Analysis of socio-technical approach and Socio User Experience Network Analysis (SNA) to address objections ergonomic loom in the village of Lumban Suhi-Sahi

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Abstract. Technological change is a good thing, but not necessarily be accepted by users. There are several factors that can cause rejection of the technology by a community. This paper aims to present a socio-technical analysis of rejection looms with ergonomic design in the village of Lumban Suhi-Suhi, Samosir Island and efforts should be made so that the tool can be accepted by the community. To achieve this objective, conducted a socio-technical approach using Socio Network Analysis (SNA) and the analysis of User Experience (UX). Data on the UX include effectiveness, efficiency, ease of use, usability, satisfaction, and attractiveness used to assess the performance of looms and looms ergonomic long as a technical comparison. While the relationship between the individual craftsmen were also collected to determine the most influential figures in the environment craftsmen as materials for SNA. The results showed that there are some gaps UX values between the two types of tools. Recommended strategy is to change the seat backrest ergonomic loom and perform social approach on three key figures in the community.

Keywords: User Experience, Socio Network Analysis, Ulos, Ergonomic Looms, Technology Rejection

1. Introduction
Ulos is one of the famous traditional cloths cultural heritage of Indonesia. One of the central region Ulos craftsmen were on the island. The loom used in this area is called Partonungan. This tool is a tool that has been used legacy passed down from ancestors to today's generation. The design has never been change trough the time passed. Based on academic preliminary research obtained that Partonungan looms cannot fulfil the standards of ergonomics because the weavers are using Partonungan in a bent position to cause a risk of Musculoskeletal Disorder (MSDS). On the other hand, Lumban Suhi-Suhi village weavers used to weave in a long time every day. If they are pursuing a target for the market (onan), weaver can weave for seven hours a day non-stop. The work posture of worker using Partonungan is shown in Figure 1.
Based on the above problems, through the activities of the Working Group Toba Lake Region Tourism and Sustainable Tourism (KK-PKDT & PB) produced a tool called "ergonomic loom". Improvements made is the addition of benches, footrests, wooden construction that is lighter, and the removal of wood to bind the seat and seat looms that are not tied to the loom. The purpose of this improvement is that the weaver avoid stooped posture, thereby reducing the risk of Musculoskeletal Disorders (MSDs) due weaving activities carried out for 5-7 hours per day. The design of the ergonomic loom shown in Figure 2.

Ergonomic looms as research results have been produced and handed to the craftsmen. However, based on the reviews after the handover, this tool is no longer use by the weavers as expected. This condition indicating that the loom should be improved and so it can be re-used by the weavers. This paper analyses the factors that cause rejection of the use of the ergonomic loom and re-design solutions offer of ergonomic loom so ergonomic looms can be reusable.

Obstacles in applying the new technology is no longer a new thing in the world of industry. Several approaches have been carried-out to solve this problem. As performed Long, TB., Et al. [2] analyzed the situation of the producers and consumers of the barriers that lead to technological adaptations ever climate-smart agriculture in Europe. More research is about the difficulty of adaptation technologies decentralized renewable energy systems in Africa even though these technologies can improve living standards [3]. The study also reviewed the socio-technical aspects of society and its relationship with technology acceptance barriers. Both of these earlier studies, studied the habits of people to determine the source of the problems of adaptation technology barriers and assesses the technical side technology that is incompatible with the values of society. Follow the same logic, this study will also move from the public social analysis and studies to relate to the technical aspects of the technology, which will be
assess by using User Experience parameters. After that recommendations will be generated to increase the adoptability of the proposed technology.

Based on preliminary research, many people refuse to use ergonomic loom because they wanted to maintain the tradition to use Partonungan looms that was inheritance in their family. However, not all families have such a legacy looms, only they still refused to use the new looms, influenced by fellow craftsmen. These conditions need to be analysed to see who are the key figures that can be a bridge to instil the idea that good ergonomic loom used. This will be done by using Social Network Analysis (SNA).

2. Methods

2.1. Data collection

The data in this study is collected by questionnaires and direct observation in the Lumban Suhi-Suhi Village. There are 28 native artisan Involved in the study range from 10 to 46 years of experience. They are the expert of weaving from the area. This study sought to explore the barrier of the adoption of the ergonomics loom and to identify the technical aspect that could be enhanced to secure the adoption of the technology. This study was undertaken in Lumban Suhi-Suhi, Samosir Island, North Sumatra Province.

Data about the series of tasks done by artisan when weaving was collected as the subject of comparison in the technical use of each kind of loom. There are various questionnaires being used in this research, they are:

a. Single Ease Question (SEQ) questionnaire to see how satisfied respondents when using a traditional loom (Partonungan) and ergonomic loom.

b. System Usability Scale (SUS) questionnaires to see if traditional looms (Partonungan) and ergonomic loom are acceptable or not.

c. Kuesioner Attrakkdiff to gauge the views of respondents in terms of satisfaction with traditional loom (Partonungan) and ergonomic loom used.

d. Social Network Analysis (SNA) questionnaires aims to determine the interrelationship among weavers in order to discover which figures that may affect reception loom weavers in the community. Questionnaire form is open questionnaire with three questions that are used are:

1) Among the crafts-men who had received the ergonomic loom, to whom do you learn to use the tool?

