

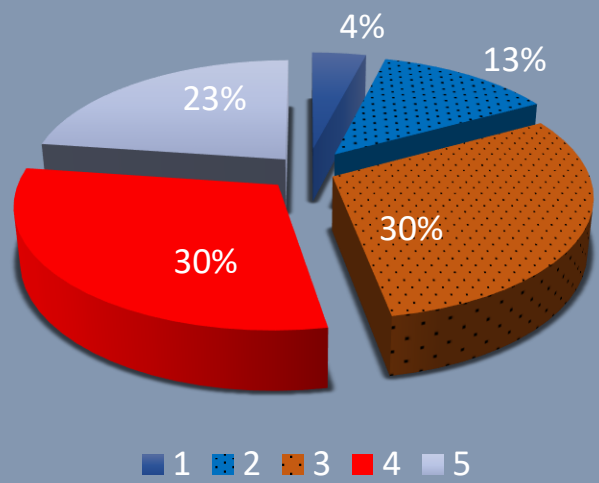
Advancing Cybersecurity Competence Assessment Framework Integrating Human Factor Dimensions

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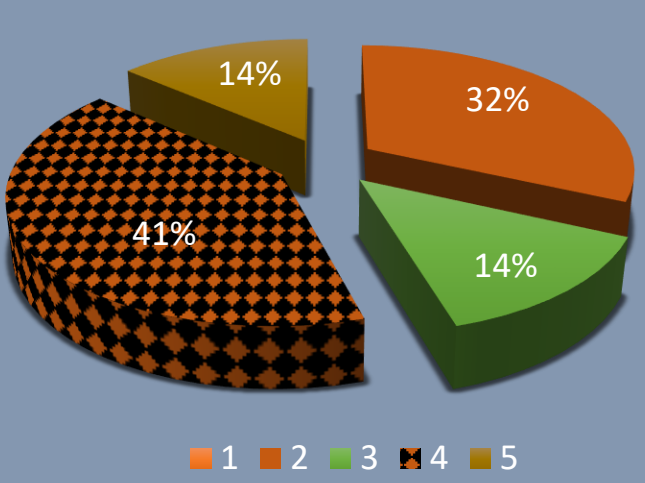
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Summary: Advanced framework for evaluating cybersecurity competence with explicit attention to human factors is introduced. It integrates cognitive, behavioral, and situational dimensions into a multidimensional competence evaluation model. To validate the proposed framework, controlled experiments were conducted with participants from the Security Operations Center representing both technical and non-technical backgrounds. Participants took part in quizzes while their heart rate variability (HRV), respiratory rate, and peripheral capillary oxygen saturation (SpO2) were measured during the experiments. The relation between the question-answer, emotional state, and measurement results was analyzed. Findings showed that integrating human factor dimensions enhances the validity and predictive value of competence assessment models.

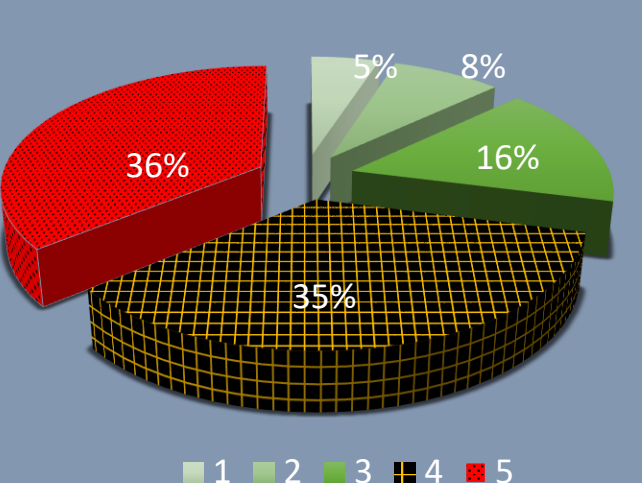
SURVEY ANALYSIS



Work in Stressful Conditions
(1 – never, 5 – always)

