# DESIGN OF WORKING SHELF AND DESIGN OF LAYOUTS ON THE WORKING TABLE WITH ERGONOMIC ANALYSIS IN HAISO COFFEE

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## ABSTRACT

In this modern age, where information, communication, and technology are developing rapidly, the food & beverage industry began to appear one by one, seeing this phenomenon as a promising business opportunity. Haiso Coffee is an example of a business in this food & beverage industry that focuses on the coffee-based drink that has recently started its business in the retail world. The problems that can be seen during the observation are the working table that still looks not tidy and neat and the worktable is not high enough, seen from the barista posture. Therefore, the research intends to design a tool that can help fix haiso coffee. The working table's design is adjusted according to the needs that haiso coffee required the matrix of needs and interests, which is based on data collected from interviews. The working table has designed a thick base to adjust an ergonomic working table's height with several additional functions. The first shelf functions as a storage and placing several machines and materials on the working table. The second one is for the showcase, which serves as a display for several haiso coffee products.

**Keyword:** Product Design, LayOut**,** ARC, ARD, AAD Ergonomics, RULA.

## 1. Introduction

The development of technology created by the humans is a dynamic process and will always evolve. The impact of current technological developments has led to the emergence of many industries in the F&B (food and beverage) sector, especially the "trendy" beverage. Haiso coffee is a newcomer to the F&B industry business, which focuses on selling coffee-based beverages in the West Jakarta area. This company has three work stations in producing the various menus they offer. The three work stations are a food station, an expresso base station, and a Manual Brew station.

After conducting brief observations and observations at Haiso Coffee, a problem was found at the manual brew station one of its work stations. The problems were found on the working table, where the workbench conditions were not well-structured, where the equipment and materials on the production table were simply exposed on the table, and there was no proper barrier between producers and consumers. The divider is only the working table itself. It is necessary to fix this problem; a working table is needed that is useful as a position regulator and layout of machine and materials on the working table and a barrier between consumers and producers.

There is also, the purpose of this research being carried out is to design the layout of the facilities (equipment and materials) on the working table. The design uses ARC (Activity Relation Chart), ARD (Activity Relation Diagram), and AAD (Activity Allocation Diagram) as a basis for layout design. The layout results from the design will be applied to the design tools to be designed.

## 2. Literature Review

### 2.1. Product Design and Development

Product design and development is an activity that begins with the analysis of market opportunities and perceptions and ends with the manufacturing, sales, and delivery stages of the product. Besides, product design and development can also be interpreted as a sequence of activities or steps in which a group tries to compile, design, and market a product [1].

The Product Development Process is a sequence of steps for converting a set of inputs into a set of outputs. The product development process is a sequence of steps or activities in which a company seeks to organize, design, and commercialize a product. Product design is a plan to create an object, system, component, or structure. In a broader sense, the design is an applied art and engineering integrated with technology [2].

### 2.2. Verein Deutcher Ingenieure 2221 (VDI 2221)

The VDI 2221 method (Verein Deutcher Ingenieure) is an engineering design method that uses a systematic approach to solve a problem and optimizes the use of materials and technology. This method will simplify and assist in designing a product, facilitating the learning process for beginners, and optimizing the designer's productivity in finding the most optimal problem solving [3]. There is a theoretical aspect of the main stages of implementing the design process and its explanation. In design, task clarification is the first stage of the design process. Clarifying tasks is an activity carried out in the form of gathering information and design constraints. The results obtained are in the form of a specification of the design criteria. Clarification of the assignment can be done with the following questions: What are the design problems? How does design produce the results? Are there any restrictions on the design? Does the selected concept meet the design objectives? Things that are owned and not owned by the design results [4].

### 2.3. The layout of the Machine and Materials on the Working Table

Facility layout is a function that involves analysis (synthesis), planning and designing between the arrangement of physical facilities, movement of materials, activities related to personnel and the flow of information needed to achieve optimal performance [5]. The layout is an organization of the company's physical facilities to increase the efficiency of the use of equipment, materials, people, and energy. The facility layout design is essential in determining activities and the relationship between facilities, equipment, materials, people, and energy to achieve efficient and effective production goals. With the positioning of the machine, the area of work, the smooth movement of materials, the number of workers, and storage, both temporary and permanent, will be organized in such a way as to increase production and minimize production costs [6].

### 2.4. Activity Relationship Chart (ARC)

Activity Relationship Chart or Work Relationship Map is an activity between each part that describes the room's importance or proximity. In other words, the Activity Relationship Chart (ARC) is a map prepared to determine the level of relationship between activities that occur in each area in pairs. Activity Relationship Chart (ARC) Activity Relationship Chart (Activity Relationship Chart) ARC) is used to analyze the level of relationship or activity relationship between one room and another (activity relationship chart) [7].

### 2.5. Activity Relationship Diagram (ARD)

Activity Relationship Diagram is a diagram of the relationship between the linkage approach's activities, which shows each activity as a basic model for planning the relationship between the flow of goods and the location of service activities associated with production activities. Before making ARD, the next step is to prepare the template block, and the template block is a template that contains the activity center and the level of relationship between each activity center [8].

### 2.6. Area Allocation Diagram (AAD)

The Area Allocation Diagram is, in principle, an area template that is structured based on ARD. AAD is a description of the final layout but each activity center does not contain facilities. Area Allocation Diagram (AAD) is a continuation of ARC where the proximity of the activity layout is determined in an Area Allocation Diagram (AAD). AAD is also a global template that can be seen only by area utilization. In contrast, the complete picture can be seen in the template, which is the final result of the analysis [8].

