



# Evaluering og procesoptimering

Masterclass for velfærdsteknologi, Aarhus

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2. Method
3. VENDLET Case
4. Simulation I
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# Determinants in Health Care Business

## Organizational

Cost Pressure  
Resource Problems  
Legal Regulations  
Business, Medical, and Pastoral View  
Meshed Processes

...

## Human

Appreciation  
Motivation  
Privacy  
Cognitive, Emotional, and Physical Load  
Subjectiveness

...

Health Care Business needs a holistic view:

Medicine, Psychology, Information Science, Technology,  
Economics, Business Administration, Law, Cybernetics

# Definitions

## Process

A process is a sequence of activities **and** states!

Two views:

- Business view is activity or task oriented
- Medical view is state oriented

## Evaluation

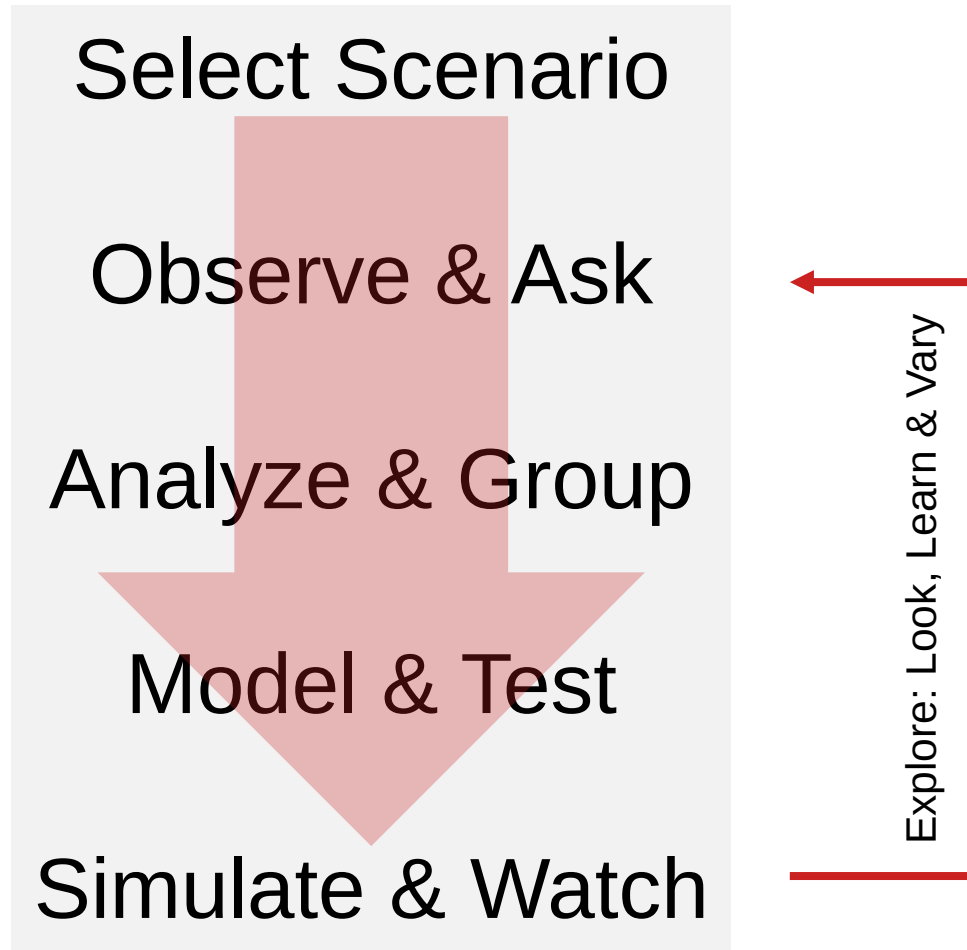
A systematic process of finding value in support of management's decision.

# Definition: Optimization

A **process**  
**configuring** a system  
for **best** results  
under given **constraints**  
to fulfil a **goal**

1. It's not a single formula
2. Doing changes properties
3. System's minimum or maximum
4. Everything has limits
5. The motivation

# Objective & Inductive Method



**With each cycle,  
we gather more data!**

# Why Simulation?

We simulate to create insights and discoveries from experiments with dynamic models of reality that cannot be done differently or only with great effort.

