The Evolution of Ergonomics Risk Assessment Method to Prevent Work-Related Musculoskeletal Disorders (WMSDS)

https://doi.org/10.3991/ijoe.v18i08.31313

Mohamad Rashid Mohamad Rawan[1], Mohd Amran Mohd Daril[1](✉), Mohamad Ikbar Abdul Wahab[1], Khairanum Subari[1], Qarna Manan[2], Shazia Parveen[3]
[1]Quality Engineering Research Cluster, Quality Engineering Section, Malaysian Institute of Industrial Technology, Universiti Kuala Lumpur, Johor Bahru, Johor, Malaysia
[2]Production Department, Ruffntuff Sdn Bhd, Negeri Sembilan, Malaysia
[3]The Association of Professional Researchers and Academicians, England, United Kingdom
mamran@unikl.edu.my

Abstract—In the last few decades, numerous of ergonomics risk assessment method was developed. These method was developed to prevent work-related musculoskeletal disorders or WMSDs among the workers. Although there is variety of methods was available to identify the present of WMSDs but the accuracy of the measurements is based on the methods applications and limitations. Due to the complexity of factors such as inhomogeneity of the working activities, the sophisticated of measurement process, the diversity of cultures, incapable to accesses various body posture, and others problem that remain unsolved, the evolution of ergonomics risk assessment methods was never ended. To react with the demanding related with the WMSDs problems, ergonomics risk assessment methods become more advance in technologies. Parallel with the upcoming challenges of industry revolution 4.0, ergonomics risk assessment methods need to be transformed and adapted with the advance technology-based methods. The industries already to step ahead and starting to represent their production activities using robotics technologies, artificial intelligence (AI), biotechnology, and super-computer technologies. Therefore, ergonomics committee and practitioner should realize the opportunities and developed new ergonomics risk assessment method that integrated with the technologies. They need to be more accessible, understood, visionary, and modernize. The evolution of ergonomics risk assessment methods must be continuing and not rely with the traditional approach only.

Keywords—work-related musculoskeletal disorders (WMSDs), ergonomics risk assessment methods, ergonomics, evolution

1 Introduction

The current revolution in industry is commonly defined through industry revolution 4.0 changing the culture of working activities in major industries [1]. Human-robotic cooperation become new culture that had been introduced to help human workers to perform manual activities effectively. The combination of human-robotic in operation process was able to create mass production based on robotic strength ability and human intellectuality. In others word, human-robotic cooperation improve production performance in the industries by matching the working environment, without the cages or barriers, to capable human workers to control robotic physical strength to perform the specific task with the intellectual ability of human to plan, react, and judge the situations. Human-robotic cooperation also one of a promising way to achieve goal of increasing productivity while minimize the production costs.

As a counteract for these new culture of working activities, the use of technologies also become current direction in ergonomics risk assessment methods [2]. The evolution of the assessment methods evolving dramatically because of demanding problems arise from the industries [1][2]. Alongside with the era of industry revolution 4.0, the development of ergonomics risk assessment methods displayed interest with the modern technologies as a tools of evaluation. This is because, during the process of collaboration between human and machine, new safety measurement need to be considered as they are integrated into one working environment and many potential factors of WMSDs there can be. The aim of this paper is to discuss the evolution of the ergonomics risk assessment methods to identify the presence of WMSDs in the era of upcoming challenges of industry revolution 4.0.

2 New challenges of ergonomics

In the era of upcoming challenges of industry revolution 4.0, the new challenge of ergonomics are associated with the nature of working activities. Major industries already transform and adapted new technology-based process. As high demanding production is required, most of industries move their used of technology toward automation and remote control [3]. The implication of these process, human workers are also demanded to cooperate with the new roles as supervisors of the automation systems. The operators or supervisors need to become multitasking and able to control the whole systems instead of one specific task. Different with the previous problems, today factors of WMSDs are more complex. Not only related with the prolong sitting or standing, repetitive task, and physical factors only, but the changing nature of working activities also created new problems of ergonomics. The impact of human-robotic cooperation may escalate the workload not only to the physical but also with the mental of the workers [4].