### 2.7. Ergonomics

Ergonomics is a science that focuses on humans' discussion as the main element in a working system. Experts in their fields issue many definitions of ergonomics. The term ergonomics comes from Latin, namely ERGON (work) and NOMOS (natural law), so ergonomics can be interpreted as the study of human aspects of the work environment that are reviewed from anatomy, physiology, psychology, engineering, management, and design/design for getting a work atmosphere in accordance with the human being [9].

### 2.8. Anthropometry

Anthropometry comes from "anthro," which means human and "metric," which means size. Anthropometry is a study of measuring the human body dimensions of bone, muscle, and adipose or fat tissue. Anthropometric data is used for various purposes, such as designing work stations, work facilities, and product design in order to obtain a size that is appropriate and appropriate to the dimensions of the human limb that will use it. Anthropometric data can be applied in several ways, including [9].

### 2.9. Rapid Upper Limb Assessment (RULA)

RULA or Rapid Upper Limb Assessment was developed to assess unpredictable types of work postures. The RULA method is a method for analyzing ergonomics of body posture at work using the upper body. RULA analysis is carried out if there are reports of complaints in the upper body caused by unergonomic postures. The RULA method is easy to use because it does not require special equipment in its implementation. Some of the factors analyzed by the RULA method are as follows: work position in a static state, workload, work duration, muscle energy used [10].

# 3. Research Methodology

This research was conducted at Haiso Coffee, which is located in West Jakarta, DKI Jakarta. This research was conducted by collecting data in direct interviews to fill out the needs matrix. This research is to make tools so that work is more efficient and effective to develop production quality. This study also aims to design the layout of the tools and materials on the manual brew station's working table. The research methodology flowchart can be seen in Figure 1.

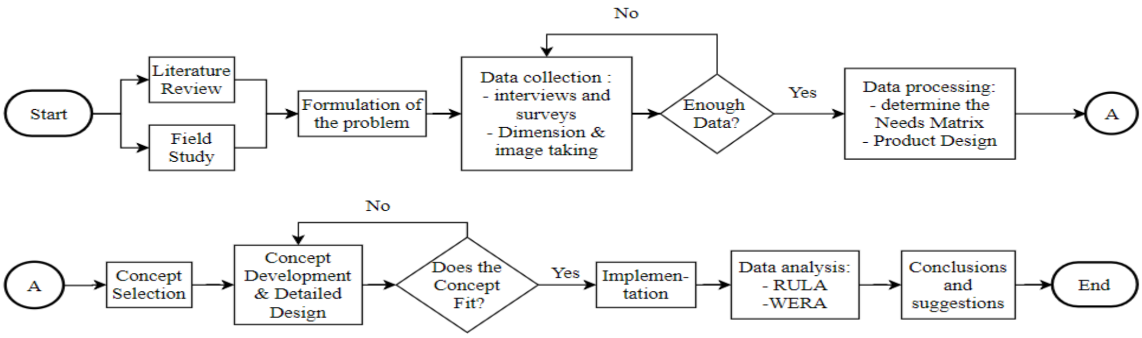



Figure 1. Research Methodology

# 4. Results And Discussion

## 4.1. Design Stage

In designing a tool, several steps must be taken to get an alternative to the design and be chosen. The needs matrix is a matrix that has a function to describe what the customer needs in making the desired product. This matrix is obtained based on the results of interviews with baristas and owners of Haisoo coffee. We can see the requirements matrix in Table 1.

Table 1. Requirements Matrix

| No | Requirements | Importance |
|---|---|---|
| 1 | Functional | 5 |
| 2 | Comfortable to use | 4 |
| 3 | Aesthetics and Neatness | 5 |
| 4 | Affordable product prices | 4 |
| 5 | Not easily broken | 5 |
| 6 | Accordance with the Workbench | 5 |

The technical specifications that have been determined will then be linked to each requirement in the matrix. Detailed technical specifications can be seen in Table 2.

Table 2. Technical Specifications

| No | Requirements | Technical Specifications | Unit |
|---|---|---|---|
| 1 | 1,2,3,4,6 | Shape Shape | Subjective |
| 2 | 2,4,6 | Product Dimensions | Cm |
| 3 | 2,3,4,5,6 | Type of Product Material | List |

This matrix has a function to show the relationship between the requirements matrix and technical specifications. The results of making the need metrics matrix can be seen in Table 3.

Table 3. Need Metrics

| Description: ● = 9 ○ = 3 △ = 1 | | Metrics | Product Shape | Product Dimensions | Type of Product Material |
|---|---|---|---|---|---|
| **No.** | **Requirements** | **IMP** | | | |
| 1 | Functional | 5 | △ | | |
| 2 | Comfortable to use | 4 | ○ | ○ | △ |
| 3 | Aesthetics and Neatness | 5 | ● | | △ |
| 4 | Affordable product prices | 4 | ○ | ○ | ○ |
| 5 | Not easily broken | 5 | | | ○ |
| 6 | Accordance with the Workbench | 5 | ○ | ● | △ |
| | Total Score | | 89 | 69 | 41 |
| | Rating | | 1 | 2 | 3 |

Based on the results of filling in the need metric matrix, we get results in the form of ratings that will be prioritized in product design and manufacture. The product's form was chosen to be in the first rank because it got the largest total value, namely 89. The product's form has a very important bond with aesthetics & neatness and comfort in using the product. The second rank is filled with product dimensions, which have a total value of 69. The product dimensions have a very important bond with the suitability of the working table. Type of Product Ingredients ranks third with a total value of 41. The shape of the product also has a very important bond with Product Price and Durability. After determining the specified specifications' rank, then next is the creation of a concept tree from these specifications.

