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Trust as a Human Factor for Sustainable Ergonomics Application in Agro-industry

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Abstract: Ergonomics application is not yet fully concerned in agro-industry due to the gap between ergonomics and welfare benefit. The welfare benefits such as wages, incentives, and other financial support have gained more interest than the ergonomics benefits as a comfortable workplace environment, work methods and workload. This study proposes trust as a human factor for sustainable ergonomics application. Trust can be defined as a user affective state that will guide individual and social decision in a work system characterized by uncertainty and vulnerability. The study objective is to analyze the trust-building process to the ergonomics application in agro-industry. The samples were previous research review from 38 food SMEs in Yogyakarta Special Region. The result indicated that building trust should consider skill, workplace environment, financial, multi-tasking, misuse and disuse of ergonomic application. Study result concluded trust could be used as a human factor in ergonomic work system of agro-industry.

Keywords: ergonomics benefit; individual decision; local work culture; social decision; welfare benefit

1. Introduction

Most of agroindustrial work system in Indonesia is typical of manual task [1]. Ergonomic has been defined as fitting the task to the human factors of the involved user in agro-industrial production system. Ergonomics application is not yet fully concerned in agro-industry due to the gap between ergonomics and welfare benefit. The welfare benefits such as wages, incentives, and other financial support have gained more interest than the ergonomics benefits as a comfortable workplace environment, work methods and workload. This study proposes trust as a human factor for sustainable ergonomics application. Trust can be defined as a user affective state that will guide individual and social decision in a work system characterized by uncertainty and vulnerability [2]. The objective of this study is to analyze the trust-building process to the ergonomics application in agro-industry. The expected advantage is to highlight the importance to quantify the abstractive parameters of trust for fourth industrial revolution 4.0 in the agro-industry. Quantification of trust could enable the data interchange in big data system to support decision and policy for agro-industrial competitiveness.

2. Materials and Methods

The analysis of trust was reviewed from our previous observation researches. The samples were 38 food SMEs in Yogyakarta Special Region, which was reviewed from author [3] and author [1]. The respondent were 30 sample members from Sleman Regional Businessmens Association for Food and Beverages [3]. Author [1] indicated the Six (6) SMEs of different food products were as crackers, nuggets, fish chips, bakpia, tempe and herbal instant beverages. Two (2) additional reviews from bakery and tobacco agroindustries.

3. Results

Recently, trust has gained more attention as human factors in several field of application. Author [4] have explored the trust analysis in multitasking workspace. Author [5] have utilized the trust in instrument of medical technology. Author [6] have recommended trust as a human factor in assesing risk in area Internet of Things (IoT). Author [7] have defined the relationship between trust and human resources in project management of spacecraft. Author [3] have identified the priority of user attribute needs as response to the introduction of KESAN (Kansei Engineering-based Sensor for Agroindustry) as a new ergonomic tool in SMEs. The highest attribute importance of this research was the willingness to use to Information Technology (IT) to implement the ergonomic application. It indicated the SMEs were familiar with the benefit of information technology to support the production system. This findings highlighted the importance of IT to support the sustainable application of ergonomic in agro-industry.

The other interesting research result by Author [1] indicated the affective condition from Six (6) SMEs of different food products as crackers, nuggets, fish chips, bakpia, tempe and herbal instant beverages. The evaluation indicated 51,3% worker in affective and 48,7% in non-affective condition. The other interesting research result by Author [8] indicated that 84,4% of worker are recommended to receive incentive and 15,6% not to receive incentive.

