor
- Ergonomic Metrics
- OWAS
- RULA

Strength and Force Exertions

- Static Strength Prediction
- Force Solver
- Arm Strength Evaluation

Hand Intensive Tasks

- Strain Index
- Force Solver

Low Back Demands

- Static Strength Prediction
- Low Back Analysis
- NIOSH
- Cumulative Loading Analysis

Fatigue / Energy Demands

- Fatigue
- Energy Expenditure
- Energy Expenditure (Manual)

Multi Factor

- Ergonomic Metrics
- EAWS

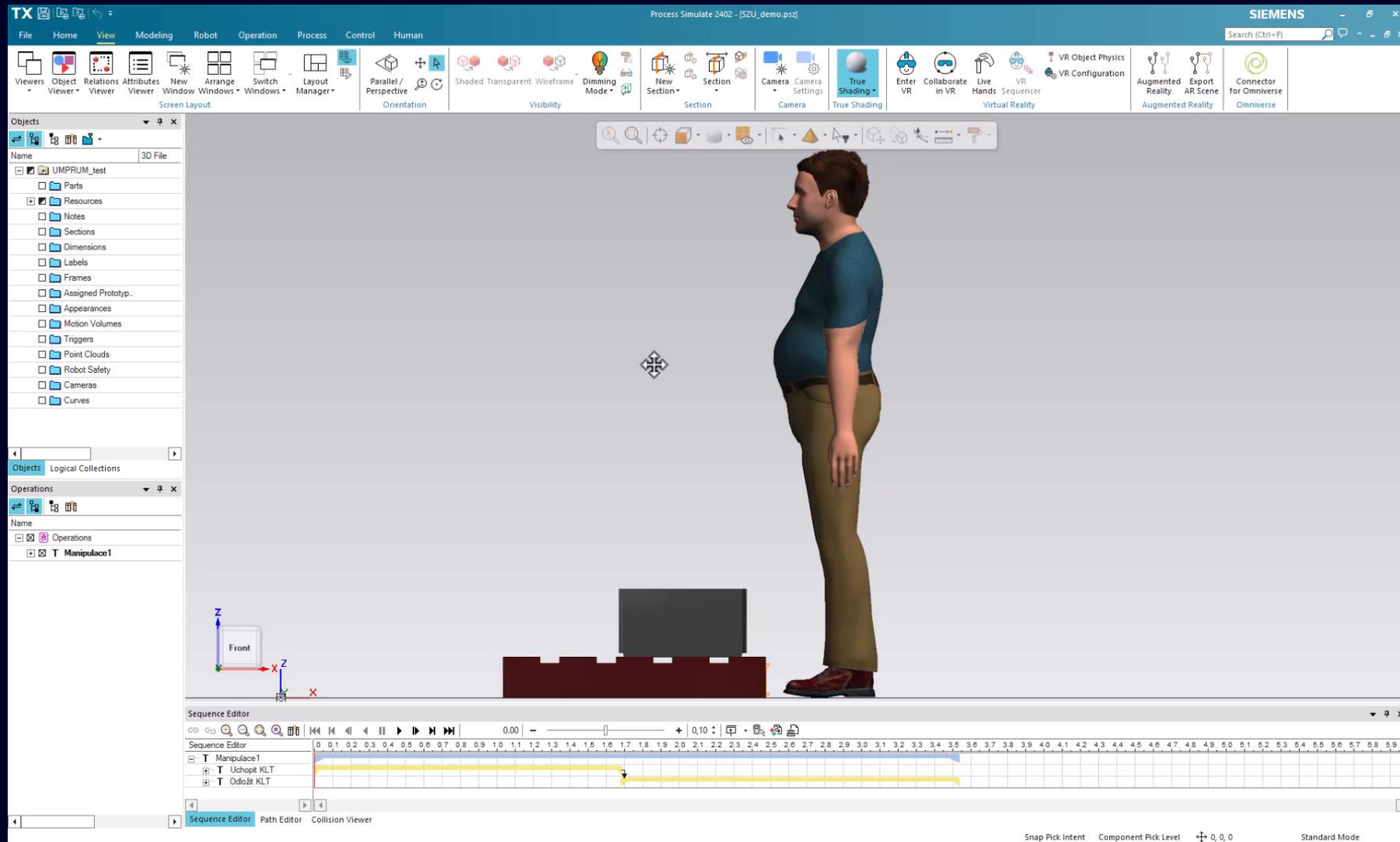
Timing

- Walk Analysis
- Timing Report

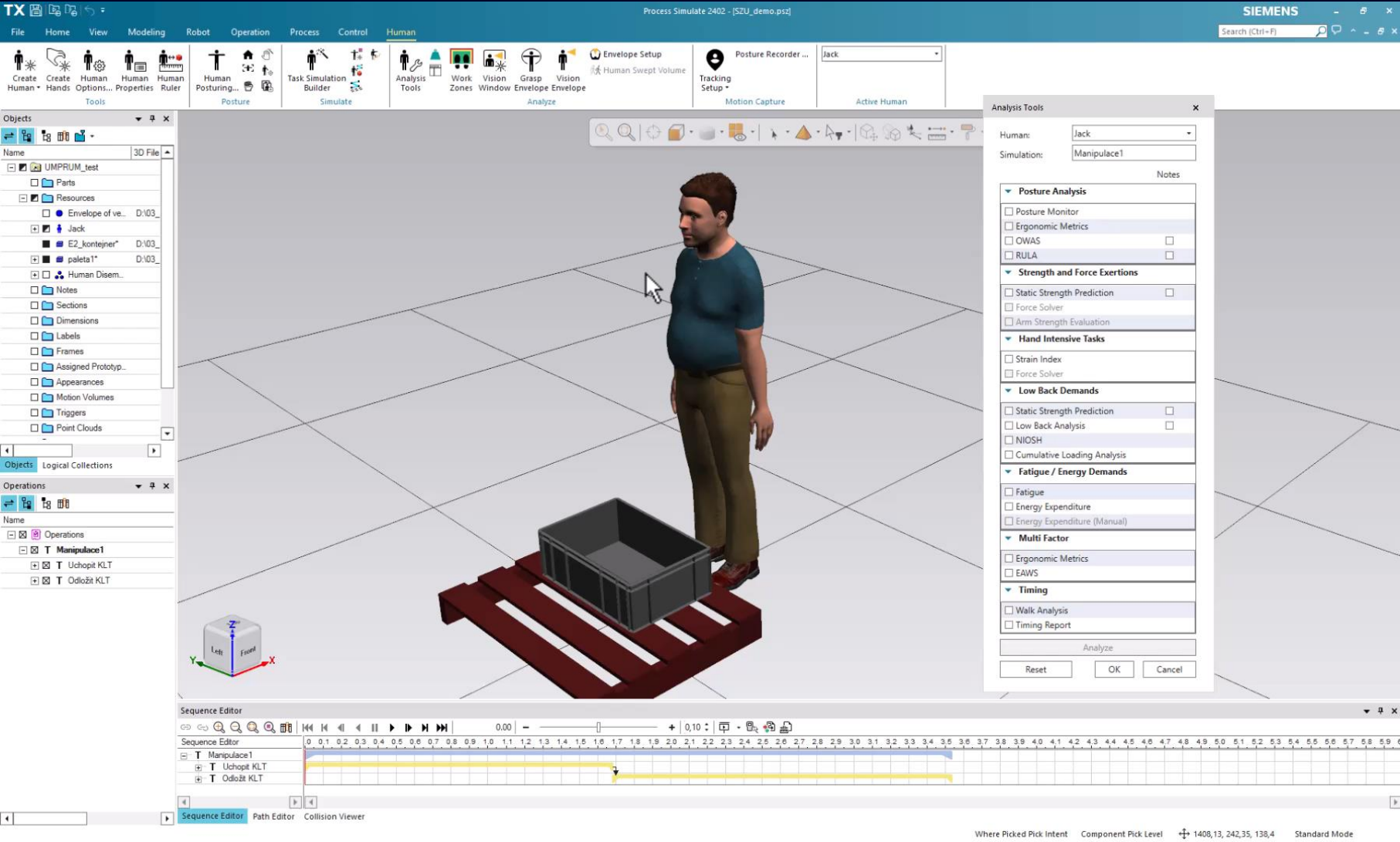
Analyze

Reset OK Cancel

Pracovní poloha dle 361/2007 Sb.