Therefore, ergonomics committee and practitioner should realize these revolution and not isolated with the traditional methods only. The changing nature of working activities mean that new approach of ergonomics risk assessment methods is necessary. Field of ergonomics faces new challenges that associated with the variety of factors of WMSDs and requires complicated judgement. As many possibilities of risk factors may

appears during working activities, early detection of presence of WMSDs can avoid potential injuries for the workers. The ergonomics risk assessment methods should be developed to be able to use the modern technologies as a device for early detection or warning signal to the workers if any endangered situations related with WMSDs during their working activities [5]. The methods also need to be developed to able to evaluate the workers while performing their tasks or activities in the real working environment without delayed them and interrupted the whole production system.

3 Implications for ergonomics risk assessment methods

Arising out from the current situations in the industries, ergonomics risk assessment methods become more advance in technology [2][5]. Over a decades, ergonomics risk assessment methods is used to identify, analysis, control, and eliminate any jeopardize activities that considered as risks on the workstations [7]. But in the modern ergonomics, the movement of sciences and technologies had been used dramatically to identify risk factors especially for WMSDs problems. The methods of ergonomics risk assessment are evolving from pen-and-paper based methods to possibilities of using electronic devices, mobile applications, Internet of Thing (IoT), data gathering, and real time evaluations [7].

Other than that, implication for ergonomics risk assessment methods associated with the more complex problems of WMSDs. The revolution of technologies in the industries for become more automation process, changes the nature of working activities significantly. The ergonomics practitioner need to develop the methods that was able to identify problems not only related with the workers physical but also with the mental workload. Without neglected the knowledge from the previous methods, the integrated methods of traditional and modern technology can accomplish the holistic methods of ergonomics risk assessment that able to understanding complex interacting system involving human dan machine [8].

The last implication is the ergonomics risk assessment methods need to present the evaluation result in the real time. At the beginning of 20th century, ergonomics risk assessment is rarely used to identify WMSDs [7]. Majority of companies and workers unfamiliar with the risk occur during performing their working activities and the important to having safety working environment. With the growing development in technologies, many methods and tools had been developed to enable the companies to analysis and optimize their employee's working environment. The awareness of the risk related to WMSDs motivate the companies to find the best methods to prevent the risk without interrupt their production process and systems. Therefore, it is important to the ergonomics practitioner to find the methods that able to generate the result in the real time.

4 Evolution of ergonomics risk assessment (ERA) methods

In the Guidelines of Ergonomics Risk Assessment at Workplace 2017 by Department of Occupational Safety and Health (DOSH) Malaysia, ergonomics risk assessment is

a systematic approach to identify, evaluating, and controlling the risk factors related with the environment and activities in workstations. The ergonomics risk assessment methods was able to identify the risk factors that might become health problems to the workers if they was exposed frequently. The ergonomics risk assessment methods can be used to identify the presence of WMSDs and recommend the users to take the appropriate actions to countermeasure the problems [6].

There are numerous methods that able to evaluate risk assessment [5]. To achieve good evaluation result, the ergonomics practitioner need to build-up the experiences to reduce the contingency for inaccuracy result. Although there are various methods can be used to identify the presence of WMSDs, there was no methods can be declared as the best ergonomics risk assessment methods [5]. Parallel with the revolution technologies in the industries, the ergonomics risk assessment methods need to be improved continuously. Figure 1 shows the evolution of ergonomics risk assessment methods from basic of using pen and paper to more complicated method of using an advance technology system. The problems to evaluate large quantities of workers and adequately handling such an amount of information is a typical challenges raised for ergonomics practitioner by the industries [3].