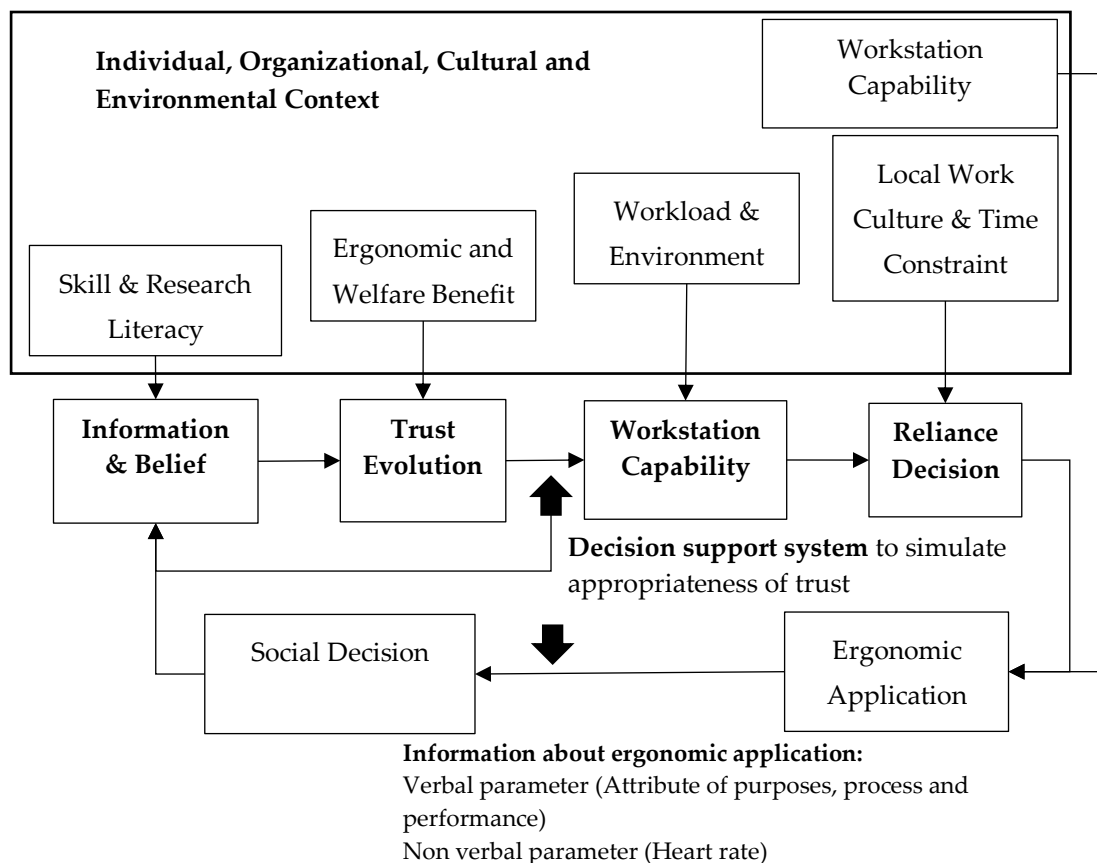


Figure 1. A conceptual model for dynamic process of ergonomic application trust in agro-industry (Adapted from author [2])

4. Discussion

4.1. Conceptual Model of Trust

Figure 1 indicated the conceptual model to implement trust as a human factors for sustainable ergonomic application in agroindustry. The conceptual model was adapted from author [2] and adjusted based on the needs to achieve the sustainable ergonomic application in agro-industry.

Reliance decision is influenced by local work culture and time constraint. Local work culture is considered as one of significant challenges in sustainable ergonomic application in agro-industry. Trust could be influenced by the local work culture in association with the work system and methods. Time constraint influenced by delay time, normal and standard time. Delay time could be minimized using the deviation between buffer and standard time. A buffer time is proposed as a solution to support the bottleneck among the work station in a production system [9]. Buffer time is determined by deviation between worker capacity and integrated workload using Drum-Buffer-Rope algorithm [9]. The workload was classified into normal, capacity constrained worker and bottleneck [9]. The constraint of personal needs and unavoidable delays could become bias for the local work culture. Standard time is determined by adding to normal time for personal worker needs, unavoidable work breakdown or bottleneck, and physical or mental worker fatigue.

Workstation capability is influenced by the interaction between worker, tool, workplace environment and material capabilities [1]. Author [9] indicated that more upstream the process, then the less ergonomic condition of worker in a workstation.

Trust evolution was influenced by trade-offs between ergonomic and welfare benefit. It could be solved by using the optimization method. This trade off to the trust could make trust as a complex computation problems. Individual and social decision influence the attractiveness of ergonomic to the the owner of SMEs as individu and cluster of SMEs as the collective. Individual trust to sustainable ergonomic application could be solved using the formula by author [10] using prominence and interpretation. The basic method for this formula is using the questionnaire to collect the data. The possibility of bias is usually high eventough the test of validity and reliability is pursued for the quality control. The alternative method of optimization and computation using artificial intelligence is highly required. The abstractive communication between 1 (one) individual owner of SMEs and other partners in same community/group for the social decision is possible to be simulated in the artificial intelligence-based research.