...because

- humans are only implicitly aware of their load during action,
- humans answer depending on their own subjective model and time course,
- measuring residents for other than medical reasons is not appropriate.

1. The method is maximally objective under given constraints
2. Evaluation of medical devices and aids is possible before use
3. Human dignity is preserved

# Which Software?

## AnyLogic

### Multi-Method Modeling and Simulation

- Discrete Events
- Agents with States
- System Dynamics

### On Premise & Cloud

### Dynamic Visualization

- Numbers
- Charts
- 2D and 3D Scenes

## ViveLab

### Virtual Testing and Ergonomics

- Simulation of Physical Dynamics
- Ergonomic Analysis and Reports

### Simulation as a Service

### Dynamic Visualization

- Numbers
- Reports
- 3D Scenes

# The VENDLET Case

VENDLET V5 is an automatic patient turning system for moving and handling the bariatric, bedridden patient.

Use VENDLET V5 if you want

- to improve your work health and safety
- to improve the client comfort
- effective use of resources



# Step 1: Select Scenarios

1. Lower Hygiene
2. Moving Up
3. Turning Regime
4. Apply and Remove Sling

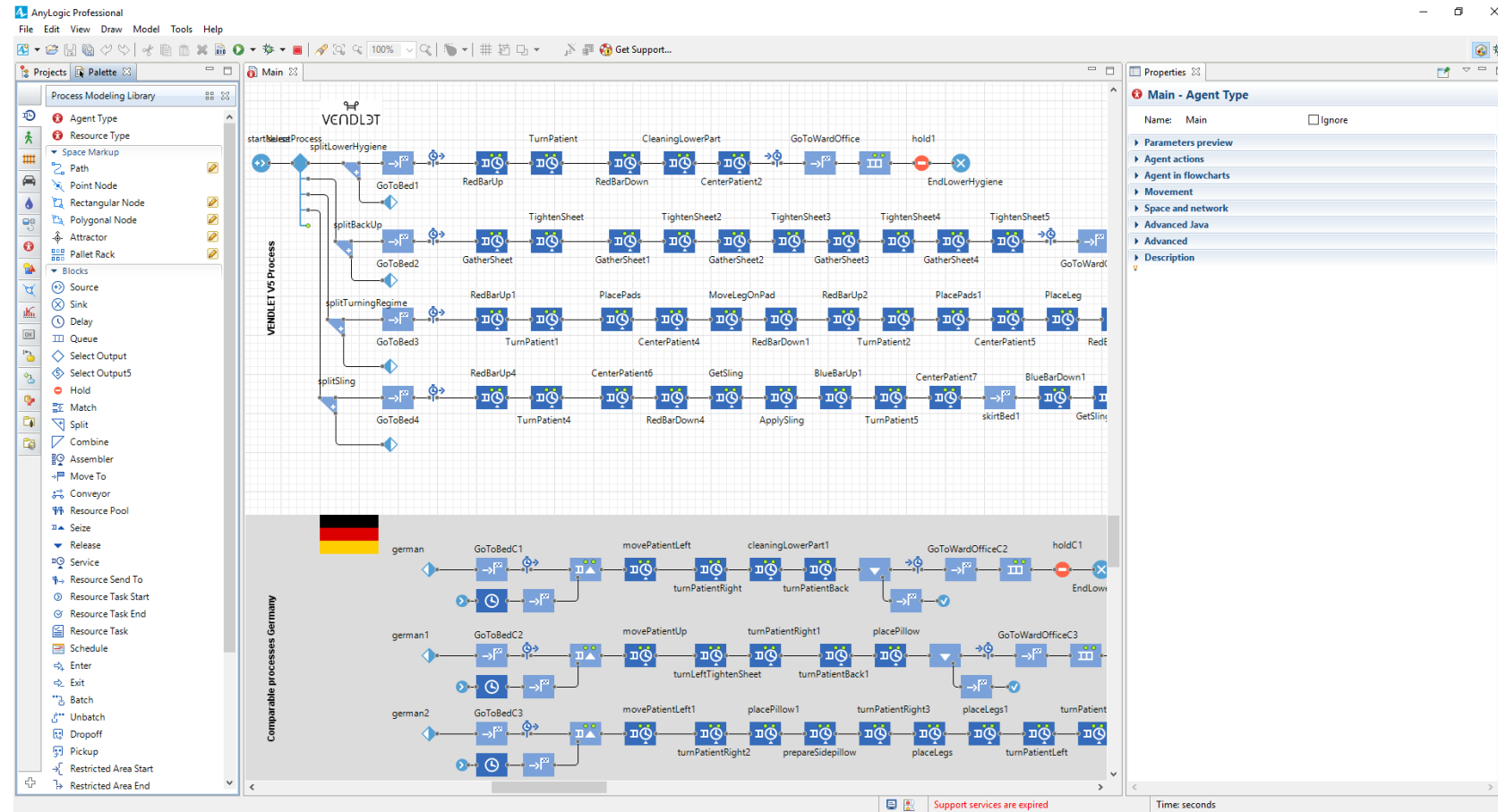
# Step 2, 3: Observe, Ask, Analyze and Group