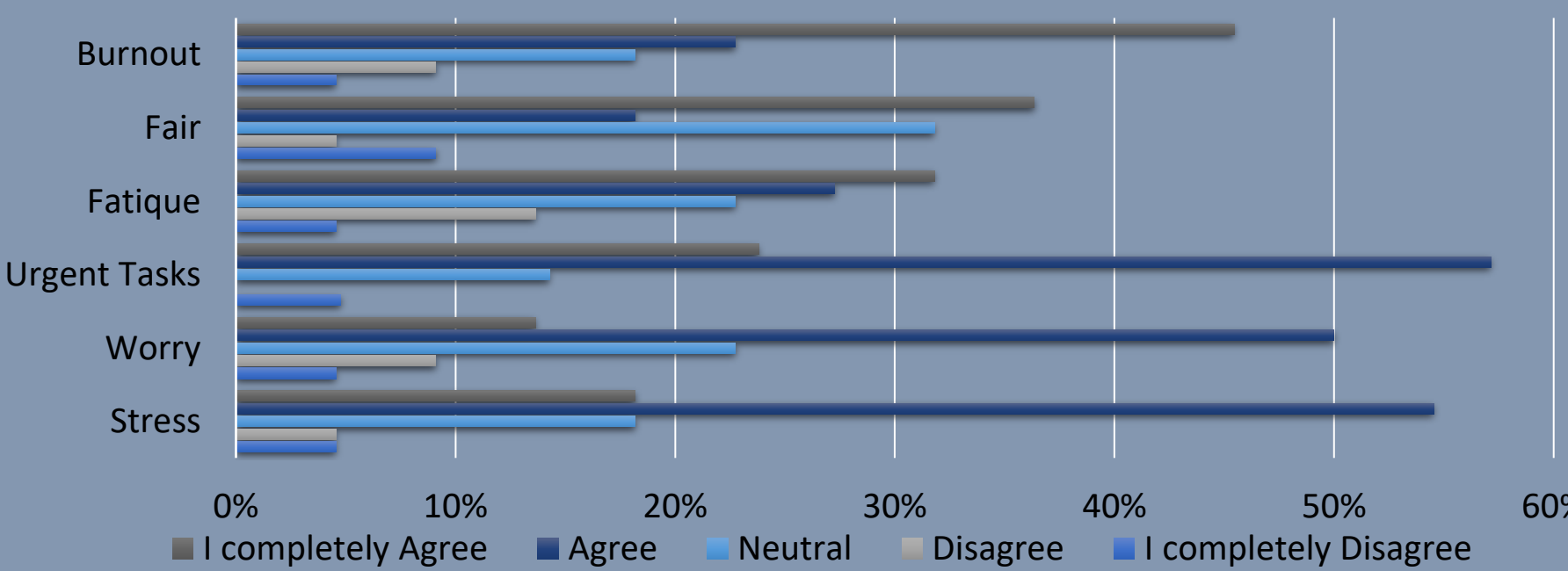


Support for Employees
With Stress and Fatigue at Work
(1 – never, 5 – always)

