INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES
HRMARS MANAGEMENT ACADEMIC RESEARCH SOCIETY EXPLORING INTELLECTUAL CAPITAL
www.hrmars.com
ISSN: 2222-6990

Concept Paper: Kaizen Principles in Aerospace Education

Zairil A. Zaludin & Kamariah Derasol

To Link this Article: http://dx.doi.org/10.6007/IJARBSS/v9-i2/5639 DOI: 10.6007/IJARBSS/v9-i2/5639

Received: *09 Feb 2019,* ***Revised:*** *23 Feb 2019,* ***Accepted:*** *04 March 2019*

Published Online: 17 March 2019

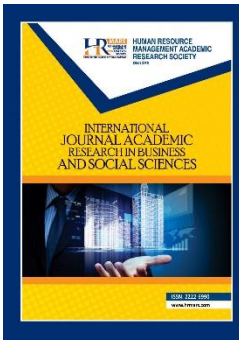
In-Text Citation: (Zaludin & Derasol, 2019)

To Cite this Article: Zaludin, Z. A., & Derasol, K. (2019). Concept Paper: Kaizen Principles in Aerospace Education. *International Journal of Academic Research in Business and Social Sciences*, *9*(2), 910–918.

Vol. 9, No. 2, 2019, Pg. 910 - 918

http://hrmars.com/index.php/pages/detail/IJARBSS | **JOURNAL HOMEPAGE**

Full Terms & Conditions of access and use can be found at
http://hrmars.com/index.php/pages/detail/publication-ethics


INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES
HRMARS MANAGEMENT ACADEMIC RESEARCH SOCIETY EXPLORING INTELLECTUAL CAPITAL
www.hrmars.com
ISSN: 2222-6990

Concept Paper: Kaizen Principles in Aerospace Education

Zairil A. Zaludin
Department of Aerospace, Faculty of Engineering, Universiti Putra Malaysia, Serdang, Selangor, Malaysia

Kamariah Derasol
Counseling Division, Universiti Putra Malaysia, Serdang, Selangor, Malaysia

Abstract
Educating students in Aerospace Engineering courses requires expensive equipment and highly trained professionals. A lot of the equipment and personnel are also used by the same aerospace industry to test and manufacture aerospace vehicles. This is a normal practice in established international universities such as those in the UK and the USA. The positive side of such practice is that it ensures that the graduates are 'industry-ready' by the time they graduate. But as time goes by, the cost of purchasing and maintaining the equipment and professionals become extremely expensive. Unlike profit making aerospace industry, Malaysian universities offering these courses are not aggressive by nature to generate their own income to sustain the use of the equipment and personnel. In most cases, universities struggle to maintain the equipment after purchase, and over time students' education are affected resulting in a terrible lost in education quality and university integrity. KAIZEN principles would be a good model to use to assist in breaking such 'pattern'. In this paper a small-scale test has been conducted using one of the most challenging course subjects offered to Aerospace students. The flight-testing laboratory course is part of the 4-year Bachelor in Aerospace Engineering course in UPM. The EAS 3924 Aviation Laboratory for Agriculture Application was used to demonstrate how KAIZEN principles have helped produced great results and played a pivotal role to break a deadlock and helped to keep the standard of aerospace education high as promised to students. The laboratory required the use of an aircraft to fly safely but the appropriate equipment was not available to students due to cost and aircraft availability. Using KAIZEN principles, it was not only feasible to run the laboratory successfully but the entire Aerospace Engineering course could now be run leaner and efficiently with the potential to supersede the course and program objectives manifold. It is possible to make aerospace engineering students receive quality aerospace engineering education whilst the university keep the cost of operation down and in the case of EAS 3924, that cost was virtually zero.