The screenshot displays a video analysis software interface. On the left, a list of activities is shown with their start and end times:

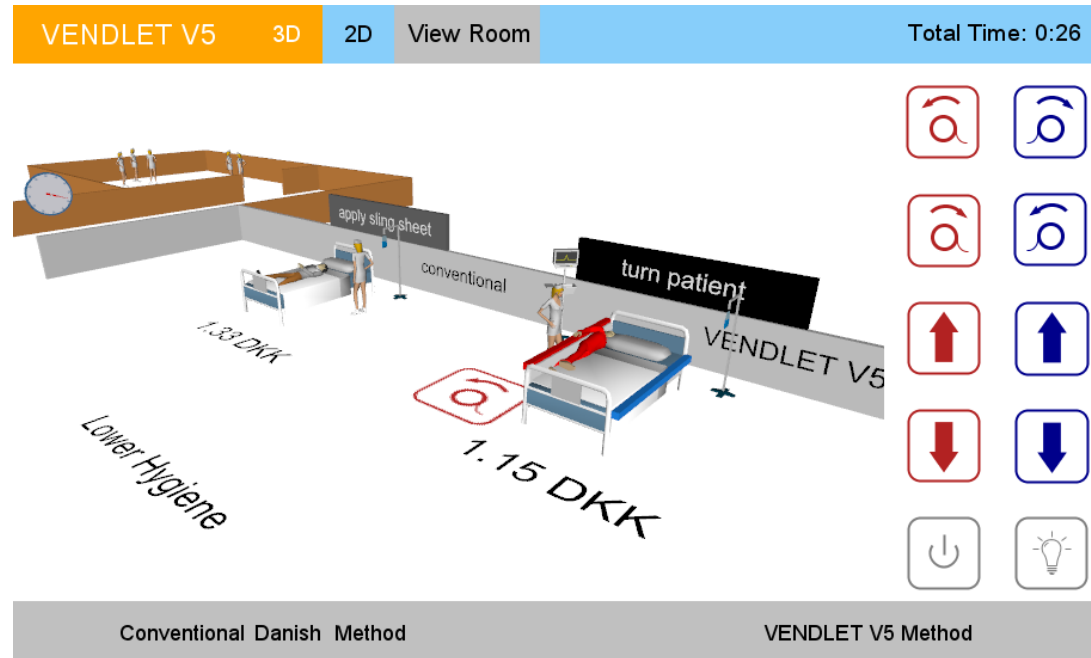
| Name             | In          | Out         |
|------------------|-------------|-------------|
| TakeRemote       | 00:03:11:09 | 00:03:14:25 |
| MovePatientT...  | 00:03:15:04 | 00:03:17:17 |
| CleaningLower... | 00:03:17:26 | 00:03:31:18 |
| CenterPatient    | 00:03:31:25 | 00:03:35:09 |
| BluebarUp        | 00:03:35:15 | 00:03:42:03 |
| TurnPatientBack  | 00:03:42:11 | 00:03:54:17 |
| PositionHead     | 00:03:54:27 | 00:03:57:27 |
| CenterPatient    | 00:03:58:11 | 00:04:02:10 |
| BluebarDown      | 00:04:02:18 | 00:04:08:28 |
| AskPatient       |             |             |