The concept classification tree has the function of dividing problem solving into different classes to compare them easily. The concept classification tree can be seen in Figure 2.

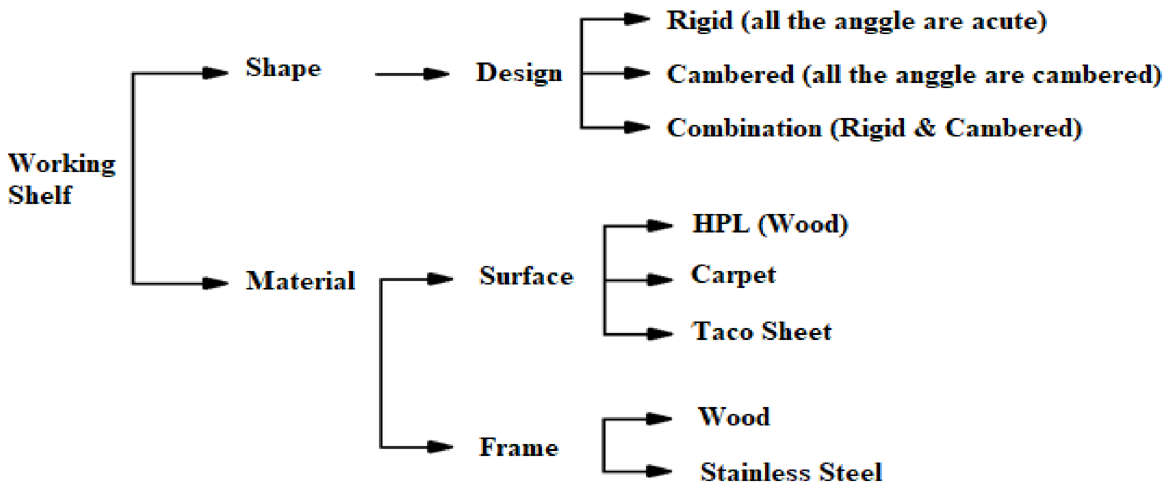



Figure 2. Concept Classification Tree

It can be seen that many possibilities and alternative product concepts to be designed. From this concept tree, we get 18 alternative concepts. Which we will discuss to get the best alternative concept. The concept screening matrix can be seen in Table 4.

Table 4 Concept Screening Matrix

| | | Selection Criteria | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Functional | Comfortable To Use | Aesthetics And Neatness | Affordable Product Prices | Not Easily Broken | Accordance With the Workbench | Amount (+) | Amount (0) | Amount (-) | Total Score | Rate | Continued |
| | Ref | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| Alternative Concept | 1 | + | + | - | + | 0 | 0 | 3 | 2 | 1 | 2 | 3 | No |
| | 2 | + | - | - | 0 | 0 | 0 | 2 | 2 | 2 | 0 | 5 | No |
| | 3 | + | 0 | 0 | + | 0 | 0 | 2 | 4 | 0 | 2 | 3 | No |
| | 4 | + | + | - | + | 0 | - | 3 | 1 | 2 | 1 | 4 | No |
| | 5 | + | - | - | + | 0 | - | 2 | 1 | 3 | -1 | 6 | No |
| | 6 | + | 0 | 0 | + | 0 | - | 2 | 3 | 1 | 1 | 4 | No |
| | 7 | + | + | 0 | + | 0 | + | 4 | 2 | 0 | 3 | 2 | Yes |
| | 8 | + | - | 0 | + | 0 | + | 3 | 2 | 1 | 2 | 3 | No |
| | 9 | + | 0 | + | + | 0 | + | 4 | 2 | 0 | 4 | 1 | Yes |
| | 10 | + | + | - | - | + | 0 | 3 | 1 | 2 | 1 | 4 | No |
| | 11 | + | - | - | - | + | 0 | 2 | 1 | 3 | -1 | 6 | No |
| | 12 | + | 0 | 0 | - | + | 0 | 2 | 3 | 1 | 1 | 4 | No |
| | 13 | + | + | - | - | + | - | 3 | 0 | 3 | 0 | 5 | No |
| | 14 | + | - | - | - | + | - | 2 | 0 | 4 | -2 | 7 | No |
| | 15 | + | 0 | 0 | - | + | - | 2 | 2 | 2 | 0 | 5 | No |
| | 16 | + | + | + | - | + | + | 5 | 0 | 1 | 4 | 1 | Yes |
| | 17 | + | - | 0 | - | + | + | 3 | 1 | 2 | 1 | 4 | No |
| | 18 | + | 0 | - | - | + | + | 3 | 2 | 1 | 2 | 3 | No |

After doing concept screening, 3 concepts were found with the highest scores, namely concepts 7, 9, and 16. After that, an alternative morphology of the selected concepts was made from the three concepts. The following is an Alternative Morphology of Selected Concepts and Alternative Concepts for Phase 2, which we can see in Table 5 and 6.