Keywords: Aerospace Education, Flight Testing, Flying Laboratory, Kaizen Aerospace, Aviation Lab

INTRODUCTION

Kaizen principles are commonly understood to carry the meaning “continuous improvement”. One would agree that the principles are encouraging society to 'grow' from where they are after they start their journey to accomplish some goals. Regardless of the state they are in as the journey continues, they are encouraged to face the inevitable problems objectively and solve those problems creatively, and proceed to grow and aim to continue to improve even further after that. This eliminates the wasteful exercise of giving up, or blaming one another for mistakes, which will only cause more waste, and not necessarily solve the main problems in the end. Such mature 'attitude' to move on and prosper in manufacturing is crucially important for obvious reasons and has been demonstrated many times to produce positive improvements in every sense of the word. In Aerospace industry, this has been documented well in Ref (1), (2) and (3). Aerospace industry is one of the most aggressive and lucrative, coated with many rules, regulations and standards in an effort to create very small, if not, zero margin for error. Such is the nature of the industry which builds extremely reliable aircraft, missiles, satellites and rockets that costs billions of dollars. KAIZEN principles have been shown to help Aerospace industry prosper. If Kaizen has been used to help the industry, the same philosophy should also be implemented in Aerospace education, in an effort to produce similar sort of quality products and service. The application of KAIZEN principles in institution of higher learning has been documented and studied as documented in Ref (4), (5) and (6). But such work in Aerospace education in universities has not yet been seen. This paper illustrates what happened if such principles are adopted well in an Aerospace education. The results showed that not only the institution of higher learning got out of an unsolvable problem, the cost of the solution was extremely lean. In fact, many positive outcomes came out from the results of KAIZEN solutions that new relationships, projects, and collaborations has happened since the success of the project. This fresh positive energy has benefited the staff and students. This is optimization we didn't previously expect nor anticipated.

PURPOSE AND PROBLEM STATEMENT

EAS 3924 Aviation Laboratory for Agriculture Application was a compulsory laboratory for the 4th year students in the UPM undergraduate Bachelor of Aerospace Engineering program. In essence, the course aimed to be similar to that offered by Cranfield University in the UK. In Cranfield University, a Jetstream 31 aircraft was used which had been fitted with additional sensors and instrumentation for their flight testing courses. In UPM, the aircraft purchased by the university was a Cirrus SR20, a low-wing light sports aircraft with a registered tail number 9M-KAA [Figure 1]. By 2016, it was discovered that a few batches of students had completely stopped flying because the aircraft had been grounded for some time due to heavy financial problems and suffering from a list of technical issues.

FIGURE 1: 9M-KAA

An immediate solution as replacement to this problem was to use the purchased Flight Simulator equipment. It was also discovered in 2016 that the flight simulator was neither operational nor commissioned completely during delivery as shown in Figure 2. It was a bad blow to the students (paid customers) who had looked forward to such adventure in their Aerospace education, most of whom had waited 4 years for it, with no such promise delivered in the end.

FIGURE 2: Unusual Flight Simulator

The purpose of this paper is to propose a solution that breaks a deadlock when faced with a situation like this due to the high cost of operating aerospace equipment and the fees associated to hiring qualified professionals to operate them during teaching Aerospace Engineering Degree program, without compromising quality or integrity. The test subject chosen to test the effectiveness of implementing KAIZEN principles was therefore, this course subject EAS 3924. The study looked into the effectiveness of implementing fundamental KAIZEN principles to break the deadlock and prosper.

PROJECT DESCRIPTION

Using fundamental KAIZEN principles, the aim of this project was to solve the problem of running an Aerospace Engineering Degree program when faced with a challenge of escalating cost of equipment and personnel without compromising university integrity and possibly improve Aerospace Education holistically. Since the subject EAS 3924 had this problem, it was a perfect candidate to be used as test subject. The project had 3 objectives:

1) Allow all students to experience the process of flight testing in *a proper flight testing environment* with *the right personnel and facilities* as per or beyond the EAS 3924 subject

syllabus as well as per mandatory Bachelor of Aerospace Engineering course accreditation requirement.