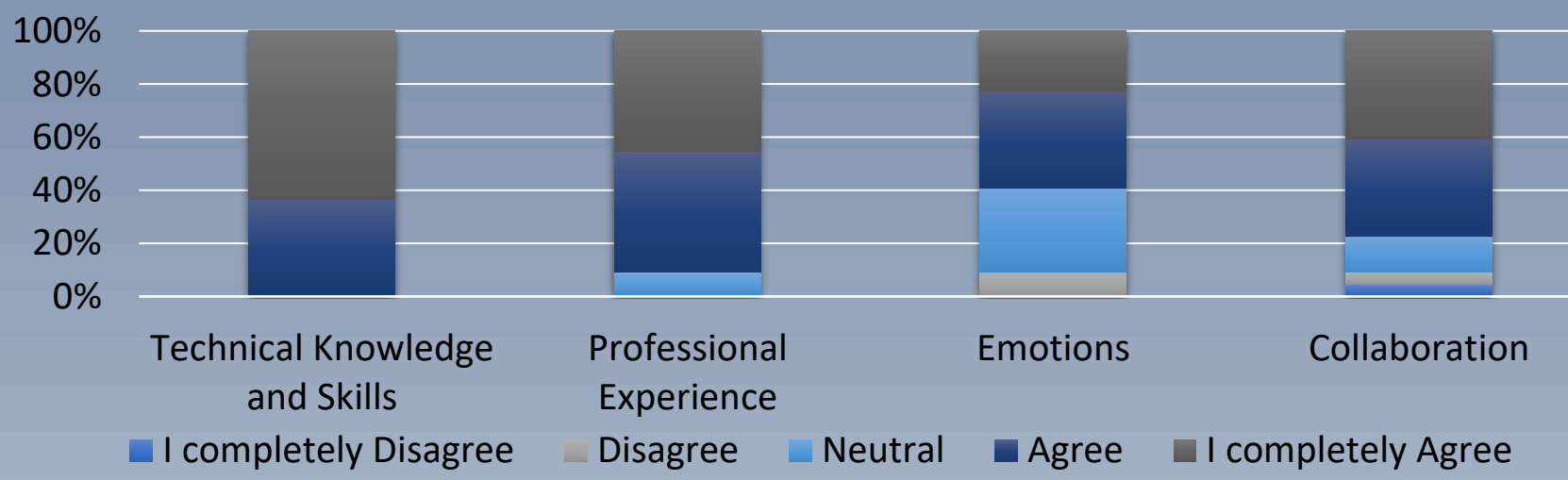


Impact of Stress on Work Quality
(1 – never, 5 – always)