Table 5. Morphology of Selected Concepts

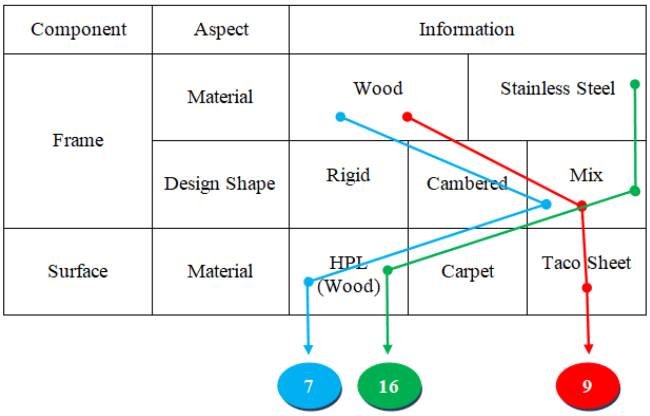



Table 6. Alternative Concepts for Phase 2

| Alternate | Material | Design Shape | Surface Material |
|---|---|---|---|
| 7 | Wood | Mix | Wood (HPL) |
| 9 | Wood | Mix | Plat Stainless |
| 16 | Stainless Steel | Mix | Taco Sheet |

Based on table 5 and 6, there are 3 types of alternative concepts, which we will again filter into one best concept using the concept assessment matrix, which we can see in Table 7.

Table 7. Concept Assessment Matrix

| Selection Criteria | Burden (%) | **Reference** | | **Alt 7** | | **Alt 9** | | **Alt 16** | |
|---|---|---|---|---|---|---|---|---|---|
| | | Score | Value | Score | Value | Score | Value | Score | Value |
| Functional | 15, 625 | 3 | 0,47 | 5 | 0,78 | 5 | 0,78 | 5 | 0,78 |
| Comfortable to use | 12,5 | 3 | 0,37 | 5 | 0,63 | 5 | 0,63 | 4 | 0,50 |
| Aesthetics and Neatness | 15, 625 | 3 | 0,47 | 5 | 0,78 | 5 | 0,78 | 5 | 0,78 |
| Affordable product prices | 12,5 | 3 | 0,37 | 4 | 0,50 | 4 | 0,50 | 3 | 0,37 |
| Not easily broken | 15, 625 | 3 | 0,47 | 4 | 0,63 | 4 | 0,63 | 4 | 0,63 |
| Accordance with the Workbench | 15, 625 | 3 | 0,47 | 5 | 0,78 | 5 | 0,78 | 5 | 0,78 |
| Water Resistant | 12,5 | 3 | 0,37 | 5 | 0,63 | 4 | 0,50 | 5 | 0,63 |
| Total | 100,00 | 21 | 3,00 | 33 | 4,72 | 32 | 4,59 | 31 | 4,34 |
| **Rate** | | | | **1** | | **2** | | **3** | |

Based on the concept assessment matrix, one concept was selected with the highest value, with a total value of 4.72. Based on the selected concept classification, the selected concept design can be made, which can be seen in Figure 3.

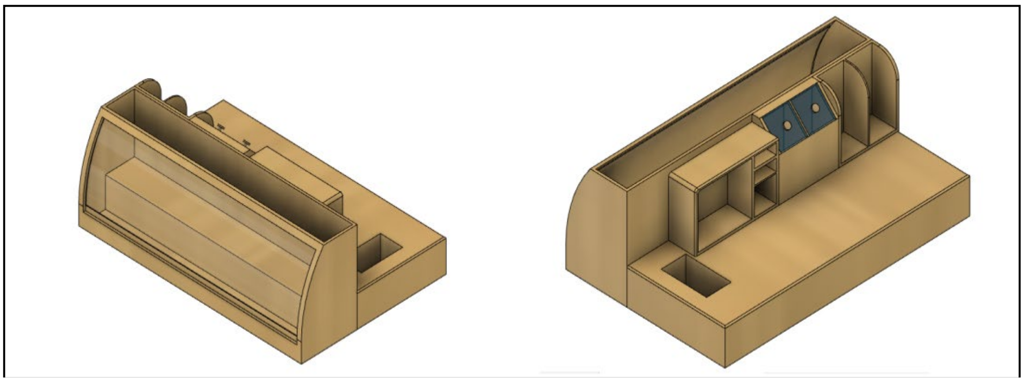


Figure 3. Selected Concept Design

### 4.2. Product Detail Development

After obtaining the selected Alternative Concept, we will make the concept based on product design, which will be further developed through several stages.

### 4.3. Activity Relationship Chart

It was making ARC using reason codes to make it easier to analyze the relationship between work stations. The reason code is coded A, E, I, O, U, so it makes it easier to analyze the proximity relationship between work stations. The following is an ARC image and an ARC worksheet in Figure 4 and Table 8

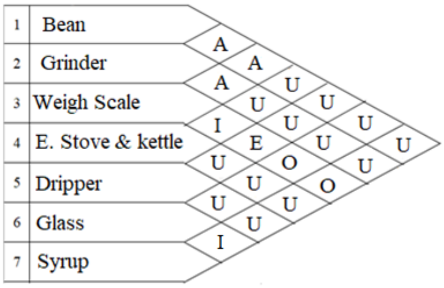



Figure 4 Activity Relationship Chart

Table 8. ARC Worksheet

| *Relationship* | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| A | 2,3 | 1,3 | 1,2 | - | - | - | - |
| E | - | - | 5 | - | 3 | - | - |
| I | - | - | 4 | 3 | - | 7 | 6 |
| O | - | - | 6,7 | - | - | 3 | 3 |
| U | 4,5,6,7 | 4,5,6,7 | - | 1,2,5,6,7 | 1,2,4,6,7 | 1,2,4,5 | 1,2,4,5 |

### 4.4. Activity Relationship Diagram (ARD)

ARD is a method in determining the layout of departments based on predetermined relationships. Based on the ARC and worksheets that have been made, the ARD design can be continued. The following is a picture of the activity relationship Diagram in Figure 5.

