SIMULATION OF PRODUCTIVITY OUTCOMES FROM WORKPLACE PHYSICAL AND SPORTS ACTIVITY PROGRAMS
WORK, MOVE & PERF QUANTITATIVE STUDY

1. Introduction

This document expands on the analytical insights drawn from the Work, Move & Perf (WMP D3.1 Quantitative Research Methodology Report), focusing on how workplace PA interventions can be simulated in economic and productivity terms. It provides a comprehensive explanation of before/after program impacts, quantifies productivity differences between sedentary and active workers, and discusses the underlying mechanisms (physiological, psychological, and behavioral) that account for these changes. The report integrates empirical data, regression modeling, and financial estimates to demonstrate how PSA programs contribute to measurable performance gains.

2. Quantitative evidence from the WMP study

The WMP D3.1 study offers statistically significant quantitative data illustrating how physical activity levels affect productivity, absenteeism, and presenteeism. The comparison between sedentary employees (<600 MET-min/week) and active employees (>1200 MET-min/week) revealed major differences in work efficiency and health costs.

Indicator	Sedentary (<600 METs/week)	Active (>1200 METs/week)	% Change
Presenteeism (days/year)	1.93	1.56	-19%
Presenteeism cost (€)	113.82	83.92	-26%
Absenteeism cost (€)	48.68	6.63	-86%
Total productivity loss (€)	221.10	180.66	-18%
WHO-5 Wellbeing Index	62	74	+19%

These figures clearly demonstrate the economic and health benefits associated with higher levels of physical activity. In particular, the 86% reduction in absenteeism costs and the 26% reduction in presenteeism costs provide a quantitative foundation for modeling ROI outcomes.

3. Simulation methodology: before/after PSA program

Simulation modeling allows organizations to forecast productivity and cost outcomes by applying observed WMP results to their workforce data. The following parameters are recommended for scenario analysis:

- Baseline absenteeism and presenteeism rates from HR data.
- Average salary and cost of lost productivity per employee.
- PSA program cost per employee/year.
- Expected improvement rates (based on WMP results): -25% presenteeism, -30% absenteeism, +15% productivity.

The formula used for ROI estimation is:

ROI = ((Savings from absenteeism + Savings from presenteeism + Productivity gains) - Program cost) / Program cost

4. Example

Assuming:

- 500 employees
- Average salary: €40,000/year
- Cost of PSA program: €200/employee/year
- Current absenteeism cost: €2,000/employee/year
- Current presenteeism cost: €1,600/employee/year

After introducing PSA:

- Absenteeism reduction: 30% → €600 saved per employee
- Presenteeism reduction: 25% → €400 saved per employee
- Productivity increase (15% efficiency gain): €1,000 value per employee

Total benefit = €600 + €400 + €1,000 = €2,000/employee
Program cost = €200/employee
ROI = (2,000 - 200) / 200 = 9.0 → For every €1 invested, the company gains €9.

5. Mechanisms explaining productivity gains

5.1 Physiological mechanisms

Regular physical activity enhances cardiovascular function, oxygen uptake, and neuroplasticity, which collectively improves focus and cognitive performance. Active workers experience lower fatigue and better energy regulation during work hours. These physiological improvements translate into consistent productivity and fewer sick days.

5.2 Psychological mechanisms

Exercise stimulates endorphin and serotonin release, reducing stress and anxiety while improving mood and motivation. The WMP study's WHO-5 results support this, showing significant psychological gains among active participants.

5.3 Organizational and behavioral mechanisms

PSA programs improve social cohesion, peer accountability, and organizational culture. Teams engaging in collective activity reported higher cooperation and satisfaction, which directly contributed to higher engagement and retention rates.

6. Predictive modeling and regression analysis

The WMP study employed logistic regression to identify predictors of productivity. The probability of high productivity (P(HP)) can be estimated as:

P(High Productivity) = 1 / (1 + e^-(β_0 + β_1·MET + β_2·WHO5 + β_3·Age + β_4·JobType))

Each β coefficient quantifies the influence of one variable on productivity, and each indicator can be measured directly from HR or survey data. The following explains how to calculate and interpret each variable.

6.1 Intercept (β_0)

Definition: Represents the baseline log-odds of being highly productive when all predictors = 0. In the WMP model, $\beta_0 \approx -2.45$, meaning that an employee who is inactive (0 METs), has low well-being (WHO-5 = 0), and works in a routine job has a baseline productivity probability of ~8%.

Calculation:

$$p_0 = \frac{e^{\beta_0}}{1 + e^{\beta_0}} = \frac{e^{-2.45}}{1 + e^{-2.45}} \approx 0.08$$

6.2 PA indicator (MET – β_1)

Definition: MET-minutes per week represent the total energy expenditure from physical activity, measured through the Global Physical Activity Questionnaire (GPAQ) (Armstrong & Bull, 2006).

Formula (from WHO):

"MET-min/week"=(Vigorous min×8+(Moderate min×4)+(Walking min×3.3)

How to calculate in HR Context:

1. Use employee self-reports or wellness app data to estimate minutes of physical activity per week.
2. Multiply by the MET coefficient depending on activity intensity.
3. Sum all sources (work, transport, recreation).
4. Divide by 600 to obtain "MET blocks," as the model uses 600 MET-min as a reference increment.

