Physical Principles of Developing the Systems of Monitoring Driver Vigilance

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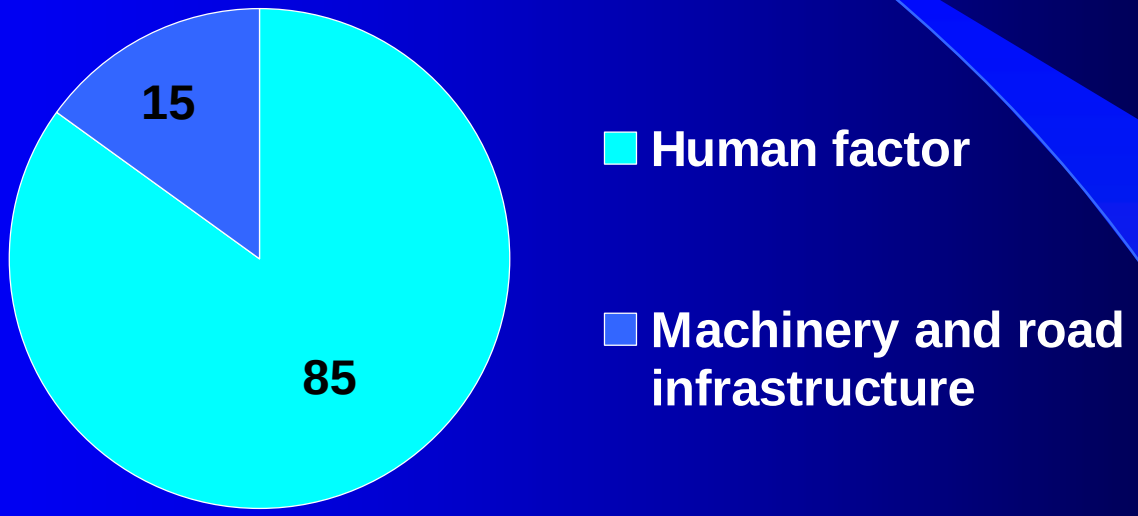
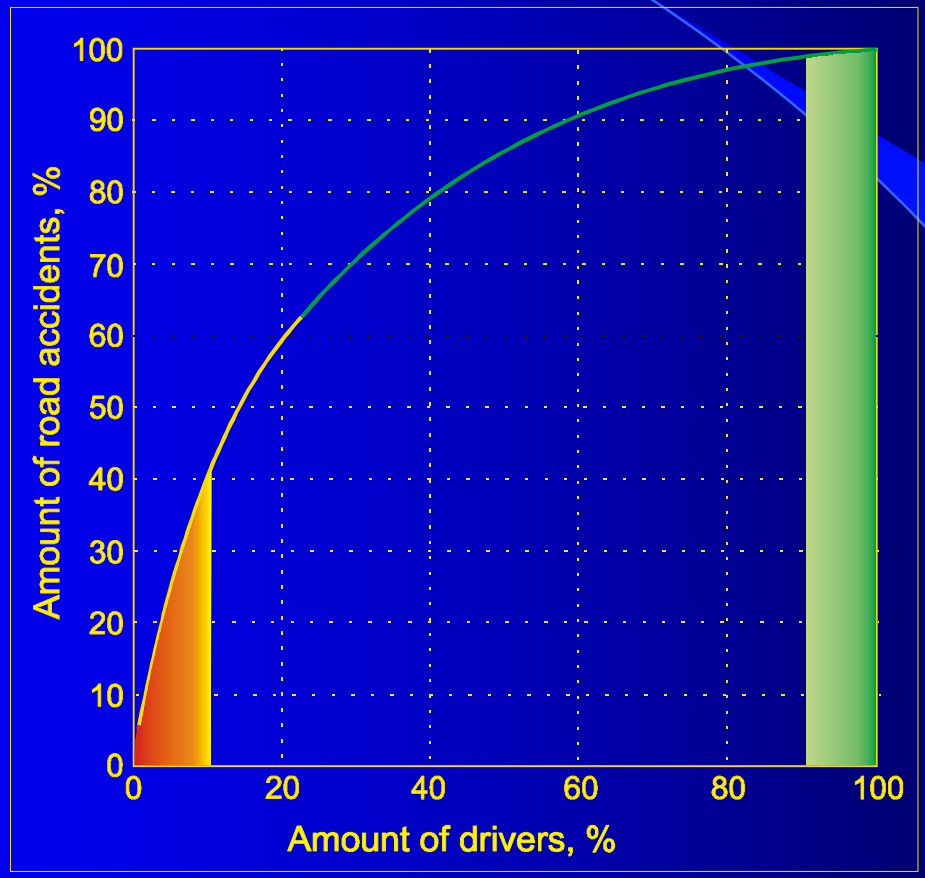
Causes of road accidents



20% of road accidents that caused serious injuries is the result of low level of driver vigilance

