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Task Analysis Assessment on Intrastate Bus Traffic Controllers

Teo Yen Bin¹, Jalil Azlis-Sani¹, Muhammad Nur Anuar Mohd Yunus¹, S.M. Sabri S.M. Ismail², Noor Aqilah Ahmad Tajedi²

¹Faculty of Mechanical Engineering and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia
²R & D, Project Development Division, Prasarana Malaysia Berhad, Wisma Monorail, Kuala Lumpur

E-mail: yenbin92@gmail.com, azlis@uthm.edu.my

Abstract. Public transportation acts as social mobility and caters the daily needs of the society for passengers to travel from one place to another. This is true for a country like Malaysia where international trade has been growing significantly over the past few decades. Task analysis assessment was conducted with the consideration of cognitive ergonomic view towards problem related to human factors. Conducting research regarding the task analysis on bus traffic controllers had allowed a better understanding regarding the nature of work and the overall monitoring activities of the bus services. This paper served to study the task analysis assessment on intrastate bus traffic controllers and the objectives of this study include to conduct task analysis assessment on the bus traffic controllers. Task analysis assessment for the bus traffic controllers was developed via Hierarchical Task Analysis (HTA). There are a total of five subsidiary tasks on level one and only two were able to be further broken down in level two. Development of HTA allowed a better understanding regarding the work and this could further ease the evaluation of the tasks conducted by the bus traffic controllers. Thus, human error could be reduced for the safety of all passengers and increase the overall efficiency of the system. Besides, it could assist in improving the operation of the bus traffic controllers by modelling or synthesizing the existing tasks if necessary.

1. Introduction

Public transportation serves as one of the most important basic public welfare throughout the world [1]. It acts as social mobility and caters the daily needs of the society for passengers to travel from one place to another.

It is undeniable that transportation and logistics are the backbone of a nation’s economy [2]. This is true for a country like Malaysia where international trade has been growing significantly over the past few decades. However, in order to compete in the global economy, transportation today not only needs to be able to provide mobility and connectivity for the society, it would also have to perform with optimum efficiency and effectiveness in a tightly integrated network of multimodal transport [2].

Bus service is the most common public transportation and plays an important role in enhancing urban travel as well as fulfilling the needs of the society. Generally, bus services operate with low
capacity and normally used in smaller cities. Nevertheless, bus services exist in larger cities as well to provide shuttle services. It is significant that the society retain good access to quality transport services. Thus, it is a necessity to ensure the services of bus transport meets the increasing passenger needs especially in urban areas. The demand for reliable, efficient, affordable and clean bus transportations is the basic welfare for the society. Therefore, it is a necessity for all workers involved in bus systems to provide quality performance in their respective task.

Therefore, bus services should require their workers to have high efficiency rate towards improving their individual performance as well as the performance of the whole system. The improvement of the bus sector in terms of effectiveness and worker’s health and safety can be done through implementation of several appropriate measures.

Bus traffic controllers are personnel who are appointed to monitor and manage the flow of bus service operation in a specific region. Conducting research regarding the task analysis on bus traffic controllers had allowed a better understanding regarding the nature of work and the overall monitoring activities of the bus services.

Task analysis assessment was conducted with the consideration of cognitive ergonomic view towards problem related to human factors. This would ensure that the bus traffic controllers could have high productivity in ensuring the safety and high efficiency of the fleet. The newly developed task analysis assessment for the bus traffic controllers were identified and this would serve as a guidance and reference related to this field.

Through this research on intrastate bus traffic controllers, practical benefits in the form of understanding the layout and task breakdown for the bus traffic controllers was obtained. The objectives of this study include to conduct task analysis assessment on the bus traffic controllers. Based on the results, recommendations will be proposed for improvements and future studies.

2. Methodology
Several techniques were used to conduct task analysis assessment on the bus traffic controllers. The main techniques of this study are as following:

i. A study of past literature review were done to obtain information involving the tasks conducted by traffic controllers.

ii. A comparison of issues, methodologies and areas of study were done and a discussion of the results regarding tasks conducted by traffic controllers was developed.

iii. Interviews were conducted to the bus traffic controllers as well as the management.

iv. Further observation was done on the bus traffic controllers.

Sixteen respondents were chosen to be a part of this study and the demography of the respondents were obtained via questionnaire. Next, interview sessions was done with the bus traffic controllers to obtain further data on the tasks and daily routine of the bus traffic controllers. Observation was conducted on the bus traffic controllers to observe the daily routine of the bus traffic controllers. Through observation, the tasks which were conducted by the bus traffic controllers were identified and recorded.

