1. Introduction.

Musculoskeletal disorders (MSDs) found in many types of professional driver. A risk level of individual factors, psychosocial factors and physical factors influenced the development of MSDs. Key segments of risk factors include the Individual risk factors such as gender [1] age [1], Body Mass Index [2], exercise [3] and smoking [2]. Physical factors such as posture sitting [2], lift luggage [4] whole body vibration [5], task duration and experience [1] [2] [3] [4]. Psychosocial factors such as stress of work, unsafe of work, lack of social support, Income is not enough, and others can affect to WMSDs [2] [3] [5]. Because of these findings, there has been major important to assess the risk factors associated with the driver's WMSDs in order to intervene in the ergonomic work of the driver. Assessment should focus on the low back, neck, and shoulder because the majority of reported injuries associated with the work in these regional bodies.

Currently risk assessment tools used to assess risk factors associated with MSDs include Quick Exposure Check (QEC) [6], Rapid Upper Limb Assessment (RULA) [7], Rapid Entire Body Assessment (REBA) [8], and et al. Although the ergonomic risk assessment tool is useful in evaluating, it has been found that there are limitations in the assessment because individual factor and psychosocial factor have rarely been considered. An assessment tool is required for the driver and assessor used assess in the workplace. This article describes the development of Driver Ergonomic Risk Assessment (DERA) and provides readers with information on recognized development approaches and the underlying ergonomics of workplace. The DERA has been designed for use by analysing the risk factors for WMSDs of the driver and for ergonomic intervention at the workplace.
2. How to develop and evaluate DERA.

Tool development was started by studying the risk factors that affected the pain and limitations of the general ergonomic assessment tool for design the prototype, its content and presentation format of DERA has been reviewed and evaluated in Phase 1. Following a test verification of the DERA in Phase 2. Figure. 1 show the process of developing a risk assessment tool.

2.1. Phase 1.

2.1.1. Literature review.

Education and compilation of risk factor include individual factors, physical factors and psychosocial factor which effects to WMSDs of the driver to determine the importance of risk factors and inclusion in the DERA. Current risk assessment techniques have been reviewed to assist in the development of tool development strategies. A literature survey was conducted survey research literature published during the year 2000 to 2016 to guide the design and development of this assessment tools. A search for related papers was carried out in scientific databases on the Internet. Most of the articles were found in Google scholar (scholar.google.com), Scopus (www.scopus.com), Web of Science (apps.web of knowledge.com), and ScienceDirect (www.sciencedirect.com). Some of local articles were found in Thai Journal Citation Index (www.kmutt.ac.th). We included mostly article types written in English and a few articles in Thai.

2.1.2. Target groups.

Four focus groups, comprising Expert group 5 people, Assessor group 7 people, Pilot testing group 20 people, and Verification group 73 people.

2.1.3. Study limitations of the risk assessment tool.

The trial evaluated using the ergonomic risk assessment tool such as Rapid Upper Limb Assessment (RULA), and Quick Exposure Check (QEC) for twenty professional drivers. Show the limitations of the assessment, and their requirements for a new assessment tool.
2.1.4. Prototype.
The study compiled research to design and revisions the assessment process and the scoring layout to be appropriate. Different color patterns in each group factors and differences in color scheme of scoring charts have been used to help design assessment tool prototypes. The data from literature review resulted lead to design a 4 stage DERA assessment process that required: (a) an driver to record the data individual factors of the driver. Calculated scores are compared to risk levels., (b) an driver to record the feeling level of Psychosocial factors in each Questions. Calculated scores are compared to risk levels., (c) an assessor to record the driving posture. Vibration level, luggage lifts and the duration of work Calculated scores are compared to the risk level., (d) a risk level to be calculated for each group is based on the sum of the risk levels assessed at each group factor.

The Driver Ergonomic Risk Assessment (DERA) is important in prioritizing interventions and evaluation the risk factor of drivers. Therefore, the development of this tool is due to the driver's needs and epidemiological evidence. These are described below for each of the factors that have been assessed by DERA. Design of DERA forms and instruction manuals that have been fixed in Phase 1 the DERA incorporates a worksheet for recording the details matter; an assessment sheet in each group of risk factors identified with a color code and the box scores the risk scores that indicate the level of risk in each group, the risk factors and the overall risk score clearly. The design this tool and content of the manual has been greatly modified in phase 1 to better understand DERA is use.