2) Students must experience flight, motion of aircraft during flight testing, able to record air data during flight testing and able to analyze those data on the ground as per course requirement.
3) Students must be able to present their findings after the flight testing was complete in the same manner as how actual Flight Test Engineers in an established aerospace company would present, to demonstrate their competency to do the job properly.

The project was also interested to observe if any other positive benefits could be achieved beyond these objectives that might benefit the society and community as a whole.

METHODOLOGY

The problem was detected in 2016. In 2017 effort began to take shape to create the best possible solution to allow flight testing course to be conducted properly for the students in the Department of Aerospace, UPM. The 2 most fundamental Kaizen principles were used: 1) Continuous Improvement and 2) Eliminate Waste.

The main problem was the in-availability of airworthy 9M-KAA Cirrus SR20 UPM aircraft for students to use. The aircraft also had to have certified pilot and ground crew before it could fly safely which the university also did not have. The cost to make the aircraft airworthy and hire the crew was too high.

In the spirit of "continuous improvement", the obvious first solution was to find a suitable airworthy aircraft and certified pilots and ground crew to operate them. With no budget allocated for this activity, the second principle of KAIZEN was used - which was to keep it LEAN and eliminate waste. It was a perfect opportunity to use 'creativity' on how to still complete this goal *without* purchasing a new aircraft (and create even more waste) or money to hire professionals to operate the machine. Using only integrity and wits, these objectives must be accomplished.

There was abundance of support from both local and international aerospace industry if one knew how to ask. As the staff of the Aerospace course should have significant Aerospace background and should be associated with the Aerospace industry, it was only natural for members of staff to seek assistance from each other *including from the industry* 'in a human way'. 'Humanizing' was also the KAIZEN way. Even in Aerospace Education 'humanizing' was clearly valid and as shown later, proven to work so well. The solution to the EAS 3924 problem was found by simply asking a local flying club, the Air Adventure Flying Club which was based in Subang Airport, to assist and support the Department of Aerospace UPM in delivering the flight testing portion of the EAS 3924 course subject. All it took, was 'ask'. The benefit of using the flying club facilities and personnel was obvious. They had 3 airworthy aircraft (Cessna 172), they operated the aircraft on daily basis and they already had certified pilots and ground crews working every day. It was what they did every day - something an institution of higher learning could not do well due to lack of experience, budget and professional crew, not to mention beyond their scope of business.

It is important to mention that although the flight testing was conducted by the flying club, the course lecturer in UPM was still driving the lessons. Using the syllabus as guide, the lecturer only had to 'lead' both the flying club and the students what to do to accomplish the course objectives successfully. A properly trained aerospace lecturer should find the management of the flight testing course easy as the course should have been in their training too at some point in their aerospace education life.

RESULTS

By simply applying the 2 fundamental Kaizen principles, the costly problems of running the EAS 3924 course subject was solved. Students essentially completed the course subject successfully and other positive outcomes resulted too. Shown next are other successful accomplishments that came out from this exercise:

1) Free membership for all participating students in 2017 worth RM180,000.00 from Air Adventure Flying Club. This membership allowed the Aerospace students to enter the club's hangar and interact with other facilities in Subang Airport.

2) Full access to 3, Cessna 172 light aircraft, owned by the Air Adventure Flying Club for all Aerospace students. Other light aircraft, private jets and aerobatic planes belonging to other owners, companies and organizations in Subang Airport were also available for students to interact with because the Air Adventure Flying Club knew all of them and introduced the students to them (instant networking with real aviators and aerospace companies).

3) All students received comprehensive briefing and lessons from pilots and ground crew in the Air Adventure Flying Club. Students were brought together in small groups to interact with the club's aviators, planes, cockpits, aircraft engine and so on. Students were however, constantly reminded to focus on flight testing an aircraft as the course subject but these interactions were equally important for flight testing purposes.