The daily routines which were conducted by the bus traffic controllers were broken down into smaller subsidiary units and a diagram for the overall task description of the bus traffic controllers was generated. This method is known as task decomposition where high level tasks were grouped into smaller constituents and this would help produce a clear structure of the overall operation. Since bus traffic controllers are often involved in monitoring and decision making, it was desirable to show the task flows as well as the decision processes in a flow chart.

It is common to use structure chart which is also known as Hierarchical Task Analysis (HTA) to represent the task analysis of a certain job [3]. This had clearly shown the sequence of activities in an orderly manner. It is common to use structure chart which is also known as Hierarchical Task Analysis (HTA) to represent the task analysis of a certain job [3]. Hierarchical Task Analysis (HTA) can be used to express physical and cognitive operations needed to achieve both goals and sub-goals of a
system [4]. It provides a detailed description of the tasks for a certain job and is often used to identify human error and decide if further analysis should be conducted.

Task analysis provides information on how a task is being accomplished with a detailed description of all the activities involved either manually or mentally. Hierarchical Task analysis is of wide range of element which may include but not limited to duration needed for the task, environmental factors involved, task allocations as well as task complexity, task frequency, equipment and machineries used for the operation. It also includes all factors that may directly or indirectly affect the person conducting specific tasks [6].

HTA can be done by examining the objectives of the processed involved in a certain operation. A detailed subordinate goals and plan will be produced during the process. This detailed diagram is known as task description. It would show an overall flow of how each subordinate task would be carried out in order to achieve the ultimate goal. In Hierarchical Tasks Analysis, it is important to treat each function individually. The task carried out should be seen and analysed separately. This would prevent confusion and complexity during the analysis. This will clearly show the sequence of activities in an orderly manner.

The task decomposition was carried out by using the following stages:

i. Prior to analysis, the task of the bus traffic controllers which were identified.
ii. The main tasks and daily routine were decomposed into several categories and subunits. These subunits were specific in terms of objectives and covered the scope of interest.
iii. A layered diagram for all the subunits was generated.
iv. The level of detail needed to decompose the main task was decided. Having appropriate amount of details had ensured that all subunits were consistent and specific. This had ensured that the task flow diagram of the bus traffic controllers was presented in an easily understood manner.
v. The consistency of decompositions and numbering was preserved while conducting the decomposition processes.
vi. The analysis were presented to respective personnel who fully understand the tasks who was the management of Rapid Bus Sdn Bhd to check for consistency.

A flow diagram of the task analysis was completed with specific tasks which included full details and interactions between the user and the operation as well as all individuals or problems related [3]. The flow diagram of the bus traffic controllers had been highlighted at specific areas to help further understand how subunits of each task would affect the main objective of the operation.

It had also helped in deciding the number of manpower and qualification of the employee to complete the task. This would assist in ensuring an optimum expenses were used to help achieve the same level of task structure in a more economic manner.

3. Results and Discussion

3.1. Demography of Respondents

The existence of bus control center had ensured the daily operations can be much more efficient and systematic. There are a total of thirty three officers working in shifts at the bus control center. These officers are in charge of the daily operation of the bus travelling in order to serve the community to mobilise around the city. This is done through supervising the attendance, driving activities and conditions of the bus drivers. Besides, bus traffic controllers are involved in fleet management where they would have to monitor the condition and flow of bus through live screening technology. They would have direct access and notifications if there were to be breakdowns, accidents or hijacking of the vehicle. Thus, immediate posting could be delivered by the bus traffic controllers to the proper parties and authorities for appropriate course of actions.

Nevertheless, out of the thirty three officers, only twenty four of them are bus traffic controllers. With the role of bus traffic controllers, the time response would be higher and this could reduce the negative implications to the minimum level.

For this particular study, only sixteen were selected as part of the respondents. Table 3.1 shows the demographic information of the sixteen respondents.
### Table 3.1: Demography of the Respondents

| Ref  | Gender | Number of Working Years | Marital Status |
|------|--------|-------------------------|----------------|
| R001 | M      | 10-20                   | Married        |
| R002 | M      | 1-5                     | Single         |
| R003 | M      | 5-10                    | Single         |
| R004 | M      | 5-10                    | Married        |
| R005 | F      | <1                      | Married        |
| R006 | M      | <1                      | Single         |
| R007 | M      | 1-5                     | Married        |
| R008 | F      | <1                      | Single         |
| R009 | F      | 1-5                     | Single         |
| R010 | F      | 1-5                     | Married        |
| R011 | F      | 1-5                     | Single         |
| R012 | M      | 1-5                     | Single         |
| R013 | M      | 5-10                    | Married        |
| R014 | F      | 5-10                    | Single         |
| R015 | F      | 1-5                     | Single         |
| R016 | F      | 5-10                    | Married        |

As observed in the table, M represents Male and F represents Female in the gender column. Thus, it can be seen that there are equal amount of male and female selected for this study which was eight for each gender. Out of the sixteen respondents selected for this study, three of them have served in the bus control center for less than a year. Seven of them have worked for one to five years. Next, five of them have a working experience of five to ten years. Finally, only one of the respondents have worked ten to fifteen years. For marital status, seven of them are married and nine of them are still single.