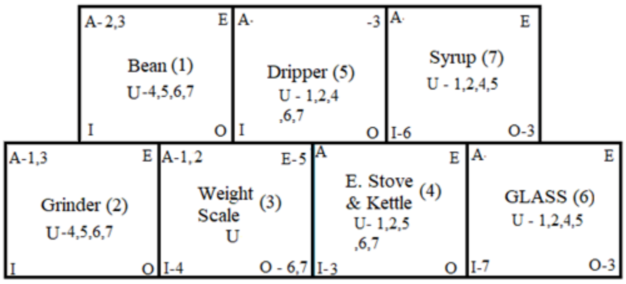



Figure 5. Activity Relationship Diagram

### 4.5. Area Allocation Diagram (AAD)

The Area Allocation Diagram (AAD) at the manual brew haiso coffee station is made based on the activity relationship diagram (ARD). Where AAD is a description of the layout of the equipment and materials, which are redesigned based on the close relationship between the attachment and the material. The following is a picture of the Activity Allocation Chart in Figure 6.

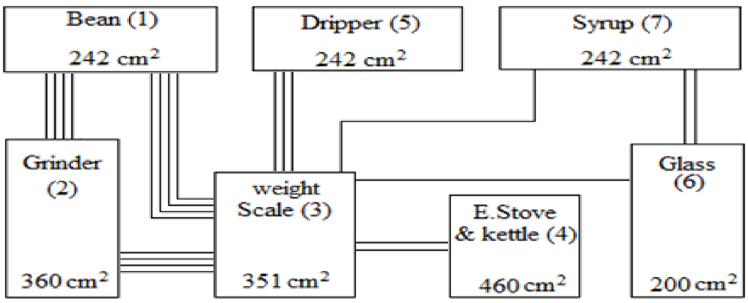



Figure 6. Activity Allocation Diagram

After obtaining the Area Allocation Diagram (AAD) as a layout design, we can immediately apply it to the land/space in the work shelf design for its arrangement. The following is a Phase-2 Plan Figure after determining the layout of each tool and material. We can see the Stage-2 Design Plan in Figure 7.

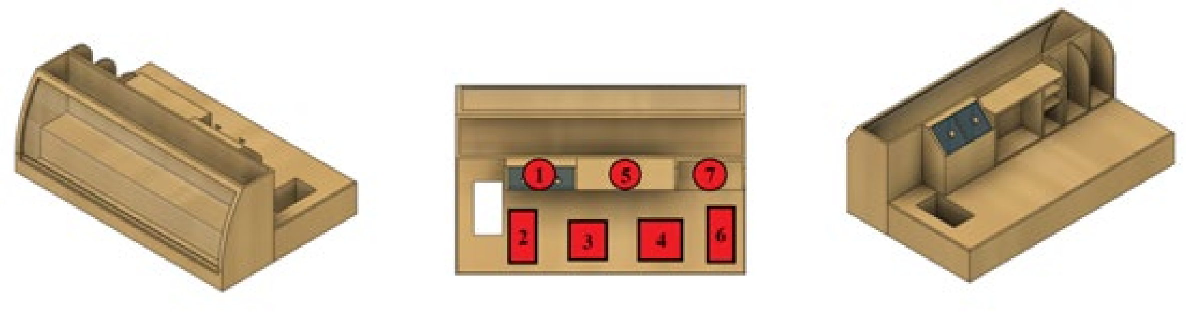
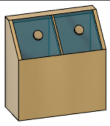
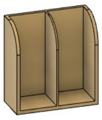
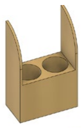
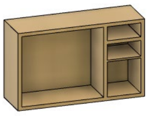
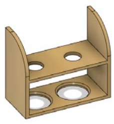
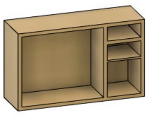
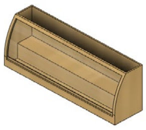
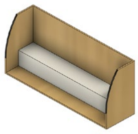
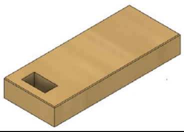
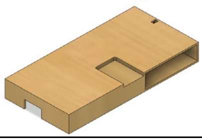



Figure 7. Design Phase-2

### 4.6. Detail Development

The next step action is to develop the details. The components in the design will be developed in more detail. We can see the detail component development table in Table 9.

Table 9. Detail Component Development of Working Table

| No | Component | Before Modification | After Modification | Description |
|---|---|---|---|---|
| 1 | *Showcase* |  |  | Changes occur in the form to adapt to the shape of the coffee bean storage tube and add aesthetic value. |
| 2 | *Workbenck Surface* |  |  | Changes occur in the form to add aesthetic value, and adjust to the shape of the syrup bottle. |
| 3 | *Coffee Bean Rack* |  |  | Changes to the concept and form to suit the dripper model used by haiso coffee better. |
| 4 | *Syrup Rack* |  |  | Changes in the form of the shelf to adjust the shape of the material that will be stored. |
| 5 | *Dripper Rack* |  |  | Changes to the concept by removing glass in order to make it easier to use. |
| 6 | *Dripper Paper shelf* |  |  | Changes occurred in form to improve tidyness in cable management and scale location adjustments. |

After the development of several components in the design of the work rack tools, there were changes to the design which resulted in the final design design. The following is the final design we can see in Figure 8