Amount of road accidents & driver's contribution with different λ



On the left - the worst drivers (10% dr – 40% r/a, $\lambda = 1 \div 10 \cdot 10^{-5}\ h^{-1}$**)**

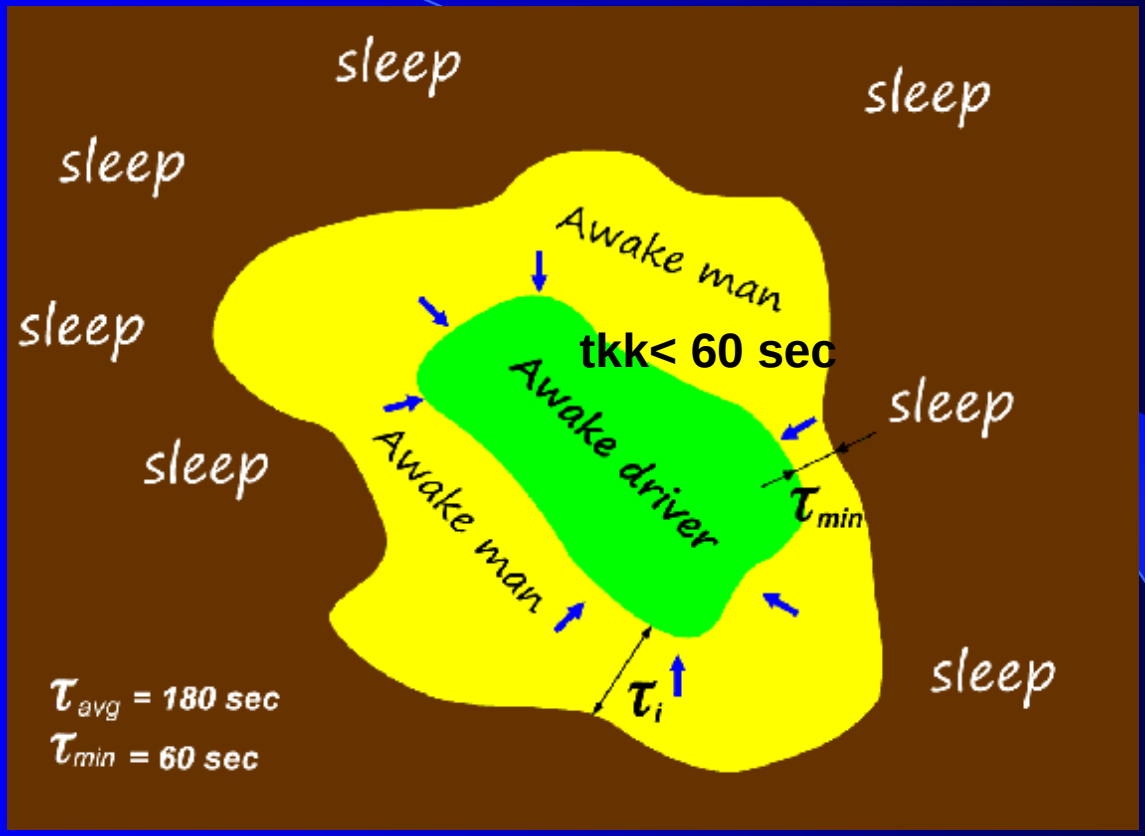
On the right- the best drivers (10% dr - 2% r/a, $\lambda \sim 1 \cdot 10^{-6}\ h^{-1}$**)**

Psychophysiological selection

Thy good driver is a person who is not only mastered in the nuances of driving, but who has a sertain set of psychophysiological qualities:

- correct visual perception of speed, distance, and the proportions of subjects
- concentration, distribution, stability of attention, not susceptible to interference
- stress tolerance

Maintaining the driver's vigilance



The problem may be stated as follows: to choose the most adequate condition (the green zone known to be OK, e.g., active vigilance) and to maintain the same. The aim of biological feedback is to return a driver to the green zone. The green zone may be of various areas, but always in the yellow one.

Verified with tkk< 60 sec as a known vigilance condition. tkk> 60 sec indicates at a hazard, which is followed by a check. The frequency of a check very largely depends on the kind of activities and on the given value of "hazardous failure".

Comparative analysis of determination of sleep or deep relaxation precursors

Technique	P	q
Change in driving “style”	0,3	5
Rational behaviour	0,3	5
Heart rate	0,3	7
Posture (muscular tonus)	0,2	5
Gaze direction	0,2	3
Bends of head (muscular tonus)	0,1	2
Oculogram	0,05	2
Blinks	0,02	3
Speech	0,005	5
Periodic checks (mb deadman handle)	0,002	>60
Microsaccades (potential);	~0,001	NA
EDR (DVTCS, 45 mln hrs of accident-free driving)	***0,0001***	***0,5***

