

The Use of Eight Aspects of Ergonomics as a Holistic Tool to Evaluate Performance of an Enterprise Properly

(A Case Study at ATC of Ngurah Rai Airport)

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Abstract

The role of Air Traffic Control (ATC) of Ngurah Rai airport of Bali is very important for the sake of continuity of air transport to and from Bali as an International airport.

In order to give a maximal service for the importance of fluent and safe flight, besides technological equipments which have been available (or will be available), employee factor and working environment are very decisive. When workloads (because of tasks and environmental factor) are well-balanced with work capacity (capacity, capability and limitation) of employees, working can be gone on well, but the reality in field shows a contra situation.

Eight aspects of ergonomics is a holistic tool to evaluate performance of an enterprise properly. By using the aspects at ATC of Ngurah Rai Airport in direct observation, it shows that there are still some conditions which are not or less ergonomic. The root of problems of the tendency encountered is that there is not ergonomic awareness to employees and to leaders yet. The fact causes there is no commitment of management against ergonomics works.

The very probable solution is necessary to be an effort to campaign ergonomics in PT Angkasa Pura involving all of elements include also decision makers. When ergonomics awareness emerges in the enterprise then the commitment against the implementations of ergonomics programs will continue to be performed by supporting of all elements from employees to the management. Only by doing so then ergonomics can be actually and continually applied at ATC in Ngurah Rai airport of Bali. This paper aimed to discuss the eight aspects of ergonomics as a holistic tool to evaluate performance of an enterprise properly by using the method of references study and completed by direct observation.

Keywords: eight aspects of ergonomics, to evaluate, ergonomics awareness.

1. Introduction

Air traffic control (ATC) is one of principal tasks of an airport as Ngurah Rai in Denpasar Bali. It is usually that the parts of ATC consists of: flight information control, aerodrome control & ground control (tower), area control centre (ACC) and provision of approach control (APP). The tasks of an operator in every part are very heavy and difficult because workings that performed are very complex and need a mental and physical stability.

Actually, although tasks and works encountered are difficult and complex, but when those are suitable with capacity, capability, and limitation of human then all can be accomplished in a good way. The problems usually emerge when there is no accord between work capacity and workload, in other word workload exceeds work capacity (Manuaba, 2005; Hofmann, 2006; DiDomenico, 2003). The branch of science which care against the accord between work capacity and workload is ergonomics. Therefore, the situation of works at ATC of Ngurah Rai airport Denpasar Bali can be proportionally understood base on definition of ergonomics. In Manuaba (1996) expressed that **Ergonomics** is a science, technology and art to suit instrument, way of work, and environment on capacity, capability, and limitation of human so that it can be found working condition and environment that is healthy, safe, comfortable and efficient and on the last can be found high productivity.

In order to evaluate application of ergonomics principles at ATC of Ngurah Rai airport, it has been done the direct visit on May 20 2006. The evaluation was done by using eight aspects of ergonomics as a holistic tool comparing the reality with hoped condition based on ergonomics principles and lastly formulated probable solutions that can be performed.

2. Discussion

2.1 Definition, Goal and Benefit of Ergonomics

In order to evaluate properly and proportionally about the reality of works situation occurred at ATC of Ngurah Ray Airport in Bali, then it has to start with definition, goal and benefit of ergonomics as expressed by Manuaba (1996), Manuaba (1999a and 1999b, Manuaba (2001), Manuaba (2003a), dan Pheasant, 1991) that can be described as follow.

Definition of Ergonomics. Ergonomics is science, technology and art to suit instruments, ways of work, and environment on capacity, capability, and limitation so that it is found working condition and environment that is healthy, safe and comfortable and on the last high productivity can be reached (Manuaba, 1996; Pheasant, 1991).

Goal of Ergonomics. The goal of ergonomics is to increase: (a) human physical and mental welfare by preventing injuries and working illness, reducing physical and mental workload and also promoting results and satisfaction of working; (b) social welfare in the form of increasing of social contact quality, and also management/organizing of working; (c) rational balance among technical,

economical, anthropological and cultural aspects of man-machine system, and also efficiency of system.

Benefit of Ergonomics. As ergonomics applied it can be found some benefits to employees, management and enterprise and also government by means of: working finished quickly, reducing of accident risk, man-day/hours is not come to nothing, working illness risk is small, increasing of strong desire and satisfaction of working, unforeseen cost can be pressed, absence of working is low, reducing of fatigue, boredom is avoided, feeling of illness is reduced or nothing, and so on. The application of ergonomics is profitable to all

Based on definition, goal and benefit of ergonomics as explained above, there is a clear reference in performing evaluation of working situation at ATC. Manuaba (2003a) dan Manuaba (1992) have given eight aspects of ergonomics as a tool by which the evaluation can be performed totally, and it has been based on definition, goal, and benefit of ergonomics. The eight aspects are (1) energy (nutrient), (2) using of muscle power, (3) posture when working, (4) condition of environment, (5) condition related to time, (6) condition of social, (7) condition of information, and (8) interaction of man-machine.