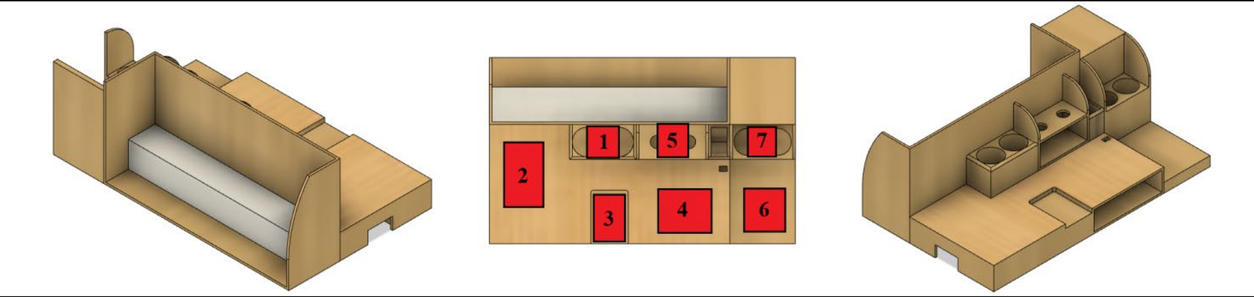



Figure 8 Final Design of Working Table

After obtaining the working table's design, a specification of the dimensions of the working table can be made using the basis of Indonesian anthropometric tables. The concept specifications for assistive devices can be seen in table 10.

Table 10. Specifications for Assistive Devices of the Working Table

| **Dimensions Part** | **Used Body Part** | **percentile** | **Leeway** | **Dimensions** |
|---|---|---|---|---|
| Work Shelf Height | Elbow Height (D4) | 50% | 3 % | 13 mm |
| Work Shelf Width | Forward Grip Length (D36) | 50% | 3 % | 69.5mm |

There are several additional feature components in tool design. These components function as containers or working table for laying machines and materials and facilitate work when using these work aids. These components consist of shelves that can have different shapes and dimensions. There is an additional storefront as a barrier between consumers and producers, as well as a means for display. The specifications of these components can be seen in Table 11.

Table 11. Working Table Components Specifications

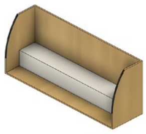
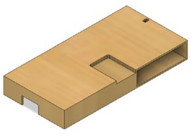
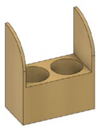
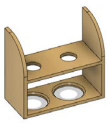
| No. | Component | Picture | Material | Dimensions (mm) |
|---|---|---|---|---|
| 1. | Showcase |  | Wood | 900 x 250 x 390 |
| 2. | Workbench Surface |  | Wood | 900 x 695 x 120 |
| 3. | Coffee Bean Rack |  | Wood | 250 x 130 x 130<br>Diameter 110 |
| 4. | Syrup Rack |  | Wood | 245 x 130 x 340<br>Diameter 100 |
| 5. | Dripper Rack |  | Wood | 270 x 130 x 245<br>Diameter: 50 |
| 6 | Dripper Paper shelf |  | Wood | 65 x 130 x 110 |

Figure 9 is the working table design and engineering drawing sheet along with the dimensional specifications.

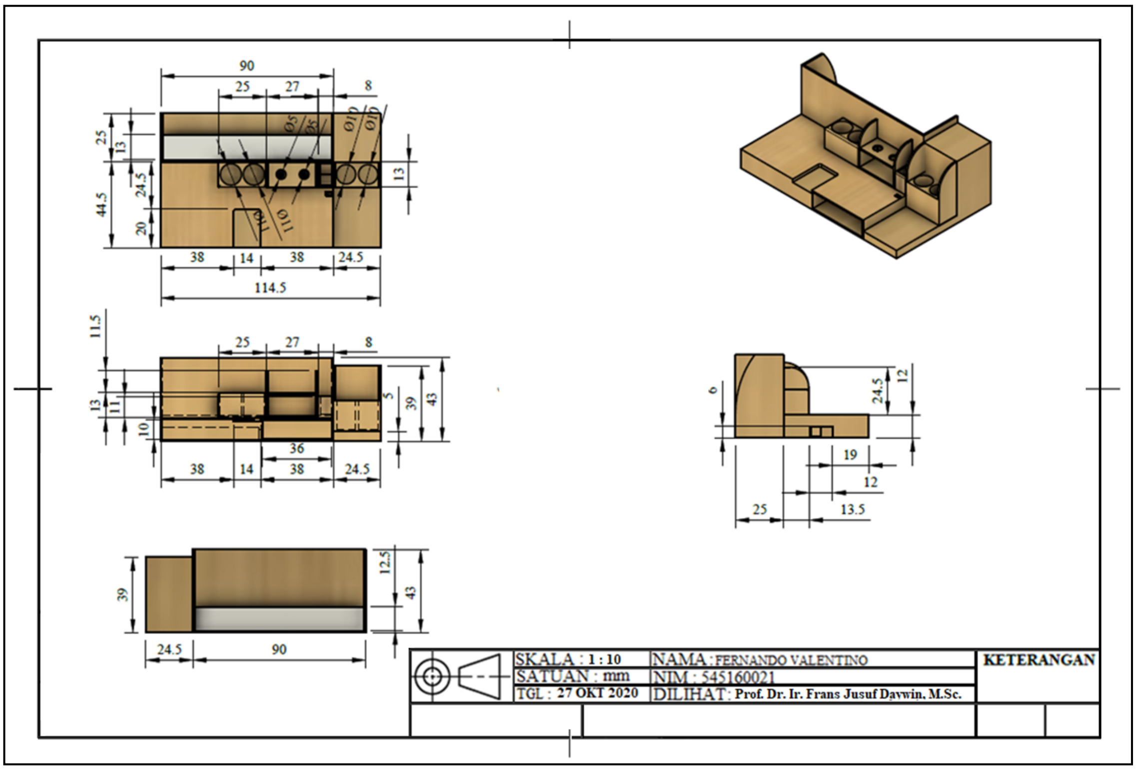



Figure 9. Design Engineering Drawing sheet

## 5. Analysis After implementation

After the work aids have been made, an ergonomic analysis is carried out to determine the comparison between implementation and implementation. The ergonomic analysis uses 2 methods, namely the RULA method and the WERA method. The first analysis conducted was an analysis using the RULA method. We can see the comparison of the RULA analysis results before and after implementation in table 12.