THE RESEARCH OF HUMAN FACTORS

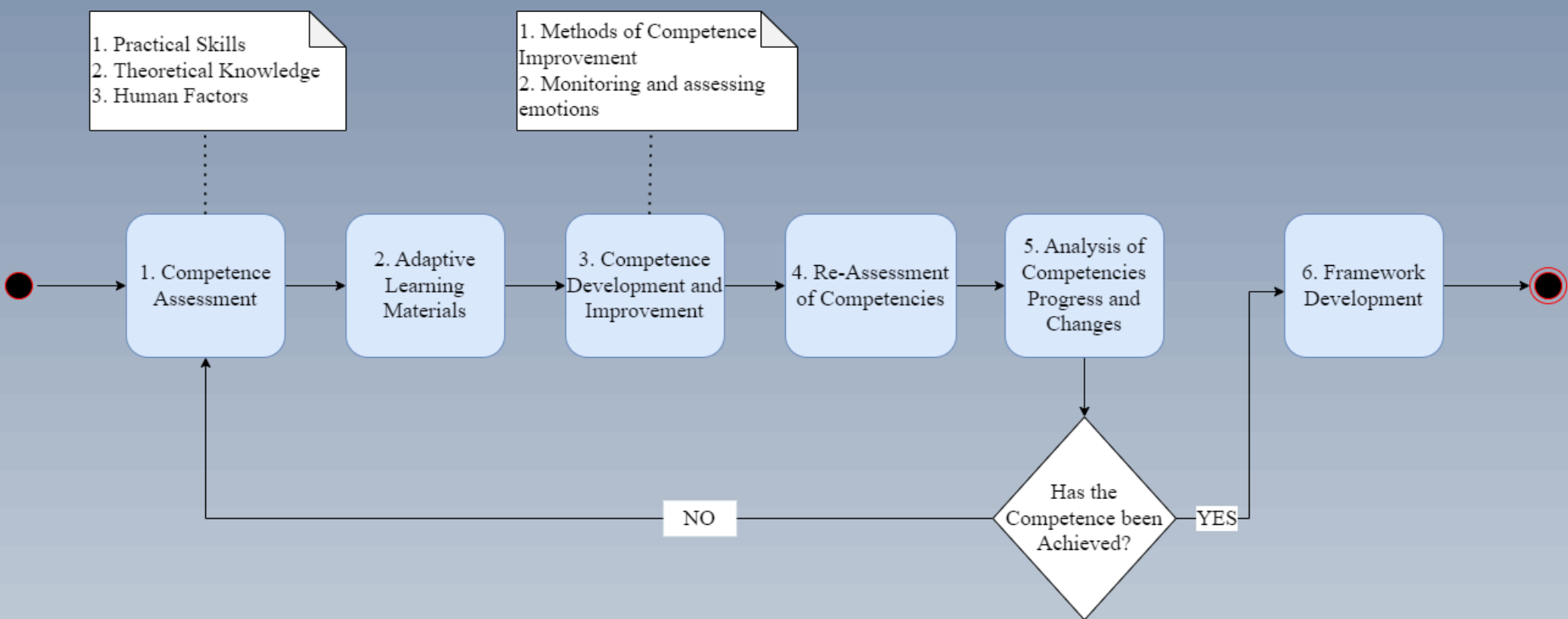


The Influence of Emotions on Work Performance

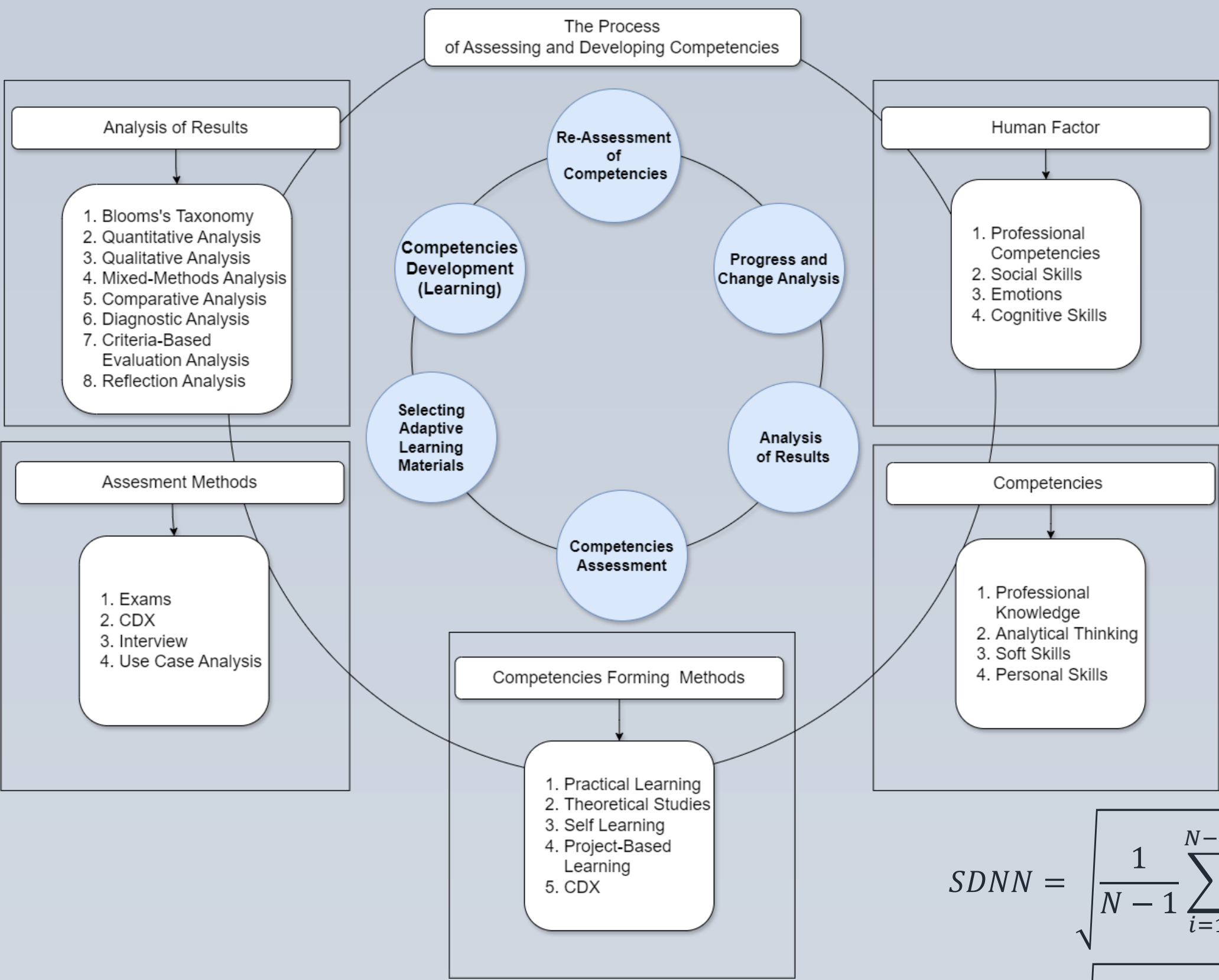


