MIRCE Science

According to Einstein *"Everything that the human race has done and thought is concerned with the satisfaction of felt needs*".

Human needs for transpiration, communication, defence, entertainment, electricity and many other functions are satisfied by ships, airplanes, tractors, computers, radios, tanks, phones and many other systems. As they are functioning in accordance to the laws of science, which are independent of time, place and human impact, their design-in performance, like speed, power, fuel consumption, range and similar, are accurately predictable at the design stage[1].

However, experience teaches us that in-service performance of these systems is dominated by energy exchanges within systems and with environment causing the loss of the design-in function(s) or performance due to: fatigue, operator induced errors, corrosion, creep, foreign object damage, a faulty weld, bird strike, perished rubber, carburettor icing, to name just a few. Hence, delivering the deign-in performance beyond the birth requires actions like replacements, repairs, modifications, diagnostics, "cannibalisations", change of operation and similar to be performed. Thus, the ability of being functional through time, known as **functionability,**[2] is an essential in-service property of functionable systems.

Also, experience teaches us that unlike quantitative information regarding the design-in performance of systems that is available on the delivery day, the in-service performance is not. Instead, it becomes known through the end-of-life statistics. The reason for this is the fact that they are evolutionary properties of the time, place and human dependent interactions between systems, natural world and human actions. Hence, in-service performance of functionable systems, quantified through the amount of work done[3] and resources consumed[4] cannot be predicted by the laws of science used for the predictions of their design-in performance.

Consequently, to address the inability of existing scientific knowledge to predict the expected work done and resources required throughout the life of functionable systems, Dr Knezevic established the MIRCE Akademy at Woodbury Park, in 1999. Staff, Fellows, Members and students of the Akademy systematically study in-service behaviour of functionable systems to:

- Physically observe the time evolution of functionable systems and measure the work done and resources consumed.
- Scientifically understand mechanisms that govern the time evolution of functionable systems, within the physical scale from 10^{-10} m (atoms) to 10^{10} m (solar system)
- Mathematically define the scheme for the prediction of in-service performance of a given design-in system, for a given in-service conditions and rules.

A science based body of knowledge, formulated through axioms, formulas, methods, rules and algorithms for predicting the in-service performance of the future systems, resulting from the trajectory of the motion of functionability through MIRCE Space constitutes MIRCE Science[5].

The ability to simultaneously predict the design-in and in-service performance of the future systems is of fundamental importance for system engineers, managers, investors, regulators and other specialists who are responsible for the satisfaction of the "human felt needs", in reliable, economical and safe manner, for the future transportation, communication, defence, energy, entertainment and many other functions delivered by functionable systems.

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[1] Boeing 747: cruising speed 895 km/h, range: 9,800 km, take-off weight 333,400 kg, fuel capacity: 183,380 l, cargo: 30 LD-1 containers, basic dimensions: wing span 59.6 m, length 70.6 m, tail height 19.3 m.

[2] Knezevic, J., Reliability, Maintainability and Supportability – A probabilistic Approach, Text and Software package, pp. 291, McGraw Hill, London 1993. ISBN 0-07-707691-5

[3] Pan Am's Boeing 747, registration number N747PA, during the 22 years of in-service life, has: flown 37,000,000 mi airborne 80,000 h, transported 4,000,000 passengers, took-off/landed 40,000 times

[4] burned 271,000,000 gallons of fuel while received 806,000 maintenance man-hours, consumed: 2,100 tyres, 350 brake systems, 125 engines among other parts, replaced passenger compartments and lavatories 4 times.

[5] Knezevic, J., The Origin of MIRCE Science, MIRCE Science, pp 234, Exeter, UK 2017, ISBN 978-1-904848-06-6