The main video player on the right shows a healthcare worker in a light blue shirt attending to a patient lying on a hospital bed. The patient is wearing a light blue shirt and dark pants. The room has large windows and medical equipment. The video player includes a timeline at the bottom with a current time of 00:04:02:18 and a total duration of 00:01:44:08. The timeline shows various activity segments with labels like 'SayHello', 'RebarUp', 'TurnPatientRight', 'Center', 'RedbarDo', 'Po', 'Take', 'Mo', 'CleaningLowerPart', 'Cent', 'BluebarUp', 'TurnPatientBack', 'Post', 'Cent', 'BluebarDo', and 'As'.

# Step 4: Modeling Processes and Agents



# Step 5: Simulation „Screenplay Window“



## Visual Screenplay

Different Views

Task Visualization

Virtual Remote Control

Shoot out Scenario

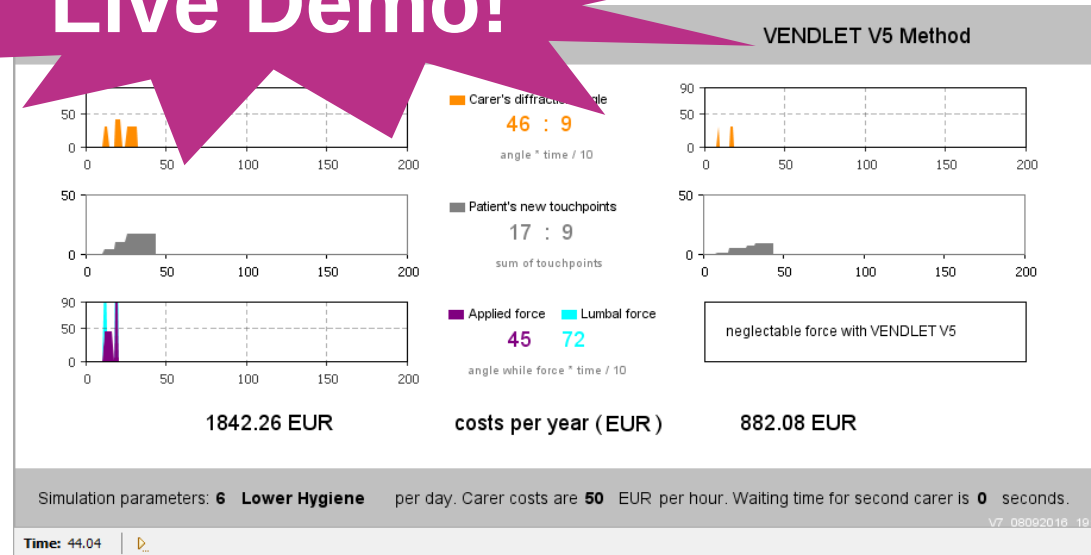
- conventional vs.
- VENDLET V5

Numbers

- Time
- Realtime costs

# Step 5: Simulation „Indicator Window“

Live Demo!



Diffraction Angle without Force  
 Count of Contact  
 Diffraction Angle with Force  
 Lumbar Forces  
 Costs per Year  
 Basic Parameters

# Results

## VENDLET Case

1. The hypotheses were confirmed
2. Amortization time is 1 year for Germany and ½ year for Denmark and Great Britain
3. Annual Savings: 4000 EUR, 7000 GBP, 63.500 DKK  
... only for 4 scenarios

## Further Insights

1. In each country the people are differently bedded
2. Meshed, parallel processes play a major role
3. Tools strongly influence human behavior
4. Carers are not aware of their load
5. Deeper analysis of physical load is required

# Simulation with ViveLab

Live Demo!