The Importance of Factors in Ensuring Performance in Cybersecurity

THE PROCESS OF COMPETENCE FORMATION AND ASSESSMENT



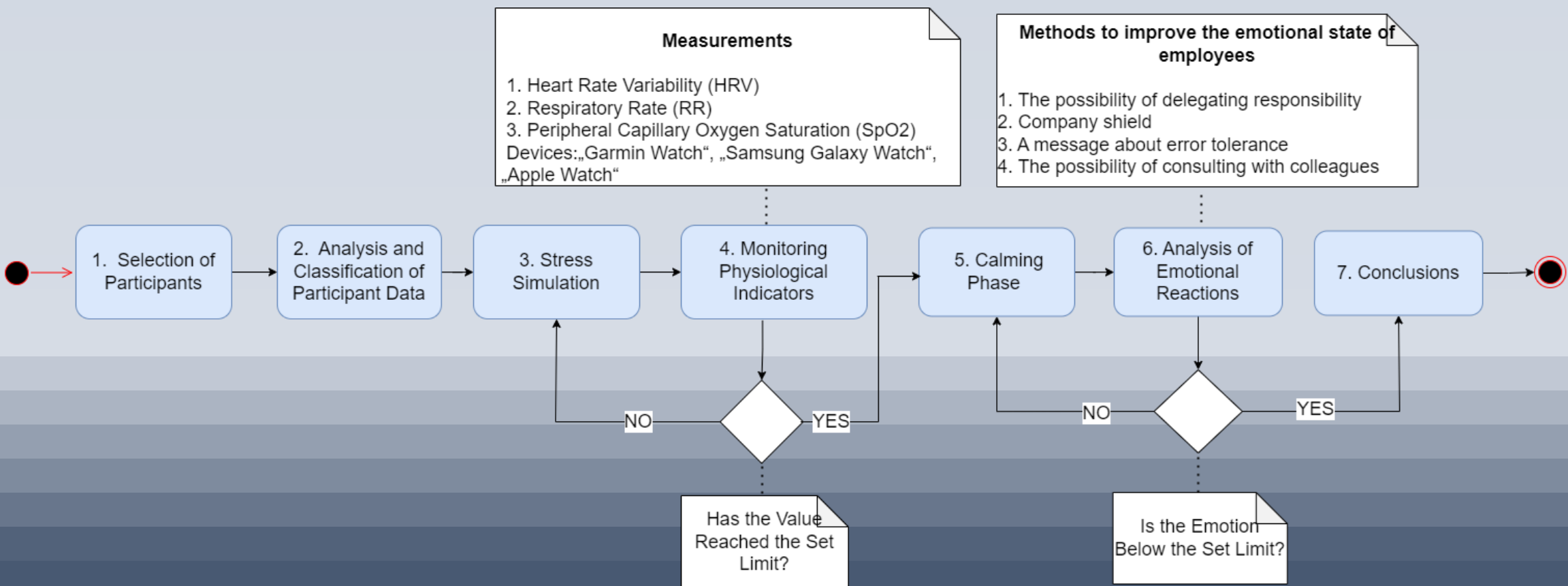
