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The Measurement of Human reliability When do Typing
Bahasa Indonesia and English word on Simulation with THERP
(Technical Human Error Rate Prediction) Methods

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Human reliability was define as a probability that someone gets occasions on the right track in the proper time (if time should be one of the constraint). As on engineering pheriperal, operator or human being some times caused the accident or error in man – machine system.

Sometime conditions of Human being in all activity was ignore, so if any malfunctions happen, which resulted lowering productivity, sometime this situations was not called extraordinary conditions, but it's said 'just normally conditions'. Human being is got to be a center of many systems all over the world *(Human-Center design concept)*, because of man/human as a designer and manufacturer of the systems should interact with the system it self for controlling the system it self

Regarding the analysis of 'Performance Level that's relate with the accuratelly and speedly of the tipyng simulations' process through the THERP model approach, we find some errors, actually when the subject (operator) typed some word from magazine or news letter. Some errors were happened that's relate with many aspect of man-machine interactions (man-machine interface).

Some kind of errors that's happened on typing process on these simulation are; word errors , word-over, miss-word, miss-space, etc. all these errors resulted by many variables, there are; variable of time, Variable of physically/fisiological environment, etc.

Regarding to the calculation through *HEP (Human Error Probability)* and *HRA (Human Reliability Assessment)* we conclude that value of HRA is greater than HEP, that's way the subject (students) when they do typing on these simulation they were on full concentrated, although some errors was always happened

Key word: Ergonomic (Human - Machine Interface), THERP, HEP, HRA

Introduction

The term human reliability is defined as a probability or likelihood of someone properly conducting a system that required the activities in accordance with the given time period (if time is a limiting factor). As in engineering peripheral or a human operator plays an important role as a major cause of error in a man-machine system. This observation is not surprising because the operator actively in human-machine systems.

The human condition is often overlooked in doing the work so that if an error occurred that resulted in decreased productivity, is often considered something that happens fairly and considered a human negligence. Human is the core of all kinds of systems that surround us *(Human-center design)*, both because of the human role as creator of the system as well as man must always interact with the system in order to control the ongoing processes in the system. Human beings as workers must be placed on the first sequence in the design, which means humans as the center of attention. In this case the work equipment, workplaces or work environments must be adapted to humans

rather than vice versa (*Fit the task to the man rather than fit the man to the task*). Humans, which is one component of a working system with all its aspects, the nature and behavior is a complex creature. Many of the mistakes that occurred not solely because of inability or service personnel who operate the equipment, but rather equipment itself, which provides opportunities for *human error*. The main problem lies in the discontinuity between human and equipment so that it operates, working errors often arise which ultimately fatal.

Data Gathering
Physiological Environment
In this case the author would define two environments to be used in performing typing, among others (According Sritomo Wignjosoebroto):

1. Normal Environment
- Temperature: 20-25 degrees Celsius
- Noise: Quiet (30-40 decibels)
- The voice that sounded:
   a. People Conversation slowly
   b. The current *Winamp*
- Illumination: Adequate

1. Abnormal Environment
- Temperature: 27-30 degrees Celsius
- Noise: Medium (40-60 decibels)
- The voice that sounded:
   a. People are chatting
   b. Roads (Motorcycle, Cars)
   c. hard *Winamp*
- Illumination: Adequate

Data Typing
In this case the student or the precise object or a person trying to make typing text in Indonesian and English languages on two different physical environments.

Error Identification
Before performing data processing, we must first make the error identification, there are:

X_1: Error Letter
X_2: letter Pros
X_3: Deficiency letter
X_4: Composition of letters Reversed
X_5: Spacing and Punctuation Errors

Table 2.1 Time of completion in the typing

Level skills related to speed in doing typing.

Table 2.2 Data English text typist (Normal Environment)

The number of errors and total number of errors

sampel	bahasa inggris				bahasa indonesia				sampel	X1	X2	X3	X4	X5	jumlah
	lingk Normal		lingk Abnormal		lingk Normal		lingk abnormal								
	t(detik)	t(menit)	t(detik)	t(menit)	t(detik)	t(menit)	t(detik)	t(menit)	1	6	6	4	2	2	20
1	443	7.38	534	8.90	294	4.90	433	7.22	2	6	6	6	3	3	24
2	416	6.93	452	7.53	337	5.62	394	6.57	3	4	4	2	1	3	14
3	683	11.38	736	12.27	552	9.20	581	9.68	4	4	6	4	1	2	17
4	554	9.23	633	10.55	425	7.08	504	8.40	5	5	6	5	3	2	21
5	517	8.62	677	11.28	263	4.38	353	5.88	6	6	6	2	1	1	16
6	607	10.12	663	11.05	332	5.53	404	6.73	7	6	4	6	3	2	21
7	566	9.43	597	9.95	258	4.30	429	7.15	8	6	6	6	4	3	25
8	462	7.70	523	8.72	326	5.43	388	6.47	9	6	5	6	3	4	24
9	651	10.85	692	11.53	491	8.18	513	8.55	10	5	6	3	3	3	20
10	693	11.55	737	12.28	435	7.25	472	7.87							