Example: 90 min of vigorous + 120 min of moderate + 150 min walking = (90×8) + (120×4) + (150×3.3) = 720 + 480 + 495 = 1,695 MET-min/week

Result**:** 1,695 ÷ 600 = 2.83 "activity blocks."

How it fits the formula:

- β_1 = 0.42 × 2.83 = +1.19 contribution to productivity log-odds.

*Interpretation***:** For every 600 MET-min/week increase, the probability of being highly productive rises by 5–6%, equivalent to about 30 minutes of brisk walking per day.

6.3 Well-being indicator (WHO-5 – β_2)

Definition: A short, validated scale measuring subjective well-being and mood over the previous two weeks (Topp et al., 2015). It is based on 5 items rated 0–5 (e.g., "I have felt cheerful," "I have felt calm").

Calculation:

$$\text{WHO-5 score} = \left(\frac{\text{Sum of item scores}}{25}\right) \times 100$$

How to implement in HR:

- Include the 5 WHO-5 items in quarterly or annual well-being surveys.
- Average employee responses.
- Transform to a 0–100 scale.

Benchmarks:

- <50 = Poor well-being (screening threshold for distress)
- 50–60 = Acceptable
- 60 = Healthy and resilient group

In the formula: Each 10-point increase in WHO-5 increases the log-odds of high productivity by 0.33. Roughly, this means a 4–5% gain in productivity probability per 10 points.

Example: An employee scoring 70 on WHO-5 contributes:

$\beta_2 = 0.33 \times (70/10) = +2.31$ to the productivity logit.

Interpretation: Improving mental well-being from 50 → 70 can increase productivity probability by approximately 12–15 percentage points.

6.4 Age indicator (β_3)

Definition: Employee age in years.

The coefficient $\beta_3 = +0.02$ indicates that productivity slightly increases with age, reflecting greater job stability, skill maturity, and emotional regulation.

How to use:

- Obtain directly from HRIS (Human Resources Information System).
- For modelling, use actual age or categorized age brackets (e.g., 18–34, 35–49, 50+).

Example: If an employee is 45 years old:

$\beta_3 \times \text{Age} = 0.02 \times 45 = +0.90$ added to productivity logit.

Interpretation: Each additional year adds about 0.5% to the odds of high productivity, up to mid-career (~50 years), after which it tends to plateau.

6.5 Job type indicator (β_4)

Definition: Categorical variable representing the nature of work. For regression modelling, job type is encoded as binary:

- 0 = manual or routine jobs
- 1 = cognitive, creative, or hybrid roles

How to calculate:

- Classify each employee's job type (using internal HR classification or ISCO codes).
- Code accordingly before running or applying the formula.

Interpretation: β_4 = +0.28 → cognitive or hybrid workers benefit more from physical activity, as movement enhances executive function and reduces cognitive fatigue. Their productivity odds are 6–8% higher than manual or routine workers, holding other factors constant.

6.5 Example

Employee A

- METs: 1200 MET-min/week (β_1 = 0.42 × 2 = 0.84)
- WHO-5: 65 (β_2 = 0.33 × 6.5 = 2.15)
- Age: 40 (β_3 = 0.02 × 40 = 0.8)
- Job Type: 1 (β_4 = 0.28 × 1 = 0.28)
- Intercept: β_0 = −2.45

Final model:

$$P(HP) = \frac{1}{1 + e^{-(-2.45+0.84+2.15+0.8+0.28)}} = 0.74$$

Interpretation: Employee A has a 74% probability of achieving high productivity. If the same employee becomes inactive (MET = 0) and well-being drops to 50, the predicted probability falls to 32%.

6.6 HR managers implementation

HR Variable	Source	Frequency	Use
MET-min/week	GPAQ or wellness tracking app	Quarterly	Identify at-risk inactive groups
WHO-5 score	Employee well-being survey	Biannual	Monitor psychological resilience
Age	HR database	Static	Adjust productivity expectations
Job Type	HR job classification	Static	Segment productivity baselines
Productivity (iPCQ)	Cost of presenteeism/absenteeism	Annual	Estimate cost savings

6.7 Summary

- Physical activity and well-being jointly explain up to 40% of productivity variance.
- Employees with ≥1200 MET-min/week and WHO-5 >60 are 2–3× more productive.
- +600 MET-min/week → +6% productivity. +10 WHO-5 points → +5% productivity.
- HR teams can track results via Excel or Power BI dashboards to quantify ROI.

7. Economic translation of findings

Assuming an average European salary of €40,000, the estimated economic outcomes from the WMP findings are as follows:

Category	Annual Savings per Employee (€)	ROI Contribution
Absenteeism reduction	500–800	2.5
Presenteeism reduction	300–500	1.5
Productivity improvement	400–600	2.0

Total estimated ROI = 6.0 (i.e., €1 invested yields €6 in return), consistent with international literature such as Braun et al. (2022) and Hallam et al. (2023).

8. Conclusion

The results of the WMP quantitative study confirm that physical activity programs produce substantial productivity and financial benefits. Simulations based on empirical data reveal that active employees not only exhibit lower absenteeism and presenteeism rates but also contribute greater value through sustained engagement and mental well-being. Organizations can reliably estimate ROI ratios between 3:1 and 6:1, depending on program scope, duration, and workforce characteristics.

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