THE FRAMEWORK FOR EVALUATING CYBERSECURITY COMPETENCIES



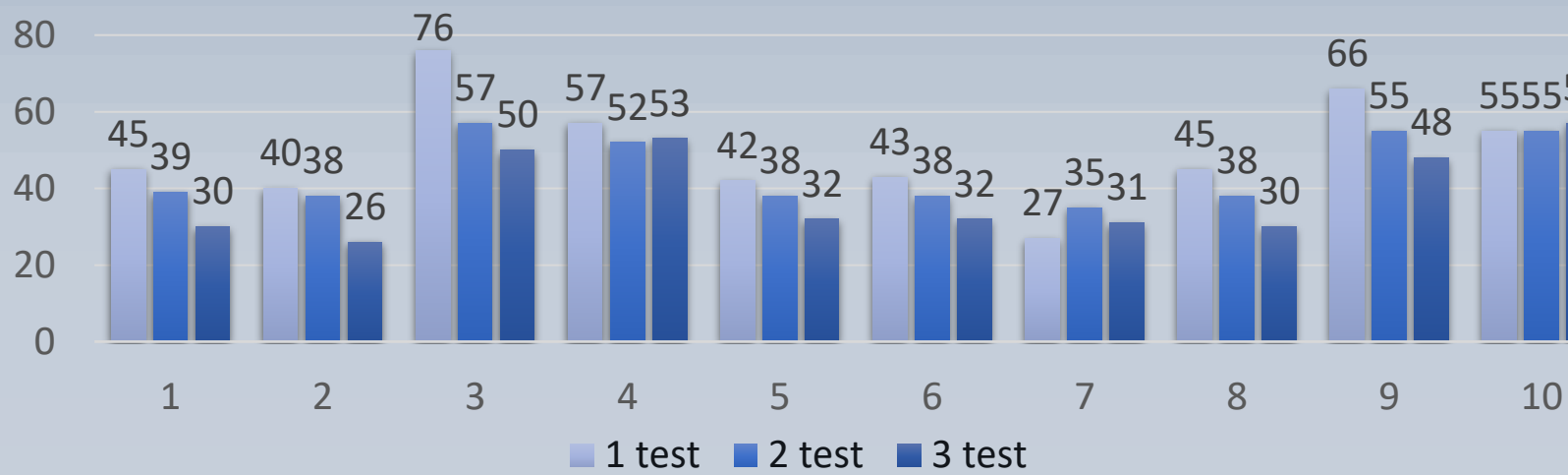
$$SDNN = \sqrt{\frac{1}{N-1} \sum_{i=1}^{N-1} (NN_{i+1} - NN_i)^2}$$