The resulting design for the DERA assessment is have 3 factor assessment include Individual factor assessment, Psychosocial factor assessment, and Physical factor assessment. In group Individual factor have 5 question for analysis include gender, age, body mass index, exercise, and smoking if driver have score in this group between 5-6 score is mean risk level low (level 1), score between 7-8 score is mean risk level moderate (level 2), score between 9-10 score is mean risk level high (level 3), and score between 11-13 score is mean risk level very high (level 4) shown in Figure. 2

![Figure 2. DERA assessment in group individual factor](image-url)
In group psychosocial factor have 8 questions for analysis if driver have score in this group between 1-9 score is mean risk level low (level 1), score between 10-16 score is mean risk level moderate (level 2), score between 17-24 score is mean risk level high (level 3), and Score more than 25 score is mean risk level very high (level 4) shown in Figure. 3

In group physical factor have 15 sections for analysis if driver have score in this group between 1-3 score is mean risk level low (level 1), score between 4-5 score is mean risk level moderate (level 2), score between 6-7 score is mean risk level high (level 3), and Score more than 8 score is mean risk level very high (level 4) shown in Figure. 4

Figure 3. DERA assessment in group psychosocial factor

Figure 4. DERA assessment in group physical factor
2.1.5. **Validity test.**

The validity of the DERA assessment was evaluated by 5 expert the results showed that assessments’ DERA have scores IOC (Item-Objective Congruence Index: IOC) more than 0.6 score in each question of 3 group factors. This IOC tool is used to evaluate the suitability of risk factors and vocabulary to make the assessment question appropriate. The DERA forms, the risk factors used to evaluate, and guide use manual have been validated by with each expert. Inspected by experts. The experts confirm that the meaning of each question is clear. The experts’ ratings (less than 0.5 = Inappropriate question, more than 0.5 = appropriate question) indicated that the DERA was appropriate assessment tool for driver.

2.1.6. **Assessor preparation.**

To make the assessor familiar with the DERA process. Instruct the assessor to follow the assessment manual and attend training on how to use the risk assessment tool at least 24 hours prior to the test.

2.1.7. **Reliability test.**

Seven assessors viewed how to work of 5 drivers (combinations of posture sitting, vibration, lifting and driving duration). Test of reliability of the group assessors. First test by used seven assessors and 5 drivers and test--again with 7 assessors who assessed the same set of 5 driver within a week. The reliability of the assessors is determined by comparing between the score 1st and the score 2nd. Based on the analysis of variance in the measurement system, the analysis found that the measurement system is volatile at acceptable levels, but condition is because % Gage R & R is at 15.16%.

2.1.8. **Pilot testing.**

The risk assessment tool for drivers was tested by 7 assessors. After completing the interview and the questionnaire to assess the usability of the tool.; found problem in group individual factor is lack of slots for age and result calculation BMI. An interview with 7 assessor users to Improvements to the risk assessment tool and recommendations on DERA use. There are issues was reviewed. (Such as icons, terminology, risk factors, the scoring chart, and defects in use). Group assessors reported that the DERA is a useful and straightforward assessment tool. However, their advice was used to refine the evaluation and user manual for final correction.

2.2. **Phase 2.**

2.2.1. **Verification testing.**

From test the ergonomic risk assessment tool for driver for driver in each group risk factor. Risk levels range from 1 to 4 levels. Higher scores indicate increased risk. When the sum of the risk scores from the three groups is called the total risk level and when the higher risk level indicates the higher level of risk. Musculoskeletal disorders and the ergonomic risk assessment tool for driver sum level risk for 73 professional drivers were significantly correlated (P = 0.024). Based on the test, the sum level risk between driver with high pain and driver with low pain. There were significant differences between the sum level risk of the drivers between 7 and 8 scores. An ergonomic risk assessment tool for driver sum level risk of 8 score it is useful to determine the level of action that should be changed immediately. Ergonomic risk assessment tool for driver is an effective and reliable way to identify the risk factors of a professional driver involved in a musculoskeletal disorder.

3. **Conclusion.**

The DERA is designed by studying the factors that contribute to pain and validation by experts. It can distinguish the level of risk in each factor. It can identify most important risk factors that cause WMSDs to be evaluated and corrected. DERA is a tool that can be used without any additional equipment and after training and testing. This tool is a reliable tool for evaluating drivers. It is possible to identify the risk level of each driver factor for modification and can be easily used. The DERA is an important is necessary in prompting improvements and it useful tool for the driver (level risk reduction of WMSD risk factors) by there is a risk level to indicate the priority of the need for change.
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