Data processing steps

Step 1

Calculating the beta parameter

Example calculations for the English Text Typing in

Normal Environments

$$\beta = \frac{2 \cdot Nc}{N} = \frac{2 \cdot 6}{20} = \frac{12}{20} = 0.60$$

For the next result can be seen in the table 3.1:

Table 3.1 *Parameter Beta* Typing Text English (Normal environment)

sampel	X1	X2	X3	X4	X5
1	0.60	0.60	0.40	0.20	0.20
2	0.50	0.50	0.50	0.25	0.25
3	0.57	0.57	0.29	0.14	0.43
4	0.47	0.71	0.47	0.12	0.24
5	0.48	0.57	0.48	0.29	0.19
6	0.75	0.75	0.25	0.13	0.13
7	0.57	0.38	0.57	0.29	0.19
8	0.48	0.48	0.48	0.32	0.24
9	0.50	0.42	0.50	0.25	0.33
10	0.50	0.60	0.30	0.30	0.30

Step 2

Calculating the "weibull" distribution

Example calculations for the English Text Typing in Normal Environments

$$Zt = \alpha \cdot \beta \cdot t^{\beta-1} = 1 \cdot (0.60) \cdot (7.38^{0.60-1}) = 0.27$$

Step 3

Calculating probabilities

Probability value viewed of Zt value (weibull distribution), because the weibull distribution is normal distribution then value seen in the table of normal probabilities.

Step 4

Make a Diagram of trees:

In this tree diagram there are three variables such as time, environment passage and an error will be outlined below:

- **Time Variable**

Example calculations English text Typing

$$\sum waktu = \text{Normal Environment} + \text{Abnormal Environment}$$

$$\sum waktu = 93.20 + 104.07 = 197.27$$

$$Rata - rata = \frac{\sum waktu}{k} = \frac{197.27}{20} = 9.86$$

Thus in English typing is included in below the average of three samples include samples 1, 2, 8. Therefore the probability for the variable of time in typing English text is

$$Probabilitas = \frac{jumlah\ sampel\ yang\ dibawah\ rata-rata}{jumlah\ seluruh\ sampel} = \frac{3}{10} = 0.3$$

- **Error Variable**

The error variables are grouped according to variables of time and environment variables.

Step 5

Calculating Chi-Square

- Conclusion

At significance level $\alpha = 5\%$, Ho is accepted, meaning that samples in weibull distribution.

Tree Diagram

Here is the code used in the tree diagram:

BR: time of typing in the below-average

AR: time of typing in the above-average

KBR: typing errors in the below average
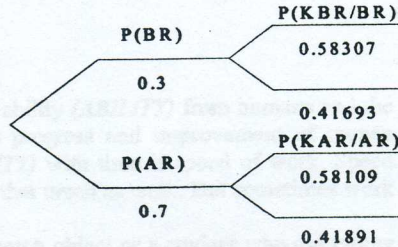
KAR: typing error in the above average

Figure 3.1 fault tree diagram for the letter (X1) in a normal environment

P(BR) 0.3

P(KBR/BR) 0.58307

0.41693

P(AR) 0.7

P(KAR/AR) 0.58109

0.41891

Step 6
Calculating the HEP and the HRA
- HEP and HRA

1. Normal Environment For Error Below Average

- HEP = P(BR).P(KBR/BR)
- HEP = (0.3).(0.58307) = 0.17492
- HRA = 1 – HEP
- HRA = 1 – 0.17492 = 0.82508

1. Normal Environment For Error Above Average

- HEP = P(AR). P(KAR/AR)
- HEP = (0.7).(0.58109) = 0.40767
- HRA = 1 – HEP
- HRA = 1 – 0.40767 = 0.59324

2. Abnormal environmental For Error Above Average

- HEP = P(BR).P(KBR/BR)
- HEP = (0.3).(0.58443) = 0.17533
- HRA = 1 – HEP
- HRA = 1 – 0.17533 = 0.82467

4. Normal Environment For Error Above Average

- HEP = P(AR).P(KAR/AR)
- HEP = (0.7).(0.58021) = 0.40615
- HRA = 1 – HEP
- HRA = 1 – 0.40615 = 0.59385

Analysis

Viewed from the graph above it can be seen that, in normal human physical work environment doing good typing English text as well as Indonesian capable of generating effectiveness and efficiency so that the maximum completion time is faster. In contrast in the abnormal physical work environment decrease the effectiveness and efficiency of less than optimal so that slower completion time. That's because the abnormal physical work environment will affect the psychology physiological functioning of the brain and nervous system that play a role in human behavior. Which means the point of interaction work in human-computer systems will be reduced. The reduction was caused by the interaction of work environment factors of the physical work that is less comfortable with the temperature and a high noise level makes the responsiveness is reduced.