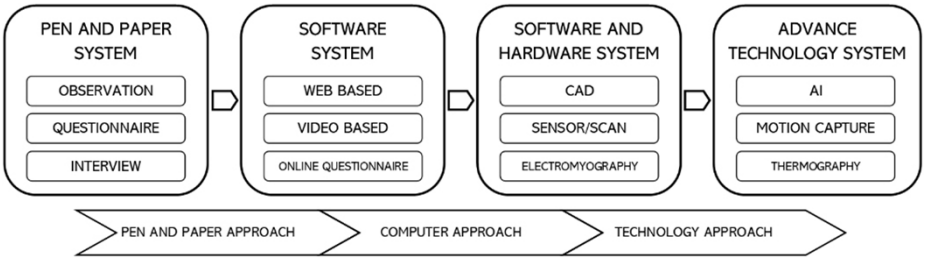

Fig. 1. Evolution of ergonomics risk assessment methods

4.1 Pen-and-paper based system

Pen-and-paper based system is common methods in ergonomics risk assessment mainly based on observation technique. In general, observation is a process of evaluation on human body postures that are easy to conduct and cost efficiency [9]. The methods of pen-and-paper is used to perform ergonomics risk assessment especially in the low intensity, repetitive work, and awkward body postures. Pen-and-paper observation approach requires the users or ergonomics practitioners to had good knowledge in field of ergonomics. Without good knowledge and experiences, the result of evaluation can be arguable. This is because, the accuracy of the result might be questionable especially it was essential because related with the human health.

There was numerous examples of pen-and-paper based methods widely used by the ergonomics practitioners around the world [9][17]. This paper is summarized several previous case studies that using pen-and-paper based methods on their research. The criteria to select these studies is based on the objectives of and familiarities of the

methods. The purposed of this selection is only to present the examples of the methods in pen-and-paper and the particular approach of each systems. Table 1 show the examples of methods in pen-and-paper systems based on previous case studies.

Table 1. Examples of methods in pen-and-paper based systems based on the previous studies case

Methods	Objectives	Body Parts
Rapid Upper Limb Assessment – RULA [10]	To provide quick screening of risk for exposure especially for work-related upper limbs disorders	Upper limbs
Rapid Entire Body Assessment – REBA [11]	To investigate risk for dynamic activities related to WMSDs	Whole Body
Quick Exposure Checklist – QEC [12]	To evaluate risk factors related to WMSDs	Whole Body
Cornell Musculoskeletal Discomfort Questionnaires – CMDQ [13]	Self-reported method that able to identify present of WMSDs by answer questionnaire survey	Whole Body
Cornell Hand Discomfort Questionnaires – CHDQ [14]	To identify present of risk factors especially for hand and wrist by answer questionnaire survey	Hand and Wrist

4.2 Software-based system

Before the existence of computer, ergonomics risk assessment methods using basic tools such as pen-and-paper and highly dependent on ergonomics experts only [15]. Alongside with the network and technology development, computer become one of the useful tools for ergonomics practitioners to developed new methods. The development of software-based methods considerable as an efforts from the ergonomics practitioner to share the knowledge about ergonomics risk with any interested parties. The aimed of these methods is to become friendly users and assessable to anyone with any level of knowledge about ergonomics [16]. Software-based methods can be defined as systematic systems that able to evaluate particular users, for particular tasks, and in a particular environment [16][17].

Software-based methods uses computer as tools to evaluate risk factors. In other words, the methods uses software to evaluate the risk factors and generate computerize outcome as the result. Software-based methods need the users to fill up the data information based on the observation on the actual problems. The methods was quite similar with the pen-and-paper but only the different was the evaluation result is automatically generated by the computer system. There was numerous methods are considered as software-based systems [15]. The methods also can be divided into several diversion such as web-based methods, video-based methods, and online questionnaire.