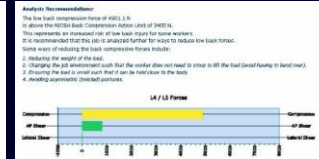
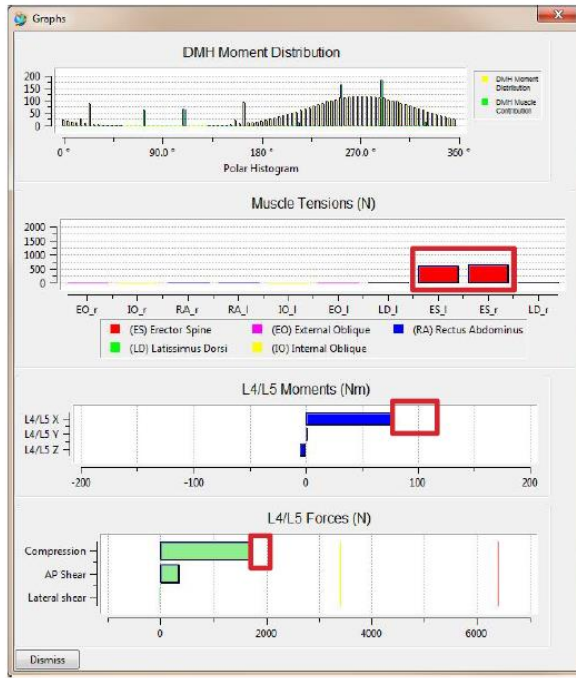
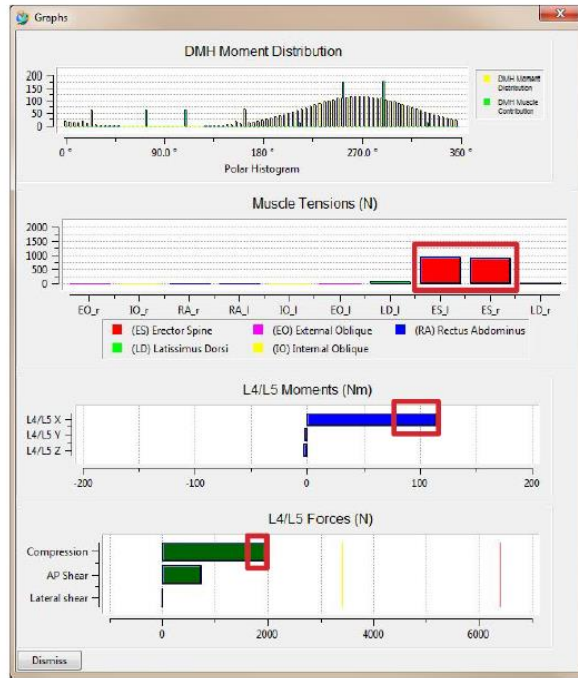
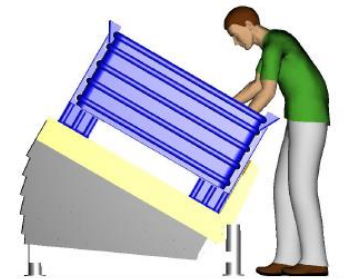
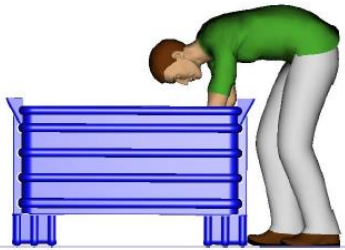


Low Back Analysis, Cumulative Loading Analysis dle 361/2007 Sb.



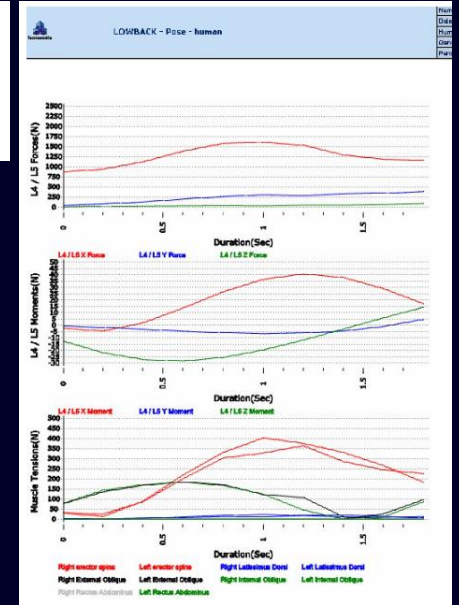
Low Back Analysis, Cumulative Loading Analysis dle 361/2007 Sb.