Type of typing could also affect the fast or the length of time of completion. In this case showed that both normal working on the physical environment as well as abnormal physical work environment, there is a difference between the completion time of typing text in Bahasa Indonesia and English text typing. It is because of the student or object research is not accustomed to typing using English so that typing perceived ability to perform more slowly than do typing by using Bahasa Indonesia. Apart from external factors or the physical work environment, sooner or long completion time depends also on factors originating from within or *internal* i.e. the human ability to

do typing.

1. Effect of Time on Error

Here there are two points that determine the work ability *(ABILITY)* from humans and the other is that work motivation is a driving force towards progress and improvement of human productivity. The relationship between work ability *(ABILITY)* with time is speed of work. Speed work is a way to improve productivity by producing output that much as well.. But sometimes work too quickly would likely cause a lot of mistakes.

As seen in the chart above the majority of the research object or a student who did typing with a faster turnaround time also did a lot of errors compared with slower time resolution. This is because that the concentration at the time of typing is not focused on when doing typing but at the time resolution, but there are a few samples or a student with a faster turnaround time can produce a small error or less and vice versa with the students doing typing for a long time to produce an error quite a lot. This is related to human capabilities and levels of concentration.

2. Influence of the physical work environment to Total Error

The existence of the physical work environment that noise will adversely affect performance or morale or motivation of human labor.. The voices above the noise *decibel* threshold of human hearing is not just going to distract the student or the research object in doing typing, whereas in the human system required the engine high enough concentrations. From beginning students to absorb information that is typed text will be *visually* and try menginterprestasikannya (perception) thoroughly. Based on the interpretation made the communication to the machine that is using the computer screen and keyboard. Furthermore, the screen will provide a snapshot of the results of such interpretation. So that it can cause a lot of mistakes.

3. Variables Used

Variables used in the processing of these data, there are three variables, among others:
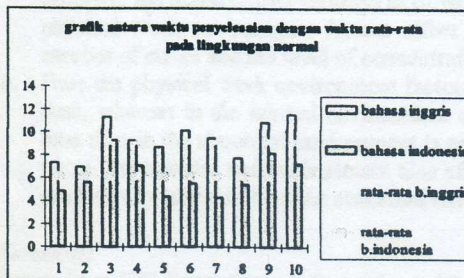
a. Variable of Time

Figure 4.1 graphs the comparison between the time of completion with the average time in a normal environment
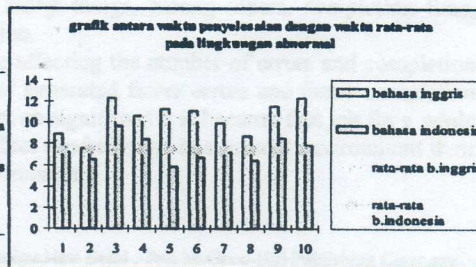
Figure 4.2 graphs the comparison between the time of completion with the average time on the abnormal environment

Based on the results of the graph can be seen that the time of completion in the Indonesian language text typing more above average compared to typing English text, it is because the human factor ie work ability *(ABILITY IN)* from the student.

b. the physical work environment variables

In the normal working of the physical environment of students or researchers object to act

211

fairly can be said, because no one interfere in work performance. While the physical work environment affects job performance abnormal students in the process of typing. Factors that influence the technical factors with the use and application of self-adjustment of adaptation required equipment first. Here abnormal physical work environment will also cause fatigue, exhaustion would occur i.e. visual fatigue, mental fatigue, tired muscles.

c. Variable Error

Based on the results of data collection can be seen the error that occurred in the process of typing the wrong letters, extra letters, short letters, reversed letters and composition of spaces and punctuation errors. The largest error in the process of typing the wrong letter and the excess letters. It was due to human factors and technical factors. These human factors associated with perception and concentration in the process of typing the resulting reflexes in the finger by pressing keys on the keyboard while the technical factor that is associated with the use and application equipment such as key placement, finger position and load your keystrokes.

5. HEP and HRA

Causal relationship between the *HRA* and *HEP* highly related to each other, if the *HRA* results is smaller than the *HEP* then when the workers are running the job, his concentration to work very little so a lot of mistakes and if the *HRA* results greater than the *HEP* then on when workers are running the job is to concentrate on their job done and very little chance of making errors.

Conclusion

a: From the results of calculation of *HEP* and *HRA* concludes that the value of *HRA* results show greater than *HEP*, so that it can be assumed that the students at the time of typing the text either Indonesian or English language is concentrating on his job in doing typing, and these errors were identified from quite a bit. This is because in typing text only takes a minute between 4-15 minutes so that the concentration level is still high, because the concentration will go down if it took long enough.

Factors that affect humans in doing the job of technical factors (equipment design) ie, each *keyboard* has a finger on the button presses charges and the design of the *keyboard is* different, the human factor (ability) of different can be seen from the time of completion, the physical work environment factors affect many things, among others, completion time, number of errors and the level of concentration.

b. Here the physical work environment factors affecting the number of errors and completion time, whereas in the normal environment of generated fewer errors and faster completion time than in the abnormal environment is not so significant it is because that job for a while just a few minutes and environment also affect productivity, in a normal environment their productivity is higher than the abnormal environment.

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