### 3.2. Development of Hierarchical Task Analysis (HTA)

Hierarchical Task Analysis (HTA) is a common approach which is done in researches with the target of achieving both goals and subgoals of a system through the expression of physical and cognitive operations [4]. It provides a detailed description of the tasks for a certain job. HTA is often used to reduce human error and assist for further detailed analysis. For this study, the details for the HTA was obtained through interview sessions and observation on the daily routine of the bus traffic controllers. A detailed subordinate goals and plan were generated and discussed with the management of BCC during the interview. This detailed diagram is known as task description and showed an overall flow of the task analysis of bus traffic controllers.

The standard operating procedure (SOP) of Bus Control Centre (BCC) is obtained from the management as a preliminary guideline to generate the HTA for the bus traffic controllers. The SOP from BCC is relatively general and did not have specific explanation on each task. Further observation and interview sessions were done to obtain a detailed description regarding the subsidiary tasks. All the tasks which are needed to be done are listed individually and categorised accordingly. Through this method of breaking down the daily routine into smaller parts, the complexity of tasks would be reduced and could be easily understood [5].

Based on the SOP obtained, Hierarchical Task Analysis (HTA) for bus traffic controllers is generated as shown in Figure 3.4. There are five subsidiary tasks on level one which are checking the radio trunk, observation by monitoring the alarm, monitor the daily operation of bus by Fleet Tracking System (FTS), last bus report and immediate issue. These can be categorised as the daily routine and tasks needed to be done by the bus traffic controllers in Bus Control Centre. Observation on bus by monitoring the alarm as well as immediate issue could be further broken down into level two to
provide a better understanding regarding the tasks. It could be subdivided to several subtasks in achieving and completing the main task.

For observation on bus by monitoring the alarm, it can be subdivided into three subsidiary tasks which are out of geofence (a virtual geographic boundary, defined by GPS), exceed speed limit and idle bus. For immediate issue, there are four smaller parts which are accidents, helpline as well as customer feedback, bus return to depot (RTD) and route disruption.

The newly Hierarchical Task Analysis (HTA) developed had allowed a better understanding regarding the nature of work for the bus traffic controllers. Using this task analysis and information, it is hoped that it can further assist the management to understand the essential necessity of the bus traffic controllers in performing their daily tasks. Besides, it ease the evaluation of the tasks conducted by the bus traffic controllers to reduce human error and consequences of misconduct.

Validation on the newly developed HTA was done by the management of the bus traffic controllers and it would assist in comprehending the essential necessity of the bus traffic controllers while performing their daily routine. Besides, the evaluation of the tasks conducted by the bus traffic controllers could be done to further reduce human error and consequences of misconduct.

4. Conclusion
In conclusion, task analysis assessment for the bus traffic controllers was successfully developed via Hierarchical Task Analysis (HTA). There were a total of sixteen respondents chosen for this study. There are a total of five subsidiary tasks on level one and only two were able to be further broken down in level two.

Through this research of workload of intrastate bus traffic controllers, practical benefits in the form of understanding the layout and task breakdown for the bus traffic controllers was obtained. Identification of the task analysis for bus traffic controllers was determined and this had provided a further understanding regarding the nature of work. This research had also achieved its primary target to understand the role of bus traffic controllers in improving the efficiency, effectiveness, reliability, quality and safety of the bus services for the well-being of the society.

Development of HTA allowed a better understanding regarding the work and this could further ease the evaluation of the tasks conducted by the bus traffic controllers. Thus, human error could be reduced for the safety of all passengers and increase the overall efficiency of the system. Besides, it could assist in improving the operation of the bus traffic controllers by modelling or synthesizing the existing tasks if necessary.

HTA would ease the improvement of the operation of the bus traffic controllers by modelling or synthesizing the existing tasks if necessary. It could also ease the task allocation of each primary tasks on the HTA as well as evaluating different stages of the tasks in order to identify and avoid potential
human errors. Thus, constant auditing on the overall system could be done to prevent failure and provide future supporting improvements. It could also ease the task allocation of each primary tasks on the HTA. Constant auditing on the overall system should be implemented as well to prevent failure and provide future supporting improvements.

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