Vyjímání dřív z palet

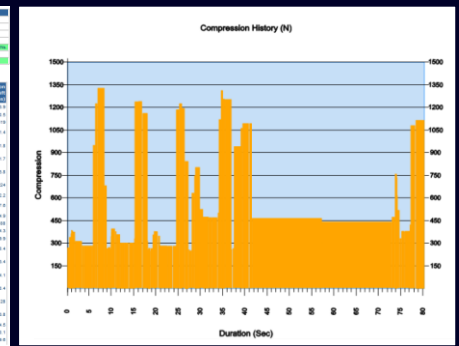


Analysis Recommendations:

1. The low back compression force of 4000 N is above the NIOSH Back Compression Action Level of 3400 N.
2. This represents an occupational risk of low back injury for some workers.
3. It is recommended that this job is analyzed further for ways to reduce low back force.
4. Some ways of reducing the back compression forces include:
 1. Reducing the weight of the load.
 2. Changing the lift arrangement such that the worker does not need to stoop or twist to lift the load (avoid twisting to bend back).
 3. Raising the box to a level just that it can be reached to the body.
 4. Avoiding asymmetric load/unload activities.



Posture	Duration (Sec)	Number of Occurrences	Compression (N)	Shear (N)	Twisting (Nm)	BackP1 (N)	BackP2 (N)	BackP3 (N)	BackP4 (N)	BackP5 (N)	BackP6 (N)	BackP7 (N)	BackP8 (N)	BackP9 (N)	BackP10 (N)	BackP11 (N)	BackP12 (N)	BackP13 (N)	BackP14 (N)	BackP15 (N)	BackP16 (N)	BackP17 (N)	BackP18 (N)	BackP19 (N)	BackP20 (N)
Posture	1.00	100	4000	1000	100	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000



Process Simulate Human + Task Simulation Builder (TSB)

The screenshot displays the Siemens Process Simulate 16.0.1 interface for a task simulation. The main 3D view shows a workstation with a human figure, a workbench, and various components. A semi-transparent text box in the center reads "Process Simulate Human TSB Simulation Tankmontage".

Object Tree (Left):

- Simulation Monitor
 - Objektbaum
 - Simulation Monitor
 - Snapshot Editor
- Object Tree
 - Objektbaum
 - Logical Collections Tree

Operation Tree (Top Left):

- Operations
 - Werk Prozesse
 - Fertigungsline Handschuhkasten
 - Kaschieren
 - Kleberauftrag
 - Montage HSK
 - TSB ZB Tank
 - Get_008725/A:1-MODULE ASM-F_TANK_F_PUMP_III
 - Put_008725/A:1-MODULE ASM-F_TANK_F_PUMP_III
 - Position_008718/A:1-95MM LOCK RING_10_34_III
 - Position_008718/A:1-95MM LOCK RING_10_34_III_1
 - Regrasp_008718/A:1-95MM LOCK RING_10_34_III
 - Put_008718/A:1-95MM LOCK RING_10_34_III
 - Get_008711/A:1-NIPPLE-F/TNK FIL VENT PIPE_20_III
 - Put_008711/A:1-NIPPLE-F/TNK FIL VENT PIPE_20_III
 - Get_008713/A:1-VALVE ASM-F/TNK VENT_15_III
 - Put_008713/A:1-VALVE ASM-F/TNK VENT_15_III
 - Get_008736/A:1-HARNES ASM-F/TNK F/PMP MDL WRG_III
 - Position_008736/A:1-HARNES ASM-F/TNK F/PMP MDL WRG_III
 - Put_008736/A:1-HARNES ASM-F/TNK F/PMP MDL WRG_III

Sequence Editor (Bottom Left):

- Sequence Editor
 - TSB ZB Tank
 - Get_008725/A:1-MODULE ASM-F_TANK_F_PUMP_III
 - A Walk
 - A Reach
 - A Grasp
 - Put_008725/A:1-MODULE ASM-F_TANK_F_PUMP_III
 - A Reach
 - A Release
 - Get_008718/A:1-95MM LOCK RING_10_34_III
 - A Bend and reach
 - A Grasp
 - Position_008718/A:1-95MM LOCK RING_10_34_III
 - A Anise and reach
 - Position_008718/A:1-95MM LOCK RING_10_34_III
 - A Reach
 - Regrasp_008718/A:1-95MM LOCK RING_10_34_III
 - A Regrasp
 - Put_008718/A:1-95MM LOCK RING_10_34_III