# Carer's Forces Heatmap of Spine (conventional)

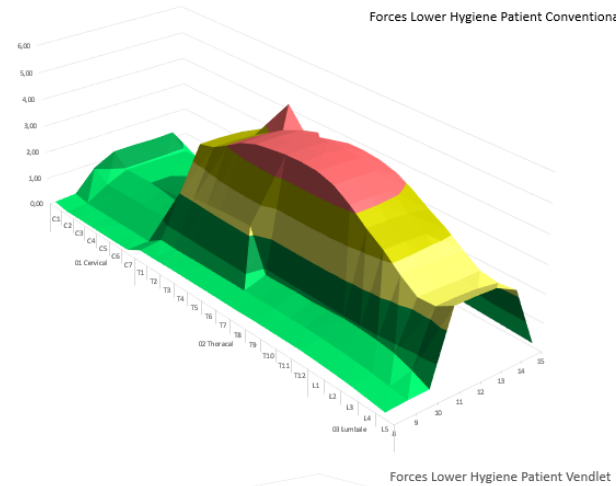
| Spine      | Part | NForce(Nm)Sec8 | NForce(Nm)Sec9 | NForce(Nm)Sec10 | NForce(Nm)Sec11 | NForce(Nm)Sec12 | NForce(Nm)Sec13 | NForce(Nm)Sec14 | NForce(Nm)Sec15 |
|------------|------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 01Cervical | C1   | 1,09           | 1,57           | 1,91            | 1,66            | 1,42            | 1,73            | 1,67            | 0,95            |
| 01Cervical | C2   | 0,41           | 0,71           | 1,13            | 0,82            | 0,53            | 0,90            | 0,83            | 0,41            |
| 01Cervical | C3   | 0,42           | 0,73           | 1,17            | 0,85            | 0,54            | 0,93            | 0,86            | 0,42            |
| 01Cervical | C4   | 0,43           | 0,74           | 1,20            | 0,87            | 0,55            | 0,95            | 0,88            | 0,43            |
| 01Cervical | C5   | 0,43           | 0,75           | 1,22            | 0,88            | 0,55            | 0,96            | 0,89            | 0,42            |
| 01Cervical | C6   | 0,42           | 0,58           | 1,23            | 0,88            | 0,54            | 0,97            | 0,89            | 0,41            |
| 01Cervical | C7   | 0,41           | 0,57           | 1,25            | 0,88            | 0,53            | 0,97            | 0,89            | 0,41            |
| 02Thoracal | T1   | 1,04           | 1,49           | 3,42            | 2,38            | 1,98            | 2,64            | 2,41            | 1,03            |
| 02Thoracal | T2   | 1,00           | 1,46           | 3,54            | 2,41            | 1,34            | 1,39            | 2,45            | 1,00            |
| 02Thoracal | T3   | 0,93           | 1,41           | 3,66            | 2,44            | 1,29            | 1,33            | 2,48            | 0,94            |
| 02Thoracal | T4   | 0,51           | 1,35           | 3,78            | 2,47            | 1,22            | 1,27            | 2,51            | 0,86            |
| 02Thoracal | T5   | 0,43           | 1,30           | 3,89            | 2,48            | 1,16            | 1,21            | 2,53            | 0,80            |
| 02Thoracal | T6   | 0,39           | 1,26           | 4,00            | 2,52            | 1,11            | 1,16            | 2,57            | 0,77            |
| 02Thoracal | T7   | 0,34           | 1,20           | 4,14            | 2,55            | 1,04            | 1,10            | 2,60            | 0,72            |
| 02Thoracal | T8   | 0,31           | 1,17           | 4,29            | 2,59            | 0,99            | 1,06            | 2,65            | 0,69            |
| 02Thoracal | T9   | 0,30           | 1,14           | 4,45            | 2,65            | 0,96            | 1,02            | 2,71            | 0,67            |
| 02Thoracal | T10  | 0,29           | 1,09           | 4,58            | 2,68            | 0,90            | 0,97            | 2,75            | 0,65            |
| 02Thoracal | T11  | 0,34           | 1,08           | 4,78            | 2,77            | 0,88            | 0,95            | 2,89            | 0,67            |
| 02Thoracal | T12  | 0,43           | 1,09           | 5,02            | 2,88            | 0,87            | 0,95            | 2,95            | 0,70            |
| 03Lumbale  | L1   | 0,38           | 0,94           | 5,10            | 2,84            | 0,72            | 0,80            | 2,91            | 0,59            |
| 03Lumbale  | L2   | 0,34           | 0,79           | 5,20            | 2,80            | 0,55            | 0,64            | 2,88            | 0,47            |
| 03Lumbale  | L3   | 0,23           | 0,58           | 5,24            | 2,71            | 0,33            | 0,42            | 2,79            | 0,29            |
| 03Lumbale  | L4   | 0,21           | 0,17           | 5,00            | 2,33            | 0,17            | 0,07            | 2,41            | 0,19            |
| 03Lumbale  | L5   | 0,72           | 0,72           | 4,74            | 1,92            | 0,20            | 0,62            | 2,00            | 0,72            |