2.1 Reality of Working Situation at ATC and Probable Solution

By using eight aspects of ergonomics as a tool, performed an evaluation how far the reality of working situation at ATC of Ngurah Rai airport Denpasar Bali follow ergonomic principles. Table 1 gives the results of evaluation performed by direct visit. Based on result of analysis in Table 1, it can be seen that there are some aspects in the reality of working situation at ATC of Ngurah Rai airport Denpasar Bali that is not yet to fit with ergonomics criterion, or is not ergonomics.

Surely, from ergonomics side, in order to solve problems identified, the actual root of problems must be looked for. Usually, what which appears as problem is truly a phenomenon. We must look for why can the phenomenon occurred, and what is the cause.

As the identified problems at ATC are watched carefully (Table 1) it can be seen that the root problems are:

1. There are not yet *ergonomic awareness* that adequate on employees (operators) of ATC, included its management. As ergonomics awareness has emerged (Anonim, 2006c), surely that it will be personal initiatives of employees to reduce risk factors that adverse them. For example it will be initiative to use own jacket because of cooler room, and so on.
2. There are not yet commitments of management (leaders) against working situation that are truly ergonomic. The results of interview with a unit leader, it is found that they cannot perform a lot to improve upon situations that is no ergonomic because all of tasks and activities have decided from above level. They just perform those decides.

Tabel 1. The results of evaluation based on assessing by using eight aspects of ergonomics. The evaluation performed by comparing the hoped conditions with the reality of working situation at ATC of Ngurah Rai Airport Denpasar Bali, and also probable solutions that can be implemented in ergonomic programs.

No.	Ergonomics Aspects	Hoped Conditions	Current Reality	Proposed Solutions
1	2	3	4	5
1	Energy (Nutrient)	<p>Nutrient must be well-balanced.</p> <p>Frequency of eating (<i>break</i>) must be proportional.</p>	<p>There are fatigue complains on operators especially to they that get night shift.</p>	<p>There are necessary commitments of management (leaders).</p> <p>It is necessary an understanding of all employees (operators) of ATC about importance of nutrient.</p> <p>There are necessary fold beds in rest rooms on the time not working, and make available <i>refreshment</i> and <i>food supplement</i> to keep condition so that the body is fit constantly during working (Tarwaka, dkk., 2004)</p>
2	Utilizing of Muscle Power	<p>In Performing activities in room of ATC, there are not compulsions out of muscles ability. Instruments must be arranged in such a manner so that motions of muscles are not contradictive with natural motions of muscles.</p> <p>Muscles must be utilized optimally or return to natural motions of muscles.</p> <p>Age must be paid attention in distributing tasks and jobs.</p>	<p>There are still compulsion postures (to reach) in pressing knobs of control in workstation (Figure 1).</p> <p>In workstation, Monitor located in area with the angle of seeing of eyes that is larger (Figures 1 and 2).</p> <p>Position of proponent instruments (cable, instrument of control etc.) are not in order (<i>unsafe condition</i>). Figure 3.</p>	<p>There are necessary commitments of managements (leaders) and employees.</p> <p>It is necessary an understanding of all employees (operators) of ATC about importance of utilizing of muscles power that suitable to limit of ability.</p>

1	2	3	4	5
3	Posture of working	It is preferable that there are no wrong or not natural body postures or compulsion postures in working.	There are no considerations about anthropometry of user on instruments and other devices. (Figure 4) .	There are necessary commitments of managements (leaders) and employees. It is necessary an understanding of all employees (operators) of ATC about importance of working posture which suitable and arrangement of workstation that is suitable with anthropometry.
4	Condition of environment	Conditions of environment consist of: temperature, humidity, illumination, chemical substances, dusts, noise, vibration, wind, and colors must be comfortable and suitable. It must be self protection equipments to suit with working environment.	There is no enough illumination in surrounding of operators working rooms especially in writing and reading data of traffic of airplane (Figure 5) , although on monitor it self operator can select to organized contrast and brightness of screen in order that it is not dazzled (glare). The temperature of room is regulated to suit with the need of instruments/devices of computer (cool enough), but for operators wearing ordinary official suit it is coolest (not using protective cloth, jacket). According to unit leader, actually the location of ATC must far enough from crowd and traffic of people for the shake of safety.	There are necessary commitments of managements (leaders) and employees. It is necessary an understanding of all employees (operators) of ATC about importance of arrangement of working environment so that it is comfortable in working.