2) When you have problems with the tool, to who do you comfortable to talk to?

3) When you feel uncomfortable in using the ergonomic loom, to whom do you communicate to decide to use or not to use the loom?

In this paper, the evaluation of answering of question 1 will discuss more intensively.

2.2. Data Analysis

Mainly two kind of analysis was being done. They are the social analysis and technical analysis. The technical approach will be carried out by the use of analysis User Interface. User Experience or UX commonly abbreviated as an overall experience of the user when using the product, system, or service. For the analysis of UX, the factors used in this study including Effectively which is calculated by the success rate of each task and Efficiency which is calculated by the minute of doing the task, Ease of Use which is calculated using SEQ, Usability using SUS [5], and Satisfaction using Attrakkdiff Questionnaire. Social analysis performed using SNA analysis. According Binsar and Dana [4] Social Network Analysis is a technique for studying the relationship or social relations among members of a group. Mapping knowledge within the framework of Social Network Analysis can be visualized or be represented by a matrix and graph form. Social Network Analysis is a development method for understanding the relationships between actors in a network system. The SNA will be done using software Ucinet 6.0 to get the key person for each question by using eigenvector and degree centrality as the parameter.
After these analyses was conducted, then recommendations will be given according those analyses. Including which part of technical issues to improve and which artisan need to be prioritized in assimilating the frame of mind that the new loom is fine to be used.

3. Result and Discussion

3.1. Result

The series of activities to be done in completing a piece of cloth Ulos, as shown in Table 1.

| No. | Task                                      | No. | Task                                      |
|-----|-------------------------------------------|-----|-------------------------------------------|
| 1   | Setting up the parts weave                | 6   | Tidy up the thread, with Balobas          |
| 2   | Installing Tundalan to waist              | 7   | Cross main thread with Turakipahan       |
| 3   | Tighten thread with Baliga                | 8   | Cross yarn pattern with Turak kilat      |
| 4   | Separating yarn with panggianuan          | 9   | Shifts Balobas to above sidurukan        |
| 5   | Set the fabric pattern with Lilies        | 10  | Reconstitute looms after used            |

Data in Table 1 represents the data used in the assessment of SEQ questionnaire for both types of looms. These task will be the technical value that determined the performance of each looms.

3.1.1. User Interface (UX) Analysis. UX analysis includes several dimensions, they are Effectivity and Efficiency, Ease of Use, Usability, and Satisfaction. Each dimension was rated for both types of looms to see performance comparison between the two. The difference in value between the two looms perspective is a value that would be ergonomic loom repair parameters.

Dimension Effectiveness rated to determine the level of success in performing the task [6], while the efficiency dimension is used to determine the time required to perform each task in Table 1 for each tool. Figure 3 shows the results of measurements of the dimensions of effectiveness.

![Effectivity value comparison between Partonungan and Ergonomics Loom](image)

**Figure 3.** Effectivity value comparison between Partonungan and Ergonomics Loom

Table 2 shows the results in measurement efficiency of each task using both tools. The results are comparing.
### Table 2. Efficiency value comparison between Partonungan and Ergonomics Loom

| Task   | Partonungan (Minute) | Weaving Tool Ergonomics (Minute) |
|--------|----------------------|----------------------------------|
| Task 1 | 168                  | 182                              |
| Task 2 | 55                   | 181                              |
| Task 3 | 144                  | 167                              |
| Task 4 | 153                  | 183                              |
| Task 5 | 347                  | 518                              |
| Task 6 | 151                  | 222                              |
| Task 7 | 45                   | 70                               |
| Task 8 | 41                   | 67                               |
| Task 9 | 44                   | 135                              |
| Task 10| 46                   | 111                              |
| Total  | 1194                 | 1836                             |
| Average| 119.4                | 183.6                            |

Based on Figure 3 and Table 2 above, the Partonungan looms are more effectively and efficiently used because it has fewer errors and faster to use. This can be caused by several factors, such as craftsmen has not been accustomed with a new engine, or the new machine has some bugs in its use.

Dimensions Ease of Use calculated knowing how easily respondents in using Partonungan looms and ergonomics looms during a series of weaving activities. Determination of Ease of Use questionnaires Single Ease Question (SEQ). Comparison of the results of calculating the dimensions of Ease of Use is shown in Figure 4.

![Ease of Use Comparison](image)

**Type of Looms**
- Partonungan
- Ergonomics

**Figure 4.** Comparisons of Weaving Tools Ease of Use Dimension between Ergonomic Looms and Partonungan

From the chart above we can conclude that the average weaver find it very difficult to perform a second task that is putting tundulan to their waist on ergonomic loom that obtain a value of 6.5 which means weaver very difficult to do the task. The smallest value obtained on the 3rd task that is tighten threads with baliga with a value of 2.86 which means it is easy to do.