Table 12. Comparison of RULA Analysis Results Before and After Implementation

| Illustration / Activity | Before Implementation | After Implementation |
|---|---|---|
| *Grinding* | 5 (High) | 3 (Low) |
| *Brewing* | 5 (High) | 3 (Low) |

The second analysis performed was an analysis using the WERA method. We can see the Comparison of the Results of WERA Analysis before and after Implementation in Table 13 below.

Table 13. Comparison of the Results of WERA Analysis before and After Implementation

| Remarks / Activity | Before Implementation | After Implementation |
|---|---|---|
| *Grinding* | 29 (Medium) | 21 (Low) |
| *Brewing* | 29 (Medium) | 23 (Low) |

From the comparison of the ergonomic analysis results that has been done using the 2 methods above, we can see that there is a decrease in the value of the risk in both methods. This condition proves that the level of ergonomics of activities has increased and this is a good thing.

## 6. Conclusion

From the research results at the Haiso Coffee shop, after observing and using quantitative methods to collect the required data, several problems were found, namely the arrangement of the layout of production machines and materials on a messy work table unorganized cable management, and several complaints. To overcome this problem of the working table design is made that can increase the height of the work table and adjust the position of the production tools and materials. In the design process, 18 basic concepts were obtained based on the Concept Classification Tree. And with the help of a matrix, the conceptual needs are eliminated to get the one best concept. After the basic concept is selected, concept development is carried out. Concept Development in the form of layout design, development of shape, function, and size so that the resulting product is in accordance with what is needed can be a solution to problems. In layout design, ARC, ARD, and AAD are used to adjust each component's position. In setting the dimensions, it is adjusted to the needs and Indonesian anthropometric data. After that, the final concept is ready to be produced. The ergonomic analysis carried out using 2 methods, namely RULA and WERA, shows a decrease in the risk value after implementing the designed working table. This proves that the existence of work and activity aids becomes more ergonomic, efficient, and effective.

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# Biography

**Fernando Valentino** was born in Jakarta, Indonesia on 6th September 1998, He graduated from a highly respected high school in Jakarta, Dharma Suci Highschool. He is cuttently on her last year in Universitas Tarumanagara, majoring in Industrial Engineering. He is also active in various activities held by the department, such as become the comitee of social service events, becoming comitee comparative study program, etc .In 2019 he had an internship at PT Kumala Buana Jaya

**Frans Jusuf Daywin** was born in Makasar, Indonesia on 24th November 1942. is a lecturer in the Department of Agricultural Engineering at Faculty of Agricultural Technology Bogor Agricultural University since 1964 conducted teaching, research, and extension work in the field of farm power and machinery and become a professor in Internal Combustion Engine and Farm Power directing and supervising undergraduate and graduate students thesis and dissertation and retired as a professor in 2007. In 1994 up to present as a professor in Internal Combustion Engine and Farm Power at Mechanical Engineering Program Study and Industrial Engineering Program Study Universitas Tarumanagara, directing and supervising undergraduate student's theses in Agricultural Engineering and Food Engineering Design. In 2016 up to present teaching undergraduate courses of the introduction of concept technology, research methodology, and seminar, writing a scientific paper and scientific communication, and directing and supervising undergraduate student's theses in Industrial Engineering Program Study at the Faculty of

Engineering Universitas Tarumanagara. He got his Ir degree in Agricultural Engineering, Bogor Agricultural University Indonesia in 1966, and finished the Master of Science in Agricultural Engineering at the University of Philippines, Los Banos, the Philippines 1981, and got the Doctor in Agricultural Engineering, Bogor Agricultural University Indonesia in 1991. He joined 4-month farm machinery training at ISEKI CO, AOTS, Japan in 1969 and 14 days agricultural engineering training at IRRI, Los Banos the Philippines, in March 1980. He received the honors "SATYA LANCANA KARYA SATYA XXX TAHUN" from the President of the Republic of Indonesia, April 22nd, 2006, and received appreciation as Team Jury from the Government of Indonesia Minister of Industry in Industry Start-Up 2008. He did several research and survey in the field of farm machinery, farm mechanization, agricultural engineering feasibility study in-field performance and cost analysis, land clearing and soil preparation in secondary forest and alang-alang field farm 1966 up to 1998. Up till now he is still doing research in designing food processing engineering in agriculture products. Up to the present he already elaborated as a conceptor of about 20 Indonesia National Standard (SNI) in the field of machinery and equipment. He joins the Professional Societies as a member: Indonesia Society of Agricultural Engineers (PERTETA); Indonesia Society of Engineers (PII); member of BKM-PII, and member of Majelis Penilai Insinyur Profesional BKM-PII.