Ergonomic benefit could be defined as one example is by author [3] from the side of comfortable display colour, compact size, form, informative, keypad, colour, size, font and the availability of manual procedure. The other example of ergonomic benefit is the interaction between workload and environment [1]. Heart rate could be suggested as one of indicator for trade off between ergonomic and welfare benefit for the SMEs. It is fit the work characteristics of food SMEs which most of them is manual, labour incentive and influenced by environmental ergonomics.

Misuse of ergonomic indirectly indicated the existence of capacity constrained worker which could work several times from its capacity in workstation of agroindustry [9]. Disuse of ergonomics application could be indicated the significant amount of less workload worker in agroindustry which could be indicated by by our previous research [9].

The social decision is accomodating the collective opinion from the user to help them to select the appropriate ergonomic technology to accept the technology. The social decision generate the belief and information which support the sustainability of ergonomic application for the agroindustry. Information and belief generate the several alternative technology as: 1) Technology innovation; 2) Technology application; 3) Technology dissemination; 4) Adoption; 5) Revitalization; 6) Upgrade; 7) Downgrade; 8) Difussion; 9) Shared technology.

4.2. Building the Trust

Figure 1 concluded that building the trust should consider skill and ergonomic literacy, workplace environment, financial, multi-tasking, misuse and disuse of ergonomic application. Skill could be

analyzed based on national standard qualification. Ergonomic literacy could be implemented by the action research of the university students who pursue the thesis in SMEs. The interaction between agroindustry and student will increase the ergonomic literacy. Providing ergonomic workplace environment will contribute to tradeoff between welfare benefit and ergonomic benefit. The example of welfare benefit is proposed using the wages based on heart rate parameters as shown in our previous results [8]. The example of ergonomic benefit was indicated by author [1] that setting the temperature control 29.1 ± 1.8 0C could save more energy in food SMEs, if it is implemented using air conditioner. Multi-tasking is indicated by no distinct differentiation between one workstation and other workstation. Overtrust may direct to misuse and distrust to disuse [2]. Misuse of ergonomic application refers to the failures that occur when owner of SMS in advertently violate critical assumptions and rely on ergonomic inappropriately. Disuse of ergonomic indicate failures that occur when SMEs reject the capabilities of ergonomic. Considering the complex fact of building trust, it required the methods to quantify it.

4.3. Quantification of Trust

Trust must be quantified to support the decision for sustainable ergonomic application in agro-industry. The next challenge is to find the method for quantifying the trust as the human factors as the perspective from the individual and social decision. There are several ways to implement trust as a human factor for sustainable ergonomic application in agroindustry as follow:

4.3.1. Questionnaire attribute

Questionnaire attribute could be used to quantify the trust based on the dimension of trust as purpose, performance and reliability. Questionnaire attribute is the easiest way of verbal parameters in Kansei Engineering to identify the user needs. The application was confirmed by author [10]. Besides, author [2] recommended the three bases of trust that is competency (performance), reliability (performance), openness (process), and concern (purpose). The dimensions of purpose, process, and performance provide a set of attributes for questionnaire that describe the basis of trust across a wide range of application domains include ergonomic application.

4.3.2. Heart rate

Heart rate is non verbal parameter which could be used to quantify the workload. The application was confirmed by author [1,8]. Heart rate is recommended for manual work type in agroindustry which is influenced by the workplace environment.

4.3.3. SWA Index

SMEs worker affective index could be used to determine the trust based on the comparison between standard and measured heart rate. The application was confirmed by author [8].

4.3.4. Collective intelligence

Collective intelligence could be used to model the trust based on the complexity of the involved verbal and non verbal parameter. The application was confirmed by author [1-8].

5. Conclusions

The result concluded that building trust should consider skill, workplace environment, financial, multi-tasking, misuse and disuse of ergonomic application. Study result concluded trust could be used as a human factor in ergonomic work system of agro-industry. Kansei Engineering framework could be used to identify and analyze the conceptual model of trust. The questionnaire attribute, heart rate, index and collective intelligence could be used as a method to quantify the trust as human factors in agro-industry.

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