Written by : Pilot. Seyed Alireza Amintabar

Commercial and Aerobatic pilot, Graduate Nelson Aviation College

Sources : Human Performance In Aviation (R. D. Campbell) , Pilot Performance (Pooley's) and Personal research of writer.

What is a Human factors ? (Introducing SHEL Concept)

There is a concept about human factors in aviation, this concept simply discuss about one important things, regardless about your role in aviation, you require to comply with human factors, otherwise at some point, something going really wrong.

Pilot. Seyed Alireza Amintabar

To operate an aircraft safely, a pilot must have an understanding of technical subjects such as aircraft engines, instruments, meteorology and navigation. To make the appropriate decisions for the safe operation of an aircraft, the pilot must exercise judgment. This is based on training, knowledge and experience, and an appreciation of all the factors which could influence the current situation, including HUMAN FACTORS. Training in human factors is a requirement of the International Civil Aviation Organization (ICAO).

There is an interface between flight crew, machine, systems, equipment and software, which come together in the airspace environment. Elwyn Edwards, a psychologist, presented the concept at a technical symposium dealing with man and machine, in 1972. He described it as the SHEL concept.

SHEL Concept.

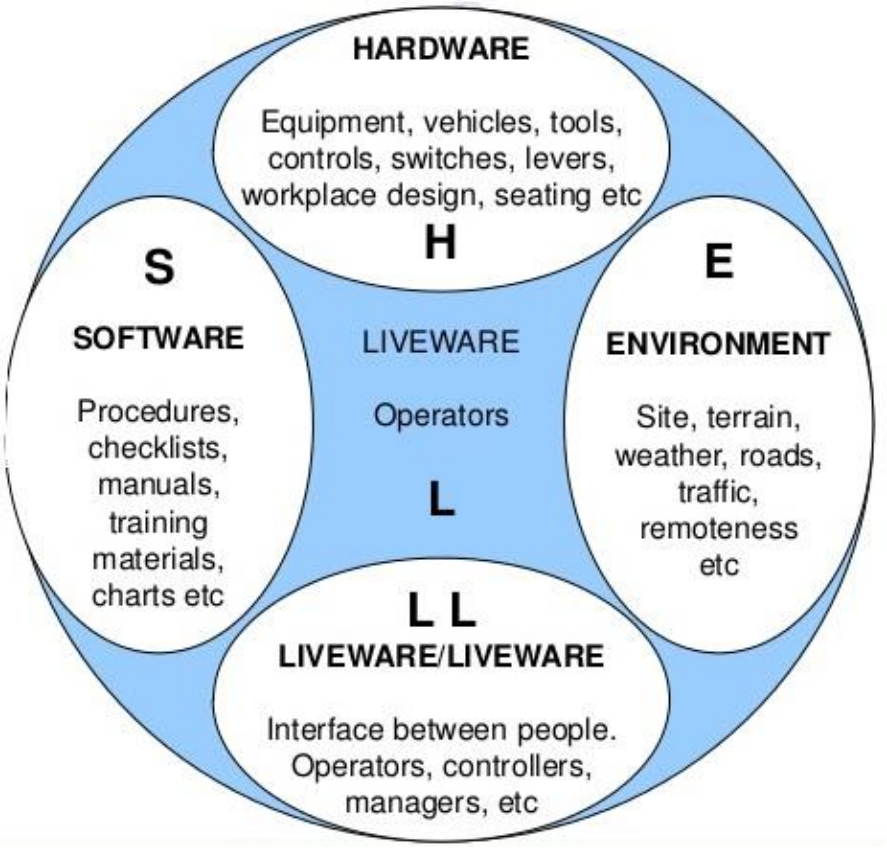
S indicates the software – the procedures and rules which have to be followed, checklists, symbology, etc.

H is the hardware – the aircraft, its systems and equipment

E is the environment in which the man/machine system operates

L is the liveware – the crew who operate the aircraft and interact with other personnel.

L sits at the center of the SHEL, because the liveware interfaces with all the other components.



Just as the aircraft structure, system and software have structural and performance limitations, so the individual who makes up the liveware is subject to limitations of human performance. Some of these limitations will vary from day to day and between individuals, whereas other absolute limitations vary little between different people.

Flying an aircraft is a psycho-motor skill which can be learned by applying theoretical knowledge during practical training. This comes more easily to an individual who possesses some basic aptitude, but constant reinforcement of the acquired psycho-motor skills is necessary throughout a lying career to maintain competence in the flying environment.

The pilot has a duty of care to other crew members, passengers, other users of the airspace and to the general public. It is a legal requirement for the pilot to be FIT TO FLY, whether flying professionally or for pleasure as a private operation. Fitness is a complex interrelationship between physiological, psychological and emotional aspects of well-being.

It is important to remember that flight safety involves all those participating in aviation activity including management, the providers of support services such as meteorological forecasting and flight planning, engineers and the regulatory authorities, not just the pilot. There must be an understanding of the potential conflict between resource availability, commercial considerations and the need to get the job done.