**Adianto** was born in Semarang, Indonesia on 29th April, 1955. Adianto completed his "Sarjana Fisika Degree" in 1982 from the Physics Department of the Faculty of Sciences and Mathematics, Gadjah Mada University, Yogyakarta. In 1978 when he got his Bachelor of Science in Physics (B.Sc.) he started working as a Staff of "Field of Nuclear Physics Laboratory"," Pure Materials Research Center and Instrumentation Yogyakarta", Atomic Energy Agency (BATAN). In 1986 to 1993 he received a scholarship from the Ministry of Research and Technology of the Republic of Indonesia to continue his studies in England at the Department of Electronic and Electrical Engineering, University of Salford, England. He received his M.Sc. degree in the field of Computer Instrumentation in 1988 and a Ph.D. degree in the field of Material Science in 1993. He returned back to Indonesia, then in 1994 he moved to Jakarta and appointed as a "Head of Engineering and Advanced Technology", (Echelon IIIA) at "Nuclear Science and Technology Empowerment Center", Atomic Energy Agency, BATAN, Jakarta. In 2000 He was assigned to the Ministry of Research and Technology to serve as Assistant Deputy for Science Accreditation and Development Center (Echelon IIA) and in 2005 he was assigned as Assistant Director for Academic Affairs, to Organize Graduate Research in PUSPIPTEK Serpong. In 2008, he took early retirement as a Government Official to take a full time lecturer at Universitas Tarumanagara, Jakarta. Adianto started his profession as a lecturer in the Department of Mechanical Engineering, Faculty of Engineering, Universitas Tarumanagara and the Department of Mechanical Engineering, Faculty of Industrial Technology, Trisakti University of Indonesia from 1994 until now. He has taught mathematics, mechatronics, English and physics, but Physics is the main subject he teaches. As a full time lecturer at Universitas Tarumanagara, in 2012 he was appointed as a Vice Dean for Academic and Student Affairs, Faculty of Engineering, and in 2016 up to now, he was appointed as a Director for Student Affairs, Universitas Tarumanagara. During his profession as a researcher at the Atomic Energy Agency, the Ministry of Research and Technology and as a lecturer at Universitas Tarumanagara, Adianto as an Associate Professor has published scientific and research papers of more than 35 titles at home and abroad.

**Lina Gozali** is a lecturer at the Industrial Engineering Department of Universitas Tarumangara since 2006 and a freelance lecturer at Universitas Trisakti since 1995. She graduated with her Bachelor's degree at Trisakti University, Jakarta - Indonesia, then she got her Master's Degree at STIE IBII, Jakarta – Indonesia, and she recently got her Ph.D. at Universiti Teknologi Malaysia, Kuala Lumpur – Malaysia in 2018. Her apprentice college experience was in paper industry at Kertas Bekasi Teguh, shoes industry at PT Jaya Harapan Barutama, and automotive chain drive industry at Federal Superior Chain Manufacturing. She teaches Production System and Supply Chain Management Subjects. She did a research about Indonesian Business Incubator for her Ph.D. She has written almost 70 publications since 2008 in the Industrial Engineering research sector, such as Production Scheduling, Plant Layout, Maintenance, Line Balancing, Supply Chain Management, Production Planning, and Inventory Control. She had worked at PT. Astra Otoparts Tbk before she became a lecturer.

**Carla Olyvia Doaly** is a lecturer in the Industrial Engineering Department at Universitas Tarumanagara graduated with my bachelor's degree from Institut Teknologi Nasional Malang, which study the Industrial Engineering program, then continued my Master Degree at Institut Teknologi Bandung majoring in Industrial engineering and management and a special field of Enterprise Engineering. I am very interested in studying industrial engineering by doing research related to System Design and Engineering, Supply Chain Management, Operations Research and Analysis, Information System Management, Occupational Health and Safety, Facilities Engineering, Quality and Reliability Engineering.

**Agustinus Purna Irawan** was born in Mataram - Musirawas, South Sumatera, August 28, 1971. Is a Lecturer at Universitas Tarumanagara and has served as Chancellor since 2016 until now. Obtained a Bachelor of Mechanical Engineering from the Faculty of Engineering, Gadjah Mada University (1995), a Masters in Mechanical Engineering from the Faculty of Engineering, University of Indonesia (2003), a Doctor of Mechanical Engineering from the Faculty of Engineering, University of Indonesia (2011), Professional Engineer (Ir) Mechanical Engineering from the Faculty of Engineering, Gadjah Mada University (2019) and Professor of Mechanical Engineering from the Ministry of Education and Culture (2014). The fields of scientific research and publication include: Product Design and Development, Strength of Materials, Natural Fiber Composites with implementation in the field of prosthesis and automotive components. Obtaining Research and Community Service Grants for Higher Education / Research and Technology BRIN / Untar / Others ≥ 100 titles; Patents: 7 and still in process: 4; Copyright: 9 books; Textbooks: 6 books; Book Chapter: 2 chapters; Scientific articles ≥ 100 titles. Obtained a Professional Certificate, namely the Educator Certificate, the Intermediate Professional Engineer Certificate (IPM) of the Indonesian Engineers Association (BKM PII) Vocational Engineer Association (BKM PII), and the ASEAN Engineer Certificate (ASEAN Eng.) From the ASEAN Federation Engineering Organizations (AFEO). He is active in education, various scientific activities, the world of business, professional associations, and various social activities. Received several awards: Best Graduate S2 UI GPA 4.00 cum laude (2003); First best Lecturer Kopertis Region III DKI Jakarta (2011); Best Presentation at the Seminar on Research Results of the Centralized Program, PUPT Dikti (2014); Honorary Member of The ASEAN Federation of Engineering Organizations, AFEO (2018); Best PTS Chancellor for the Academic Leader Award Program (2019).