3D View (Center):

- Human figure (TSB ZB Tank)
- Workbench with components: 008739/A:1-HARNES ASM-F/TNK F/PMP MDL WRG, 008718/A:1-95MM LOCK RING_10_34, 008725/A:1-MODULE ASM-F_TANK_F_PUMP_III
- SIEMENS logo and slogan "Ingenuity for life"
- Timeline at the bottom: 0.00

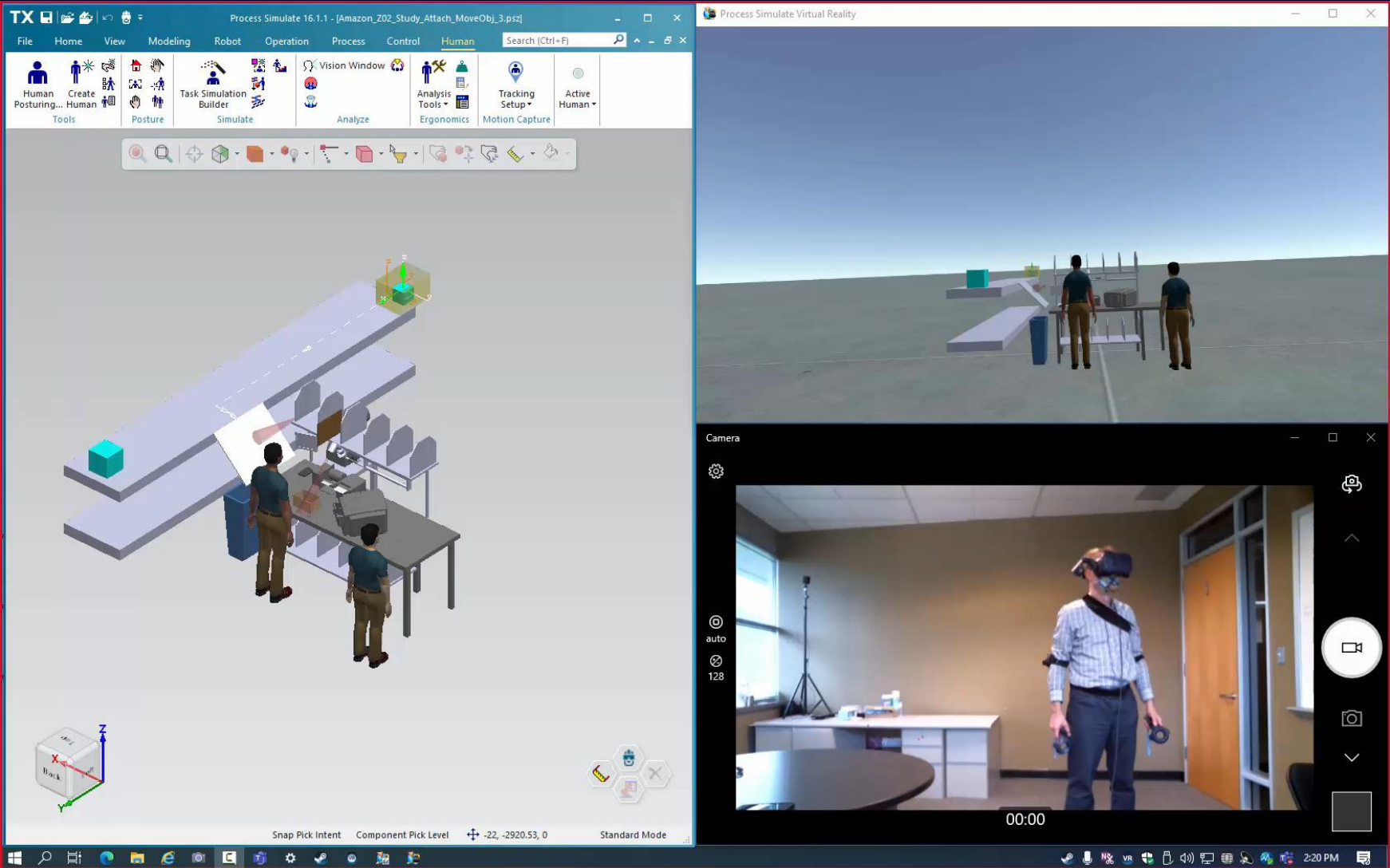
Bottom Status Bar:

- Snap Pick Intent
- Component Pick Level
- Coordinates: -19264,95, -6361,31, 0
- Standard Mode

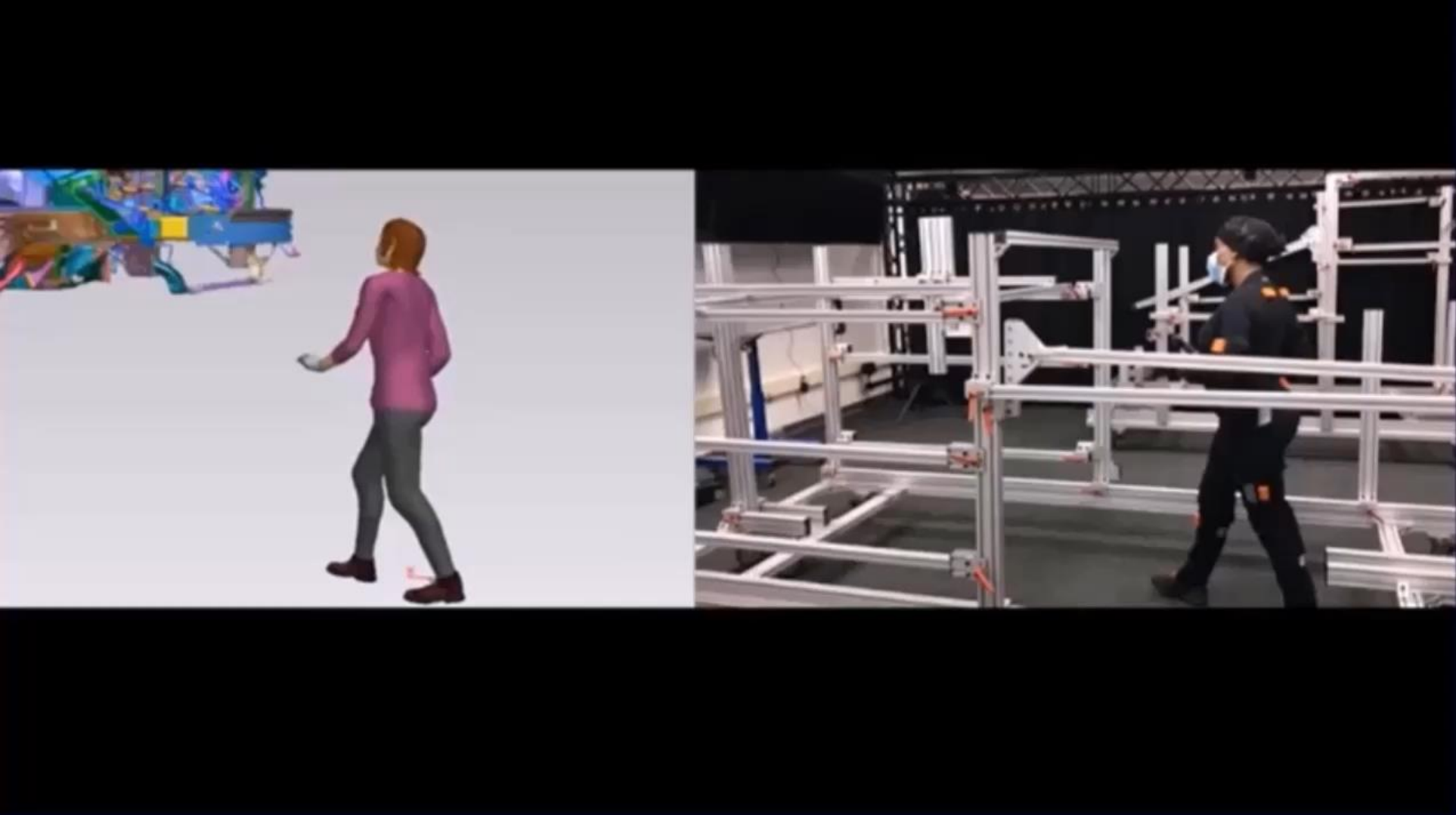
Process Simulate Human + VR



Process Simulate Human + VR + 6x HTC trackers



Process Simulate Human + Motion Capture



Děkuji za pozornost

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