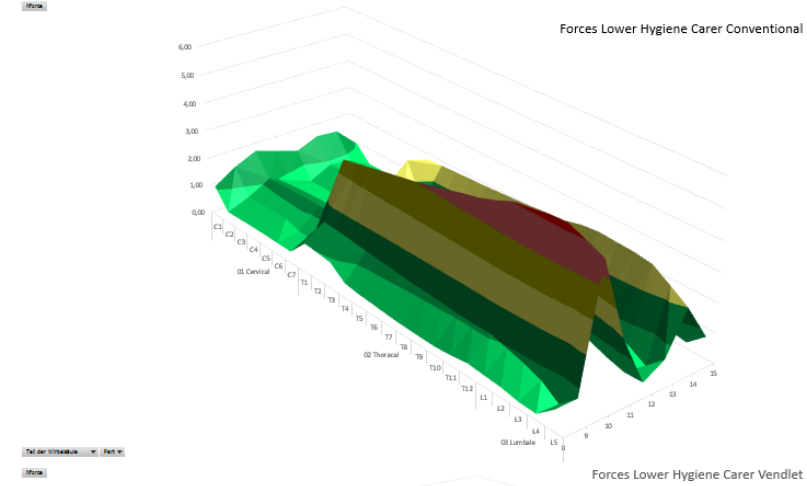
# Comparison of Force Maps

Conventional

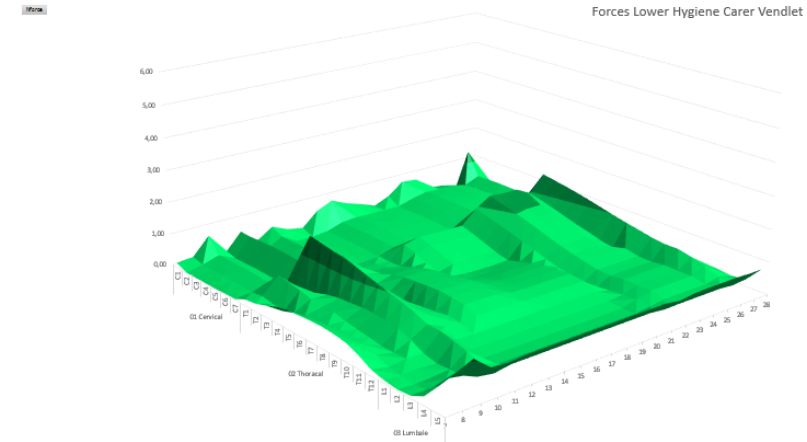
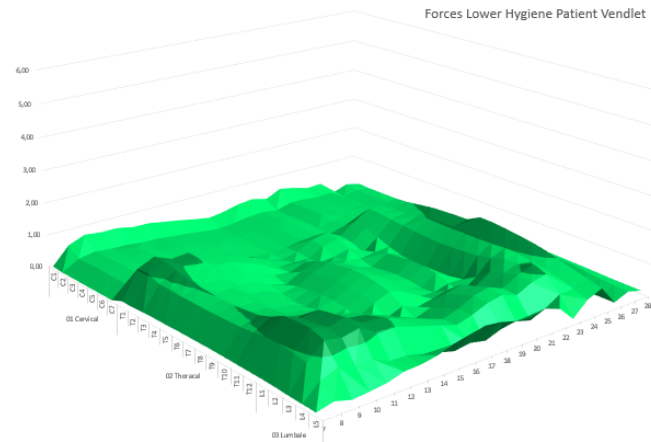
Patient