This paper is summarized several previous case studies that using software-based methods on their research. The criteria to select these studies is based on the research objectives, methods functional, and familiarities of the methods. The purposed of this selection is only to present the examples of the methods in software-bases system and the particular approach of each systems. Table 2 show the examples of methods in software-based system based on the previous case studies.

Table 2. Example of methods in software-based systems based on the previous case studies

Methods	Objectives	Body Parts
Occupational Repetitive Action – OCRA [18]	The result shows the analysis in detail and consist of the evaluation result of risk factors. The method consists of two specific tools (OCRA index and OCRA checklist).	Upper limbs
ErgoEASER software [19]	Helped create a checklist by which workstations' ergonomics was assessed. The questions were based on the selected ergonomic principles.	Whole Body

4.3 Software and hardware system

As result of the upcoming challenges in industry revolution 4.0, the demand to getting precise and accurate evaluation for ergonomics risk assessment methods is high [20]. Therefore, the combination of software and hardware approach was developed to address the limitations of the particular issues. The evolution of ergonomics risk assessment methods is necessary to ensure the ergonomics practitioner had relevant methods to counter the current problems. The combination of software and hardware approach allowing certain improvement over traditional methods [20]. This methods was able to generate high accurate result without any bias or human manipulation.

There are various tools can be considered as the combination of software and hardware methods. Electromyography and sensor-based methods is one of the common tools use to evaluate ergonomics risk factors of the workers. In other hand, electromyography of EMG and sensor become measurement tools that attached to the workers body to evaluate the presence of WMSDs. The workers can continue their working activities and any hazardous act can be identified directly. The data gain from the evaluation is generate by computer systems and the details of the evaluation process are presented in report form [20][21].

According to the previous case studies, there are several methods considered as software and hardware systems. This paper selected and summarized the methods based on the research objectives, functionality, and familiarities of the methods. The purposed of this selection is only to present the examples of the methods in software and hardware system and the particular approach of each systems. Table 3 show the examples of methods in software and hardware systems based on the previous case studies.

Table 3. Examples of methods in software and hardware systems based on previous case studies

Methods	Objectives	Body Parts
Exposure Variation Analysis – EVA [22]	Method to monitor ability to optimal regulate exercise intensity of professional athlete during time-trial competitions.	Whole Body
Joint Analysis of EMG Spectrum and Amplitude – JASA [23]	Method that offers a valuable tool for the indication of estimating the muscle fatigue. The result is based on three out of four tested muscles.	Whole Body
Open-Source Software – OpenSim [21]	Simulation technique to predict MDSs. Formulated is used to replicate modelling before able to measure the working activities.	Whole Body

4.4 Advance technology-based system

Advance technology-based system become current direction in development of ergonomics risk assessment methods [2][5]. There are variety of methods and tools in modern ergonomics was able to identify the presence of WMSDs and optimize the working environments to benefits the workers. But most of the methods had significant limitations especially in time consuming and complex task involved during the evaluation process [24]. Risen from the current situations in the industries, most of the companies aware about the important of ergonomics risk assessment among their employees but slowly demanding the process of evaluation without interrupt their production systems [24]. In the meantime, existence methods requires the workers to active participate during the process of evaluation and may affect their productivity. Therefore, it is necessary for the ergonomics practitioner to developed new ergonomics risk assessment methods that capable to collect the data on the real time situations while the workers performing their actual working activities normally.

There are various tools and systems that can be used to integrate with the ergonomics methods to evaluate the risk factors. Tools such as motion capture camera, thermography, and sensor is capable to become measurement devices with high accuracy and reliable result [5][24][25]. Other than that, there are also an advance systems that able to evaluate motion such as artificial intelligent (AI), virtual environments (VRs), and 3D camera system. According to the previous, several case studies has been conducted using advance technology as tools for the ergonomics risk assessment methods as shown in Table 4. This paper is summarized the previous case studies that used advance technology-based systems on their research. The criteria to select these studies is based on the research objectives, tools functionality, and familiarities of the methods. The purpose of this selection is only to present the examples of the methods in advance technology-based systems and the particular approach of each systems.