Usability dimension analyzed by looking at the total value of the use of ergonomic loom and Partonungan based on questionnaires System Usability Scale (SUS). Based on the calculation Partonungan loom that get a score value of 82.86 were included into the excellent category and ergonomic loom score was 56.61 which included into good category. This shows that looms ergonomic considered quite beneficial in weaving, but more craftsmen find it easy to use the loom Partonungan.
Satisfaction dimension obtained from the result of questionnaires Attrakdiff recapitulation. The average satisfaction value of the Partonungan loom is at 40.07 which is higher than its value ergonomic loom which only valued at 29.21. Based on the questionnaire attrakdiff, it is found that the average value of each dimension of satisfaction from the quality of pragmatic, hedonic quality-identity, hedonic quality-simulation, and attractiveness, looms Partonungan has a higher value than the ergonomic loom. The lowest value was on pragmatic quality which is compatibility of tools functions to achieve its goals. This shows that the ergonomic looms less attractive because it can satisfy the expectations / the needs of the users in terms of its functionality.

3.1.2. Socio using SNA. SNA calculation results are grouped on the answers of the three questions on the questionnaire SNA (see section 2.1 (d)). The result analysis SNA diagram of question 1 using Ucinet 6.0 program is shown in Figure 5.

Figure 5. Relationship diagrams Question 1

Figure 5 shows the results of the first question is "Among the craftsmen who had received the ergonomic loom, to whom do you learn to use the tool?". The biggest green circle marks show the craftsmen who have the highest voting results based on questionnaires SNA. The quantitative indicators are the score of eigenvector and degree centrality. Figure 5 indicate that the craftsman with the initials RST is a figure who became a role model in the study of ergonomic loom. Recapitulation of workers with the highest score for the third SNA question are shown in Table 3.
Table 3. The most influential social craftsmen in the community based SNA Analysis

| No. | Question | Initials Name Craftsmen and Scores | Scores eigenvector | Score Degree centrality |
|-----|----------|-----------------------------------|--------------------|-------------------------|
| 1   | Among the craftsmen who had received the ergonomic loom, to Whom do you learn to use the tool? | 1. RST = 0.429 2. PS = 0.387 3. MYS = 0.323 | 1. RST = 22.00 2. PS = 18.00 3. SP = 16.00 |
| 2   | When you have problems with the tool, to Whom do you comfortable to talk to? | 1. PS = 0.520 2. MYS = 0.335 3. RST = 0.291 | 1. PS = 25.00 2. RST = 19.00 3. TAS = 15.00 |
| 3   | When you have problems with the tool, to Whom do you comfortable to talk to? | 1. PS = 0.526 2. RST = 0.300 3. MSY = 0.296 | 1. PS = 25.00 2. RST = 17.00 3. NUS = 16.00 |

3.2. Discussion

Based on this research, ergonomic loom has many shortcomings in its performance compared Partonungan looms. So it required some adjustments so that the loom can be accepted by the craftsmen. The strategy proposed for improvements include:

1. Technical factors
   Based on the results of the assessment several dimensions UX, Partonungan looms have a better performance than the ergonomic loom. The main problem of ergonomic looms located on the movement constraint in using a loom ergonomic for weaving, thereby reducing the sense of comfort and productivity craftsmen. Dimensions of Effectivity, Efficiency, and Ease of Use showed the lowest value in task 2 which is to install tundalan to their waist. This is because the backrest on the seat which restrict the movement of the craftsmen’s elbow. Hence the backrest of the chair are advised to be fixed so as not to disturb the movement of craftsmen in weaving.

![Figure 6. Position ergonomic backrest on Ergonomic looms](image)

2. Factors Social Analysis
   Each community has a different social dynamics depending on the circumstances of each. There are communities that tend to move in the interests of the group [7] and [8] and some are individual. Based on social factors, figures that may affect acceptance loom weavers in the use of the character ergonomic RST, PS, and MYS. These people are the most senior figures correspond to weavers’ social culture community in the Lumban Suhi-Suhi Village. These characters are people who has the longest experience to work as a weaver and has the greatest social status in the community of craftsmen. This is in accordance with the customs of local culture, which is still very strong with traditional Batak culture. This trend indicates that the weavers’ community will tend to follow the advice or direction of the three characters.
4. Conclusion

Transition of technology is concerning not only the potential benefits to be gained but also the adoptability of the technology to the users. In this study, the ergonomically designed loom is not well accepted by the craftsmen because they prefer to use their family legacy looms. This condition is not desirable, because the old designed could cause the MSDS for the craftsmen in the long term of use. The socio-technical approach is done to increase of the adoptability of the new technology. For the technical aspect, it is found that the old loom design is more effective and easy to use compare to the new design. The main cause is the back of the chair, which impede the movement of craftsmen at work. To facilitate the social approach, then there are three figures that should be prioritized is RST, PS, and MSY who has a big social influences over the weavers in this community.

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