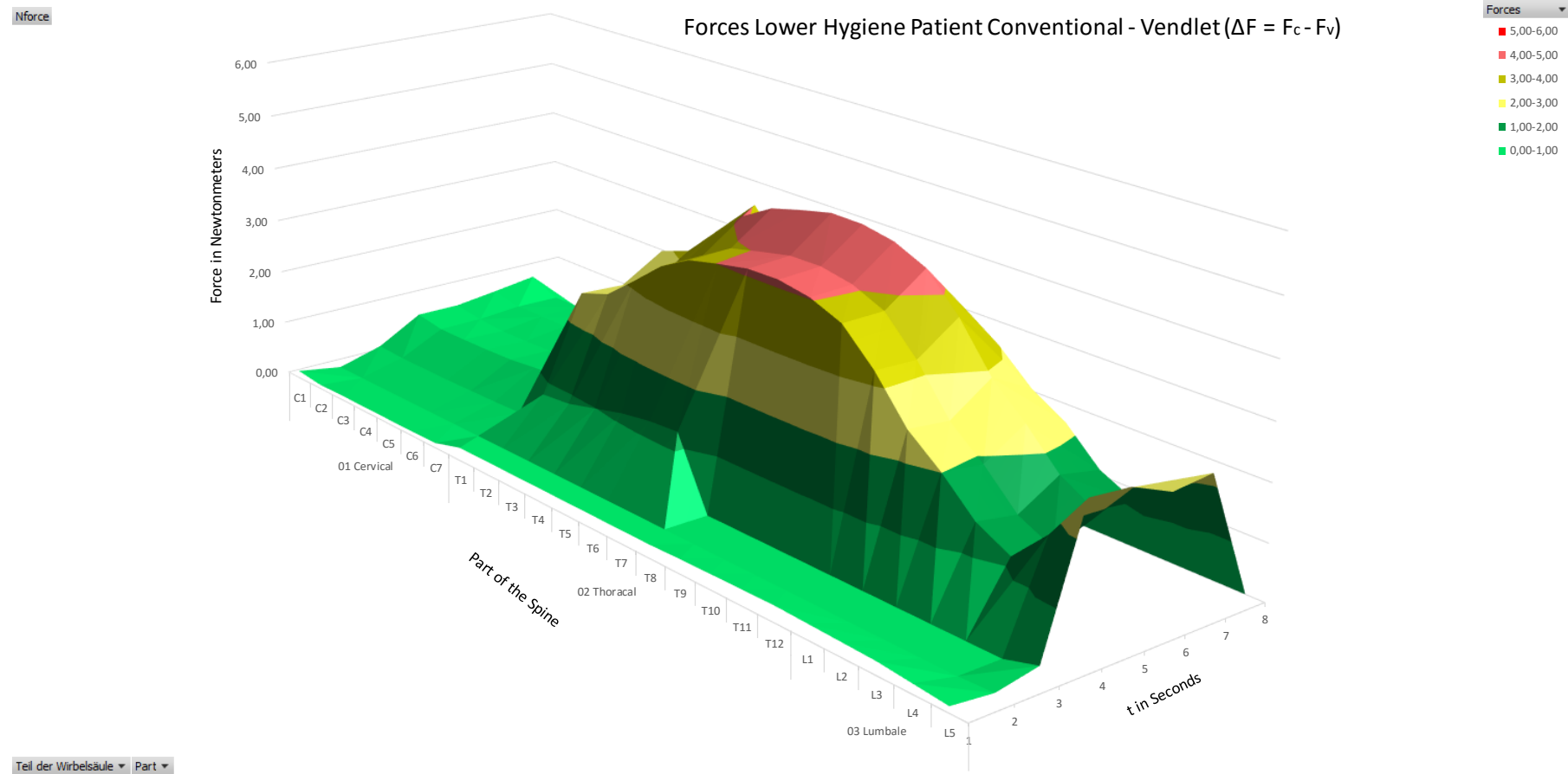
Carer



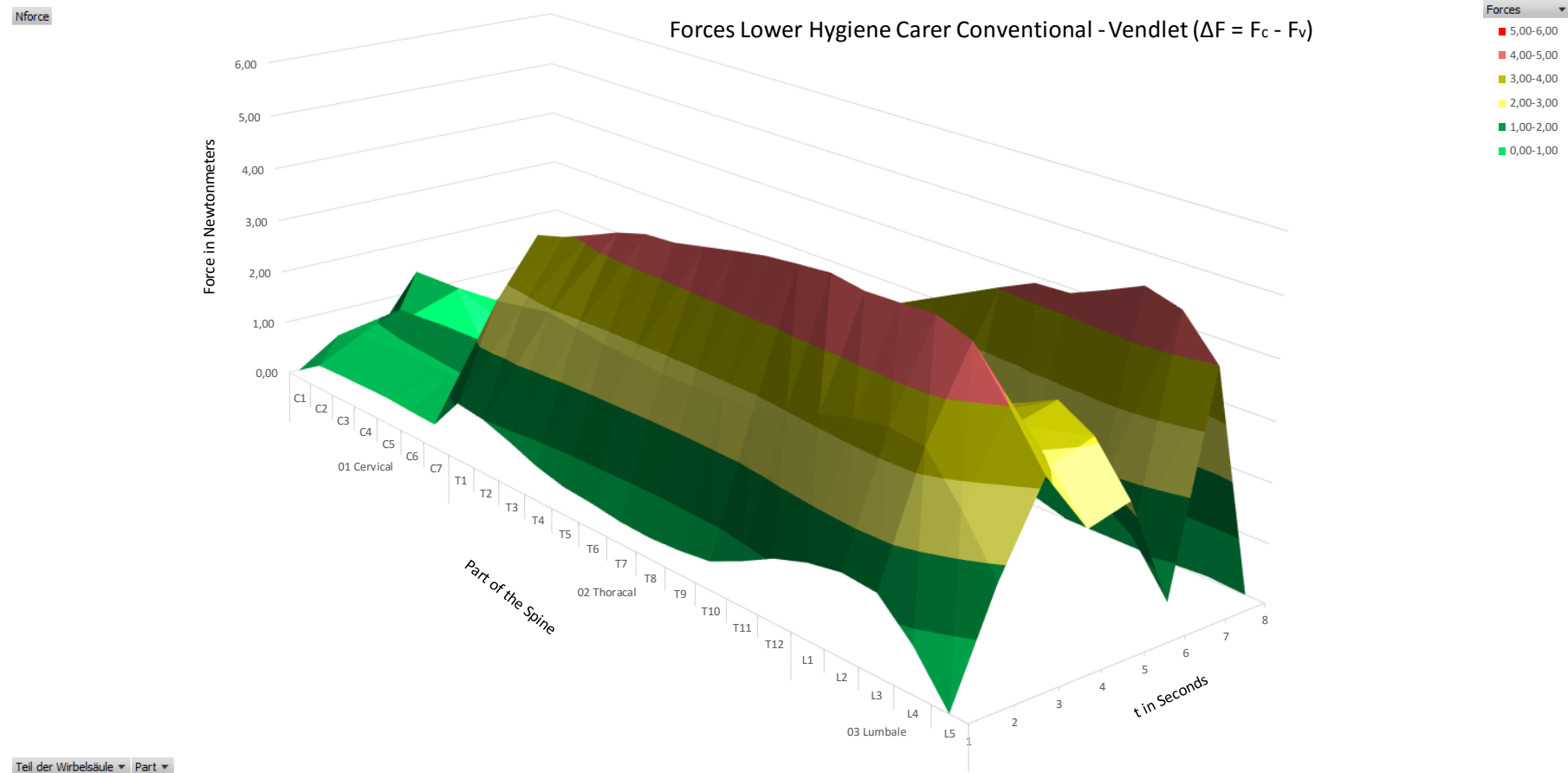
VENDLET



# Patient's Comparison Chart



# Carer's Comparison Chart



# Final Conclusions

1. There is an objective method for evaluation and decision support
2. Modeling supports empathy and understanding
3. Optimization and learning is done in adaptive cycles
4. Behavioral change will happen without indoctrination
5. Objective results at manageable costs
6. The method is highly scalable and
7. preserves human dignity



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