Table 4. show the examples of methods in the advance technology-based system based on the previous case studies

Methods	Objectives	Body Parts
Infrared Thermal Imaging [5]	To evaluate ergonomics risk factors using thermography and using temperature as measurement.	Whole Body
Vision-based Motion [24]	Using vision-based motion approach to monitoring workers behavior for safety and identification of risk factors.	Whole Body
Virtual Environments Applications – VRs [25]	Computer generated 3D model and workers can interact with the generated surrounding as in real time.	Whole Body

5 Conclusion

The evolution of the ergonomics risk assessment methods must be continuing. The current industry revolution 4.0 changing the culture of working activities dramatically in many industries. The new culture of human-robotic cooperation had been introduced to benefit the workers and help them to improve their productivity. The workers was able to control robotic physical strength and efficiency, without denied the intellectual ability of human to react with the situations based on their judgements. To be able to achieve the optimization of productivity, companies must encourage their workers to be aware about the ergonomics risk factors. Within the new culture of working activities, new safety measurement need to be considered many potential factors of WMSDs might happened to them.

Alongside with the new norm, the ergonomics practitioners need to develop the methods that able to counteract the industrial demand. Though there were no methods can be declared as the most effective method to prevent WMSDs, new methods is the only passage out for the argument. By integrated the advanced technology-based into the ergonomics methods, plenty of arisen limitations can be solved. Advance technology-based methods also capable to evaluate the risk factors in more precisely and accurately. It is because, the sensitivity and accuracy of measurement using the technologies such as video motion and thermography cannot be debatable. Other than that, by using the technology-based method, the process of evaluation can be done in real time situations.

As the majority of the industries already prepared to transform the working environment into human-robotic cooperation, they was expected to improve their production capacity into the maximum level. Therefore, to conduct the ergonomics risk assessment, the ergonomics practitioners cannot use the traditional methods. In previously, the process of evaluation requires the workers to active participate with the procedure and normally the evaluation process will interrupt the workers productivity. The evolution of ergonomics risk methods create smart solution and capable to evaluate the workers while performing their actual working activities in their working workstations. This method improvement also help the ergonomics practitioner to process more evaluation data within the least time.

Finally, the published studies related to the ergonomics risk assessment methods need to be increase in numbers. In the future, researcher can explore the opportunities to evolving the ergonomics risk assessment by utilize and integrate the advance technology with the modern ergonomics methods to be associated with the upcoming challenges of the industry revolution 4.0. The ergonomics practitioners also need to step ahead to create an awareness about the important of assesses the ergonomics risk factors especially in the working activities and environment. They need to educate the top management about the essential to ensure the safety, welfare, and health of the workers in the workstation. The workers are deserved to be working in the excellent environment and come back to their home with good health conditions.

6 Acknowledgment

Authors are grateful to corresponding authors Ts. Dr. Hj. Mohd Amran Mohd Daril and Professor Dato' Dr. Hjh. Khairanum Subari for their guidance and support. Not to forget to Ir. Ts. Dr. Mohamad Ikbar Abdul Wahab, Ms Qarna Manan and Dr Sara Berraies for input given to increase the understanding toward the topic. Authors wish to thank to the Quality Engineering Department, Universiti Kuala Lumpur, Malaysian Institute of Industrial Technology (MITEC) for their cooperation.