4) Aerospace students received access to the Department of Meteorology, Selangor in Subang Airport and comprehensive briefing by their professional personnel. The students were shown how weather measuring instruments were used, some of which were rarely seen by the public. The results produced by the equipment were used to create weather reports and prediction which were transmitted in real-time to pilots world-wide.

5) Aerospace students also saw a demonstration and briefing by the Airport Fire and Rescue Services (AFRS) under the Malaysian Airport Berhad (MAB) on handling emergencies in airports especially during flight testing. The Fire Services crew demonstrated the use of their fire engine in the event of major accident during flight testing.

6) Aerospace students had a special access to visit the Air Traffic Control (ATC) Tower in Subang Airport where air traffic controllers showed how they controlled Subang Airport airspace and ground movements at all times including during flight testing.

7) Air Adventure Flying Club sponsored 1 flight for 3 lucky Aerospace students. They had to perform aerial flight testing using similar flight test instructions used to test aircraft such as the Airbus A380 and Boeing 777. Other students who did not fly acted as ground flight test engineers supporting the 3 students at all times. This was the same arrangement in the Aerospace industry.

8) 'The Star', a mainstream Malaysian daily newspaper, learned about this collaboration effort between the Department of Aerospace, UPM and the Air Adventure Flying Club and published a 3-page Cover-Story article in the newspaper [7].

FUTURE POTENTIALS IN APPLYING KAIZEN IN AEROSPACE EDUCATION

Many other similar cost cutting exercises could be done for other laboratories and lectures in the aerospace education simply by working together closely with the current aerospace industry. This has the positive benefit to narrow down the gap even more between the aerospace education sector and the aerospace industry. 'Humanizing' healthy aerospace co-operation between academia and companies, for the benefit of producing quality aerospace students, should be a culture in Malaysian Aerospace ecosystem. Using KAIZEN principles as guide, this vision may be possible to achieve in the quickest time.

CONCLUSIONS

The work documented here has shown how using KAIZEN fundamental principles have helped to break the deadlock for one of the most popular aerospace course subject in the Bachelor of Aerospace Engineering course. Simply practicing the attitude of 'continuous improvement' and 'eliminate waste', by being honest and transparent about the problem, and genuinely sincere to find the best solution to the problem and move on, the Aerospace students received their education satisfactorily, amazing professional relationships were established and the university integrity remained intact.

REFERENCES

Haque, B. (2003). Lean Engineering in the Aerospace Industry, *Proceedings of Institute of Mechanical Engineers, Part B: Journal of Engineering Manufacture*, 217(10), 1409 - 1420.

Forman, C. R., & Vargas, D.H. (1999). Affecting the value chain through supplier kaizen, *Hospital Materiel Management Quarterly*, 20(3), 21-27.

Mathaisel, D. F. X. (2005). A lean architecture for transforming the aerospace maintenance, repair and overhaul (MRO) enterprise, *International Journal of Productivity and Performance Management*, 54(8), 623–644.

Kregel, I. (2017). Applying Kaizen to University Teaching Through Weekly Course Evaluation, 4th International Conference On Lean Six Sigma for Higher Education, Purdue University, 25-26 May 2017. Edinburgh, UK: Heriot-Watt University School of Social Sciences.

Emiliani, M.L. (2005). Using Kaizen to Improve Graduate Business School Degree Programs, *Quality Assurance in Education*, 13(1), 37 - 52.

Awi, A. (2016). *The Effect of Lean Kaizen Application on Student's Satisfaction in Malaysian Higher Education Sector* (Doctoral dissertation). Retrieved from

https://curve.coventry.ac.uk/open/file/abd4114f-c873-4208-bbc2-78f69ad03e8f/1/Thesis%20Nur%20Aishah%20Awi%20%284651170%29_Redacted.pdf

Menon, S. (2017, Dec 17). More to Designing Plane - Putting Knowledge into Practice, *The Star Newspaper (Star Educate Section)*, p. 1, 6, 7.