1	2	3	4	5
5	Condition of time	It is preferable that there are arrangements of optimal working time in one day, there are schedule for rest includes rest to eat.	There are complains of operators about sift of working and rest especially to they that get night shift.	<p>There are necessary commitments of managements (leaders) and employees.</p> <p>It is necessary an understanding of all employees (operators) of ATC about importance of considering of time condition in performing of working activities.</p>
6	Social condition	It is self-regard, motivation, and working satisfaction. Cause to be effective <i>reward</i> and <i>punishment</i> regularly. It is organizational management supporting against rule of <i>reward</i> and <i>punishment</i> .	Data of Reward and punishment are not found, but generally like in other government institutions those are not yet applied in the same manner as those should be.	<p>There are necessary commitments of managements (leaders) and employees.</p> <p>It is necessary an understanding of all employees (operators) of ATC about importance of considering of social condition in every activity.</p>
7	Condition of information	<p>There are well two ways communications among components of organizational framer. There are empathies by appreciating and respecting one another in making communication.</p> <p>Utilized information media are with proper manner and displays used are suitable with rules and regulations.</p>	There are still weaknesses in utilization of media, especially in case displays that there are not yet suitable with rules and regulations, when operators interact with instruments. According to some operators especially for climatic information (from BMG), there are frequently disturbance because of interactions with radio and television waves.	<p>There are necessary commitments of managements (leaders) and employees.</p> <p>It is necessary an understanding of all employees (operators) of ATC about importance of considering of information condition in every activity.</p>

1	2	3	4	5
8	Man-Machine Interaction	<p>In every instrument and device, display and control must be compatible. In automation problem, load allocation between man and machine must be actually performed in fair and wise manner.</p> <p>The physical and mental vitality of people must be kept and developed so that they ability to perform tasks.</p>	<p>There is arrangement of instruments whose control knobs far from reaching of operators so that there are compulsion postures. There are monitors (displays), which located far from seeing of operator.</p>	<p>There are necessary commitments of managements (leaders) and employees.</p> <p>It is necessary an understanding of all employees (operators) of ATC about importance of considering of ergonomic man-machine interaction in all instruments used.</p>

The solution that can be performed to emerge ergonomics awareness to employees and management (leaders) are necessary to be seminary and workshop aimed to champagne ergonomics awareness institutionally by bring everyone include decision maker to take part. The method like this can be used widely because it has been proved success at several places like (Manuaba, 2003b; Manuaba, 2004) in Total Balikpapan, Bali and in Udayana University. As ergonomics awareness emerges on employees and principally on management (leaders) then it can be hoped that ergonomic programs can be applied continually at ATC of Ngurah Ray airport of Denpasar Bali (Anonim, 2006a; Anonim 2006b). According to Marras dan Allread (2004) it will be sustainable ergonomics processes by involving everyone connected to take part. Only by doing so, all of problems that seem as phenomenon like results analysis in Table 1 can be overcome or minimized.

3. Conclusion

By discussion this paper, it can be taken some conclusions as follow:

1. Based on tool of eight aspects of ergonomics it was evaluated that at ATC of Ngurah Rai airport Denpasar Bali are still working situations that are not yet ergonomic or are less ergonomics.
2. The root of problems encountered at ATC of Ngurah Rai airport Denpasar Bali is there is not yet ergonomics awareness on employees (workers or operators) principally on management (leaders), so that there are not commitments against the implementation of ergonomics programs continually.
3. The probable solutions to overcome problems encountered at ATC of Ngurah Ray Airport Denpasar Bali are by performing seminary and workshop in order to champagne ergonomics awareness. These efforts can be performed by involving every element connected to take part included decisions makers (management and leaders) of PT Angkasa Pura. It is hoped that these efforts can emerge ergonomics awareness and commitment against ergonomics processes by implementing ergonomic programs continually at ATC.

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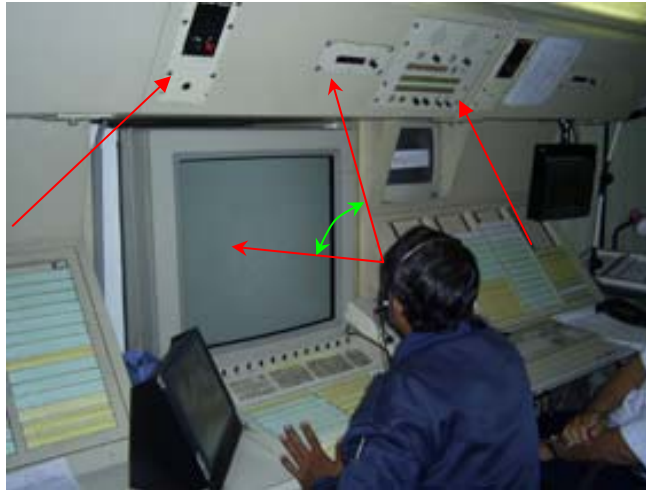


Figure 1. Knobs located far from reaching causes duress postures.