7 References

[1] Gualtieri, L., Rauch, E., & Vidoni, R. (2021). Emerging research fields in safety and ergonomics in industrial collaborative robotics: A systematic literature review. Robotics and Computer-Integrated Manufacturing, 67, 101998. https://doi.org/10.1016/j.rcim.2020.101998

[2] Gášová, M., Gašo, M., & Štefánik, A. (2017). Advanced industrial tools of ergonomics based on Industry 4.0 concept. Procedia Engineering, 192, 219–224. https://doi.org/10.1016/j.proeng.2017.06.038

[3] Cacciabue, P. C. (2008). Role and challenges of ergonomics in modern societal contexts. Ergonomics, 51(1), 42–48. https://doi.org/10.1080/00140130701800878

[4] Lee, S., Liu, L., Radwin, R., & Li, J. (2021). Machine Learning in Manufacturing Ergonomics: Recent Advances, Challenges, and Opportunities. IEEE Robotics and Automation Letters. https://doi.org/10.1109/LRA.2021.3084881

[5] M. R. Mohamad, Mohd D., A.W. Mohamad et. al. (2020). The development of ergonomics risk assessment method using infrared thermal imaging. International Journal of Advanced Trends in Computer Science and Engineering, 9(1.1), 142–148. https://doi.org/10.30534/ijatcse/2020/2691.12020

[6] Department of Occupational Safety and Health (DOSH) (2017). Guideline on Ergonomics Risk Assessment at Workplace. Malaysia: DOSH. https://www.dosh.gov.my/index.php/competent-person-form/occupational-health/regulation/guidelines/ergonomic.[Accessed 20 Oct 2021].

[7] Kadir, B. A., Broberg, O., & da Conceicao, C. S. (2019). Current research and future perspectives on human factors and ergonomics in Industry 4.0. Computers & Industrial Engineering, 137, 106004. https://doi.org/10.1016/j.cie.2019.106004

[8] Wilson, J. R. (2000). Fundamentals of ergonomics in theory and practice. Applied Ergonomics, 31(6), 557–567. https://doi.org/10.1016/S0003-6870(00)00034-X

[9] Rahman, M. N. A., & Mohamad, S. S. (2017). Review on pen-and-paper-based observational methods for assessing ergonomic risk factors of computer work. Work, 57(1), 69–77. https://doi.org/10.3233/WOR-172541

[10] Yazdanirad, S., Khoshakhlagh, A. H., Habibi E., et al. (2018). Comparing the effectiveness of three ergonomic risk assessment methods-RULA, LUBA, and NERPA—to predict the upper extremity musculoskeletal disorders. Indian Journal of Occupational and Environmental Medicine, 22(1), 17–21. https://doi.org/10.4103/ijoem.IJOEM_23_18

[11] Hignett, S., & McAtamney, L. (2000). Rapid entire body assessment (REBA). Applied Ergonomics, 31(2), 201–205. https://doi.org/10.1016/S0003-6870(99)00039-3

[12] Oliv, S., Gustafsson, E., Baloch, A. N., et al. (2019). The Quick Exposure Check (QEC)—Inter-rater reliability in total score and individual items. Applied Ergonomics, 76, 32–37. https://doi.org/10.1016/j.apergo.2018.11.005