p – probability of a hazardous failure

q – average number of checks per hour of work

Engine Driver Vigilance Telemetric Control System (DVTCS) in Russia

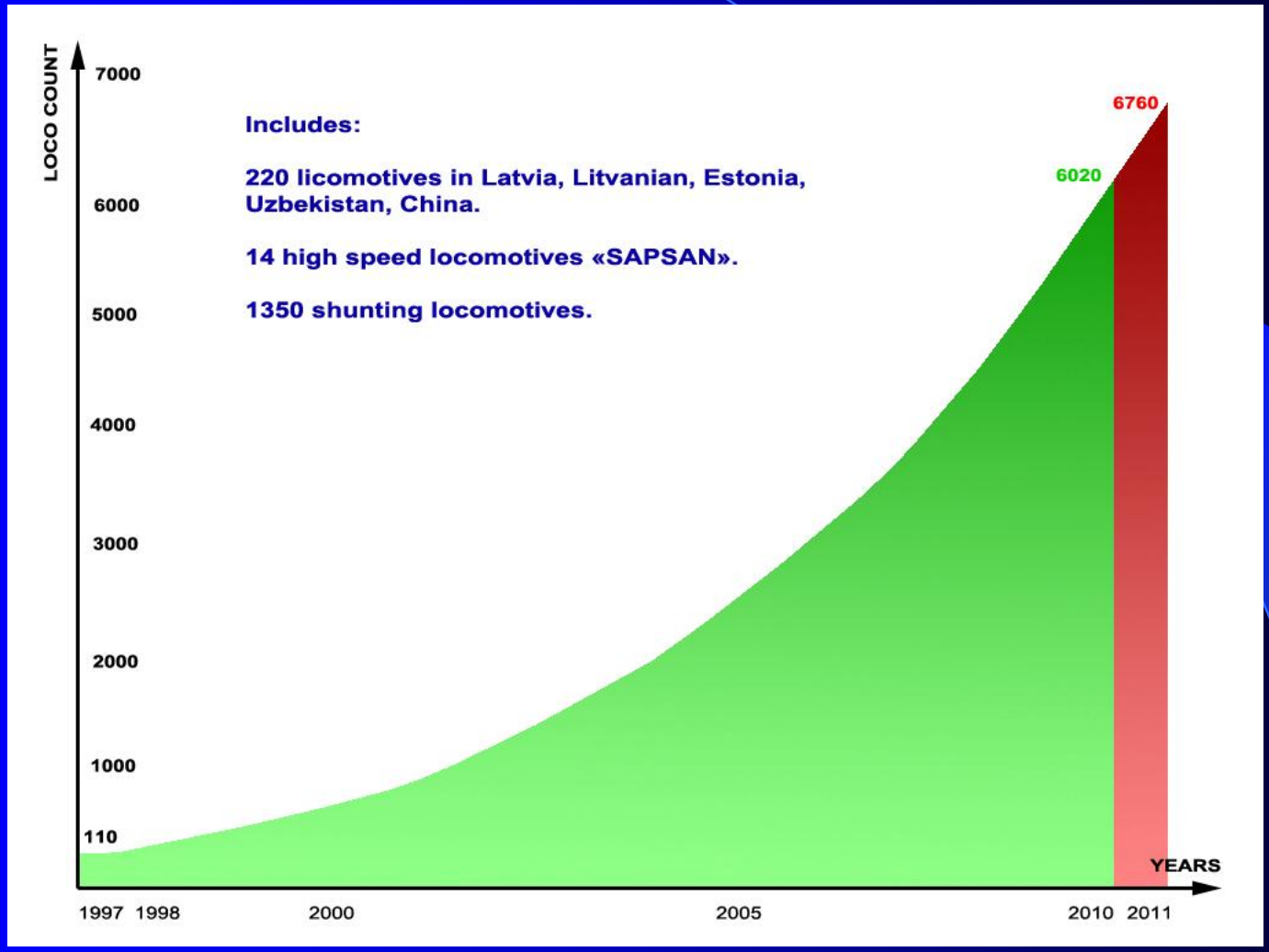
- Over 15 years of exploitation on Russian railways
- Over 5 thousand locomotives
- Over 18.000 engine drivers
- The total running hours is 45 million man-hours

For the time the DVTCS was operated there were no registered accidents caused by the driver fallen asleep

Options of DVTCS and EDA sensors

DVTCS for the country in Asia

History of DVTCS usage



DVTCS application on locomotive in the country in Asia

Driver work capacity support system

The system is intended for continuous monitoring of driver physiological state. It informs the driver that he moves from the active state to a psychophysiological relaxation or drowsiness. The system will give the alarm signal in the case the driver come nearer to unworkable state.

The bracelet intended for capacity for work of the driver “DRIVE WELL”

DRIWELL®

Resume

If we will put to use the psychophysiological selection of candidates to drivers, and filter out those who are unsuitable for driving a car, the average number of road accidents will be reduced by over 40%.

If we will equip all cars in Russia with effective systems for monitoring of drivers, up to 4 thousand lives would be saved per year.

Thank you for your attention!