Thus it is essential for all those involved in aviation to be AWARE of human performance and limitations and how these may influence competence and flight safety. This requires an understanding of basic aviation physiology, health maintenance and basic aviation psychology.

There is a one question that need to be asked by pilots, how becoming a competent pilot? Not just a person who follows require checklists to get the job done! (Good enough, is not good enough!)

The answer is, the traditional flight training philosophy is based on knowledge, skill and experience. The development of psycho-motor proficiency leads to good handling skills, and is achieved by constant practice following demonstration by the instructor of the appropriate aircraft handling technique.

However, the new concept of a human factors approach to flying training includes consideration of the following factors:

Attitude development, Stress management, Risk management, Flight deck management, Crew co-ordination and psycho-motor skills. This has the objective of reducing human error by creating awareness of judgment and decision making, and the development of professionalism.

Assessment of competency must take account of all these factors. Professionalism suggests the involvement of learning or science, with and understanding of broad issues and implications. Proficiency, on the other hand, implies expert dexterity in doing a task, but without consideration of the wider issues.

Accident statics is quite considering in aviation. Travel by air is a safe means of transport, a one in a million risk of being killed or seriously injured requires five hours travel by air, compared with five minutes travel on a bicycle or 30 minutes in a car or on foot (UK 1994 statics).

Prior to 1960, the annual accident rate for scheduled air carriers was something over 60 per million departures. In the ten years to 1970, this rate improved dramatically to about one or two per million departures. Between 1980 and 1996, there were 621 global fatal accidents to jet and turboprop aeroplanes weighing more than 5,700 kg, resulting in 16,849 fatalities (source UK CAA CAP681). The fatal accident rate for all north American and European operators during this period was 0.37 and 0.52 per million departures respectively, with JAA full member operators achieving 0.35 per million.

As a result of the increase in world air traffic, annual number of fatal accidents increased globally by 32% during the period 1980-1996. If this growth in fatal accidents were to continue, by the year 2010 it is

predicted there would be an annual average of 44 fatal accidents, almost one per week! Assuming the same accident rate per million departures. However, over the period 1990-1996 the trend was decreasing.

Half of these 621 fatal accidents occurred during the approach and landing phases of flight, and in 41% of fatal accidents the most frequently identified causal factor was 'Lack of position awareness in the air'. The most frequently identified consequences were 'Collision with terrain/water/obstacle' and 'controlled flight into terrain' , followed by 'Loss of control on flight'.

Nearly 40% of all these fatal accidents involved aeroplanes which had not been fitted with currently available safety equipment, such as a ground proximity warning system (GPWS) or enhanced GPWS. In 88%, crew members were identified as a contributory causal factor, with 76% identifying crew as a primary causal factor. Only 11% of these fatal accidents to aeroplanes above 5,700kg involved an aircraft primary causal factor.

In non-scheduled general aviation, the statics are quoted as a fatal accident rate per 100,000 flying hours. For UK registered aeroplanes of 5,700kg and below, during the ten years prior to 1998, the average rate was 1.5, representing an average of twelve fatal light aeroplane accidents per year. The main causes, accounting for 86% of fatal accidents, were:

-Continued flight into bad weather, including impact with high ground and loss of control in instrument meteorological conditions (IMC)
-Loss of control in visual meteorological condition (VMC), including stalling/spinning
-mid-air collision
-over running short runway
-collision with ground obstacles during approach to land
-fuel exhaustion
-impaired pilot performance due to alcohol or drugs.

Monitoring accident statics allows trends to be identified, which can lead to changes in training and regulatory requirements.

There is an another important concept called ***Flight safety***. Improvements in technology, manufacturing standards, maintenance, operational procedures and training are responsible for much of the improvement in the accident rate since 1960. In the last 20 years, the proportion of accidents ascribed to human error has remained constant in excess of 70%. However, it should be noted that human error does not imply pilot error. Equally, flight crew error cited as a causative factor should be often more properly viewed as the flight crew's inability to break the chain of events leading to the accident. Nonetheless, there has been a human failing at some stage.

Human error will occur, no matter how good the training nor how competent the individual. The designers of aircraft systems and those who develop operational procedures have to allow for this basic human limitation, and build in fail-safety. Trainers have to ensure that crew members understand the importance of monitoring their own actions and those of the rest of the crew, and to have the confidence to give and accept challenges. This underlies the principles of crew resource management (CRM); it is important to realize that these principles apply equally to the pilot of a small light aircraft such as Cessna 172 or as much as to the crew of a large passenger jet airliner like B747.

The goal of most airliners is to achieve a profit from the safe carriage of passengers and/or cargo to and from destinations around the world. All the humans involved in this activity have needs, and for the passengers to arrive safely and punctually at their destination with their baggage, the airline must provide a serviceable and correctly equipped aircraft. This can be achieved only by having an efficient infra-structure in place, which meets the human needs of the airline employees and so contributes to flight safety. The same argument relating human needs to flight safety applies equally to air traffic control, engineering and all other support services. Everyone within the aviation industry contributes to flight.