[13] Shariat, A., Tamrin, S., Arumugam, M., et al. (2016). The bahasa melayu version of cornell musculoskeletal discomfort questionnaire (CMDQ): Reliability and validity study in Malaysia. Work, 54(1), 171–178. https://doi.org/10.3233/WOR-162269
[14] Damodaran, K. K., Sharma, V., & Purushothaman, S. (2019). Relationship between the hand discomfort with the dimensions of hand and touch screen mobiles. Drug Invent Today, 12.
[15] Lowe, B. D., Dempsey, P. G., & Jones, E. M. (2019). Ergonomics assessment methods used by ergonomics professionals. Applied Ergonomics, 81, 102882. https://doi.org/10.1016/j.apergo.2019.102882
[16] Reiterer, H., & Oppermann, R. (1995). Standards and software-ergonomic evaluation. In Advances in Human Factors/Ergonomics (Vol. 20, pp. 361–366). Elsevier. https://doi.org/10.1016/S0921-2647(06)80243-1
[17] Lenzi, S. E., Standoli, C. E., Andreoni, G., Perego, P., & Lopomo, N. F. (2018, August). A software toolbox to improve time-efficiency and reliability of an observational risk assessment method. In Congress of the International Ergonomics Association (pp. 689–708). Springer, Cham. https://doi.org/10.1007/978-3-319-96083-8_86
[18] Occhipinti, E. (1998). OCRA: A concise index for the assessment of exposure to repetitive movements of the upper limbs. Ergonomics, 41(9), 1290–1311. https://doi.org/10.1080/001401398186315
[19] Lubkowska, W. (2017, November). The potential of computer software that supports the diagnosis of workplace ergonomics in shaping health awareness. In AIP Conference Proceedings (Vol. 1906, No. 1, p. 180008). AIP Publishing LLC. https://doi.org/10.1063/1.5012461
[20] Ranavolo, A., Ajoudani, A., Cherubini, A., Bianchi, M., Fritzsche, L., Iavicoli, S., ... & Draicchio, F. (2020). The sensor-based biomechanical risk assessment at the base of the need for revising of standards for human ergonomics. Sensors, 20(20), 5750. https://doi.org/10.3390/s20205750
[21] Delp, S. L., Anderson, F. C., Arnold, et al. (2007). OpenSim: Open-source software to create and analyze dynamic simulations of movement. IEEE Transactions on Biomedical Engineering, 54(11), 1940–1950. https://doi.org/10.1109/TBME.2007.901024
[22] Ouvrard, T., Pinot, J., Groslambert, A., & Grappe, F. (2017). Exposure Variation Analysis (EVA) method to monitor ability to optimally regulate exercise intensity of professional cyclists during official time-trial competition. Journal of Science and Cycling, 6(3), 58–59.
[23] Hägg, G. M., Luttmann, A., & Jäger, M. (2000). Methodologies for evaluating electromyographic field data in ergonomics. Journal of Electromyography and Kinesiology, 10(5), 301–312. https://doi.org/10.1016/S1050-6411(00)00022-5
[24] Han, S., & Lee, S. (2013). A vision-based motion capture and recognition framework for behavior-based safety management. Automation in Construction, 35, 131–141. https://doi.org/10.1016/j.autcon.2013.05.001
[25] Wilson, J. R. (1999). Virtual environments applications and applied ergonomics. Applied Ergonomics, 30(1), 3–9. https://doi.org/10.1016/S0003-6870(98)00040-4

8 Authors

Mohamad Rashid Mohamad Rawan, Quality Engineering Research Cluster, Quality Engineering Section, Universiti Kuala Lumpur, Malaysian Institute of Industrial Technology, Johor Bahru, Johor, Malaysia. E-mail: mrashid.rawan@s.unikl.edu.my

Mohd Amran Mohd Daril, Quality Engineering Research Cluster, Quality Engineering Section, Universiti Kuala Lumpur, Malaysian Institute of Industrial Technology, Johor Bahru, Johor, Malaysia.

Mohamad Ikbar Abdul Wahab, Quality Engineering Research Cluster, Quality Engineering Section, Universiti Kuala Lumpur, Malaysian Institute of Industrial Technology, Johor Bahru, Johor, Malaysia. E-mail: mikbar@unikl.edu.my

Khairanum Subari, Quality Engineering Research Cluster, Quality Engineering Section, Universiti Kuala Lumpur, Malaysian Institute of Industrial Technology, Johor Bahru, Johor, Malaysia. E-mail: khairanum@unikl.edu.my

Qarna Manan, Production Department, Ruffntuff Sdn Bhd, 71309 Rembau, Negeri Sembilan, Malaysia. E-mail: qarna@ruffntuff.com.my

Shazia Parveen, The Association of Professional Researchers and Academicians, England, United Kingdom. E-mail: shazia.parveen88@yahoo.com

Article submitted 2022-03-13. Resubmitted 2022-04-23. Final acceptance 2022-04-24. Final version published as submitted by the authors.