Figure 2. Knobs and switches located far from reaching causes duress postures and angle of seeing that is very large.



Figure 3. Location of devices (cables, control instruments etc.) is not yet in order.



Figure 4. Chairs used by operators have the height 66-49 cm from the floor. Because the height of range of feet motion is only 63 cm, so that chairs cannot enter below the desk. Backrest cannot be used.

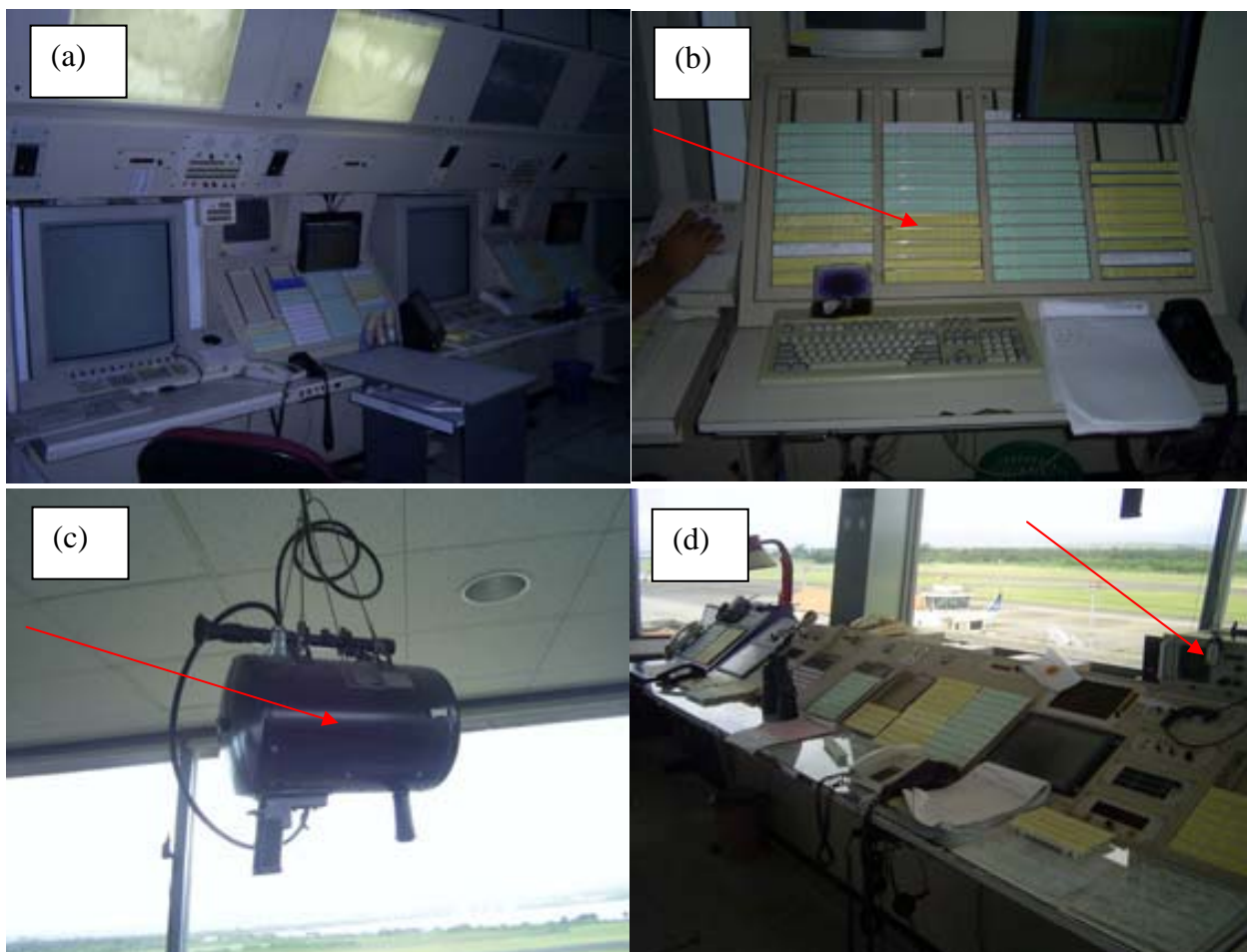


Figure 5. (a) Illumination is not enough especially when reading and writing data of airplanes traffic (b). There are instruments that their placements (according to interview with operators) block the viewing (c) include the viewing to airplanes in place of landing.