$$RMSSD = \sqrt{\frac{1}{N-1} \sum_{i=1}^{N-1} (RR_{i+1} - RR_i)^2}$$

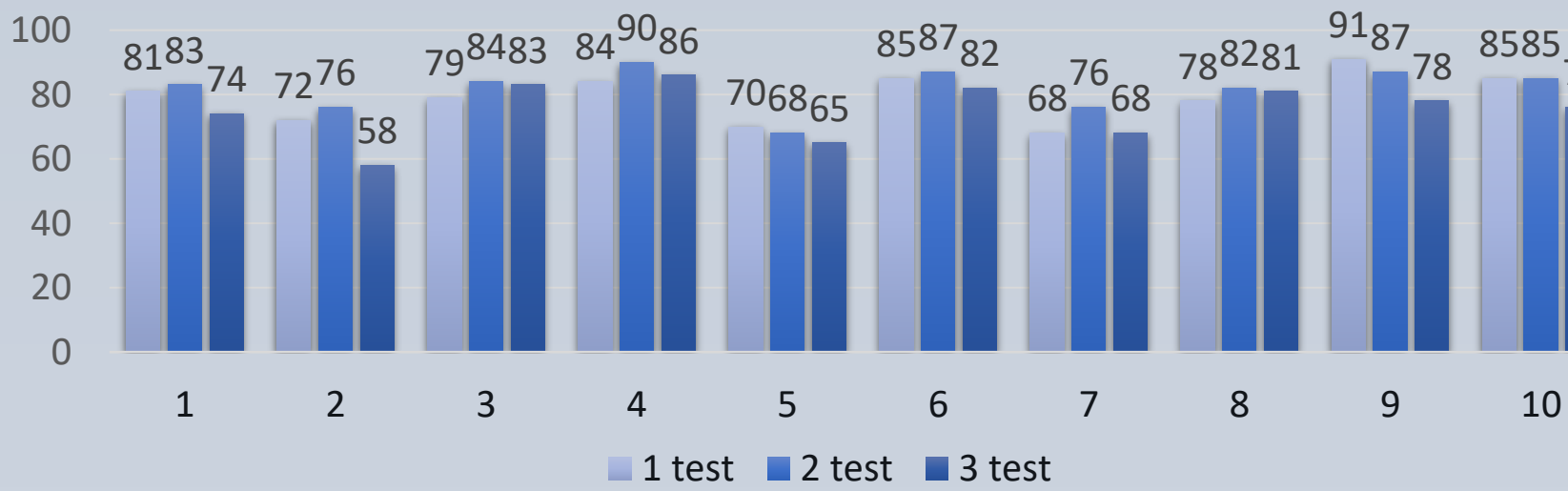
THE RESEARCH WORKFLOW



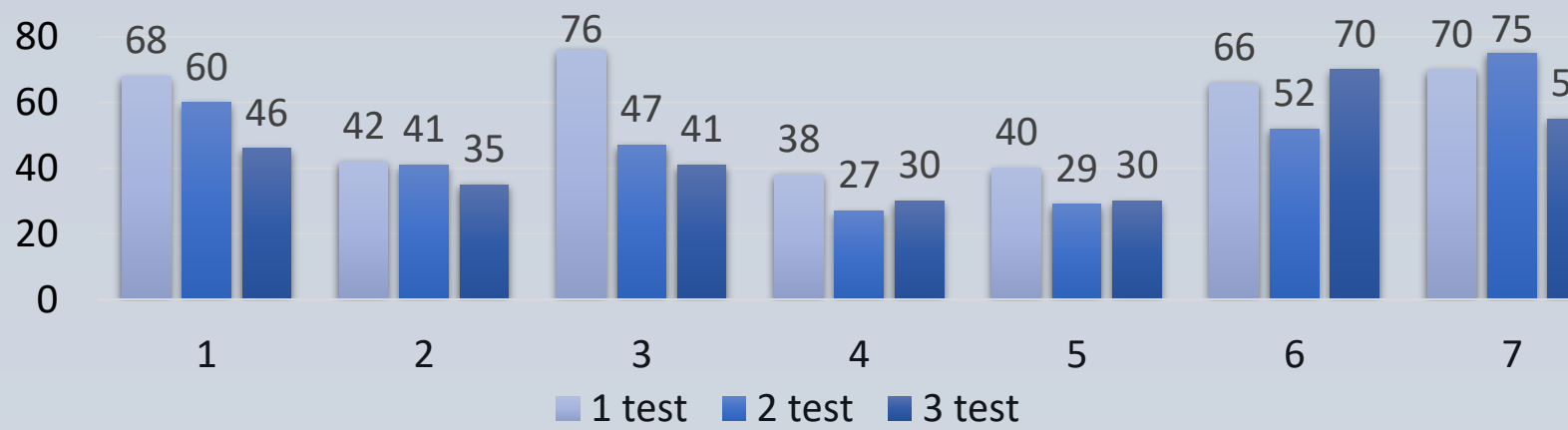
MEASUREMENTS RESULTS



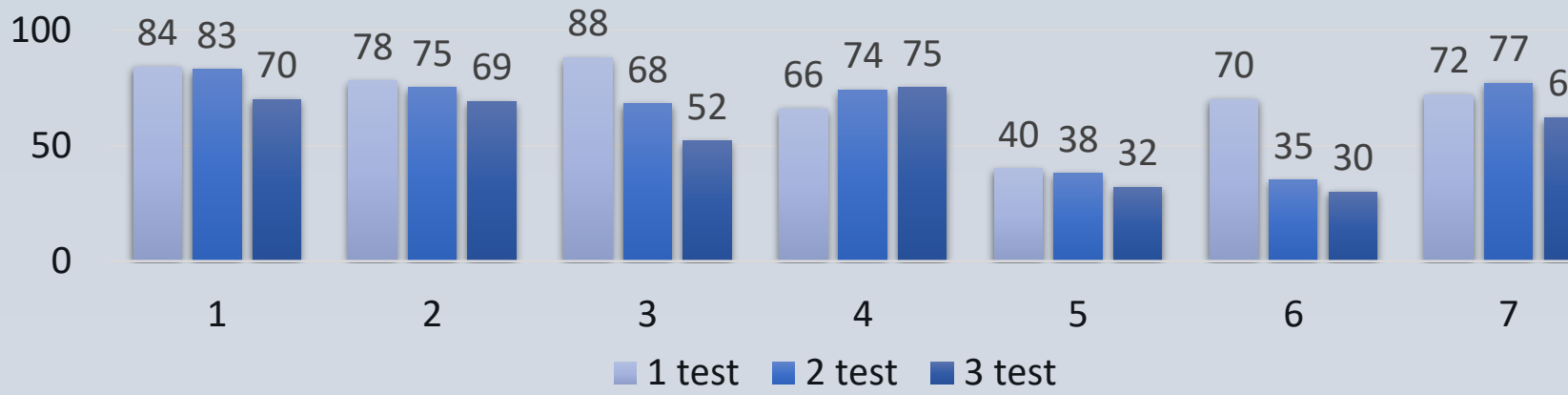
Technical Team Test Results (avg. Stress Level)



Technical Team Test Results (AVG) Pulse Level



Operations Team Test Results (AVG) Stress Level



Operations Team Test Results (AVG) Pulse Level

Smart Devices Used to Measure Stress

Smart Devices	Stress Measurement Indicator	Measured Stress	The Average Stress Level
Garmin Smartwatch	RMSSD (Root Mean Square of Successive Differences, RR intervals)	Instant Stress	➤ Low Stress Level: 0-25 ➤ Moderate Stress Level: 26-50 ➤ High Stress Level: 51-75 ➤ Very High Stress Level: 76-100
Apple Watch	SDNN (Standard Deviation of NN intervals)	Long-Term Stress	
Samsung Galaxy Watch	RMSSD + SDNN, RR+NN intervals	Instant Stress + Long-Term Stress	

*58% of Garmin watches, 23% of Samsung watches, and 19% of Apple watches participated in the study