

DESIGN FOR HUMAN SAFETY AND HEALT IN MANUFACTURING SYSTEM

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Abstract. Purpose of this research is to create a tool designed to assist workers in carrying out production activities and prevent work accidents caused by machinery . The method used for product design, which is guided by a book of product design and development written by Karl T. Ulrich and Steven D. Eppinger, which explains the steps in designing a product. The results obtained are that there is a chosen concept from several available concepts that have undergone a phase of concept evaluation, concept screening and concept evaluation. The selected concept will be used as a design to make similar products. 12 available concepts must be evaluated and screened concepts very carefully, in order to get the maximum results, the pugh method is used to assist in the process of evaluating and screening the concepts so that 3 selected concepts will be developed. The concept evaluation for the 3 selected concepts must be done by comparing the rating and weight value of each concept, to make it easier to use a formula so that it can assist in carrying out the assessment process and 1 concept selected will be used as a product. The conclusion is that in designing a product phases must be passed, so that the results obtained are satisfied and in accordance with the references used.

1. Introduction

Design for human safety and health in manufacturing systems is a design tool that will be used by workers in assisting activities on the production floor. This tool is made by following the steps found in a reference book, Ulrich Eppinger and several national and international journals that explain product design and explain health and safety. In addition to being guided by a journal, there is a quote from PERMENAKER No. 5 of 1996 which explains the function of occupational health and safety (K3) [1].

Design is a process of interrelated decisions whose aim is to define a proper configuration and efficient management strategies for a production system which assemblies components into a final product. Several are the dimensions to consider in design [2]. Selecting the right design concept at conceptual design stage in product development process is a crucial decision [3]. This technooogy has met the current need of industry owing to its shorter design and improved design quality [4]. Manufacturers are being driven to produce products quickly with high quality and low cost so that they can compete in the global market [5]. One area of business that often uses social media as a promotional place and offers its products is the fashion business [6] To achive sustainable product design, it is crucial to us sustainability assesment during the product design process [7]. The task in any productive endeavour is the process and product design, which extends from the design of operations to decisions

on how to accomplish task or work assignments. [8] Designers sometimes think they can use their knowledge, common sense, and intuition instead, or they rely purely on designing to standards. [9] Before examining the non-technical skills, it should be emphasised that this focus on workers' behaviours is only one component of an effective safety management strategy. [10,13]

Previous research that has advantages and disadvantages makes this research more focused on designing a product, with the aim of creating a tool designed with the Ulrich method that illustrates the steps of product design making this research successful in creating a product products that can be used by workers to improve work safety and the production process. The tool helps workers push the cassava into the iris machine only by pushing the lever and will avoid the work habits that are bent.

2. Method

Research activities carried out at CV. KHARISMA which produces cassava chips and banana chips is located in the village of Cicadas, Subang district which counts for approximately 2 months from May to June. The data obtained is the data from the open questionnaire and customer statement questionnaire distributed to all employees who work, the data is processed and then the results are obtained to design a product that is a work tool on the production floor. Designing a tool requires a method so that the desired product becomes appropriate, and the method used is the product design and development book written by Karl T. Ulrich and Steven D. Eppinger.

Designing a product there are several stages that must be passed from starting with the mission statement there are steps to identify customer needs, set target specifications, design product concepts, choose product concepts, test product concepts, set final specifications, plan development paths to the development plan. All that can be called a concept development process. [11]

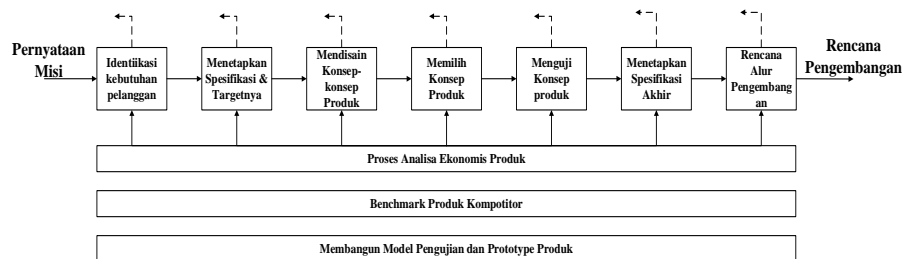


Figure 1. Concept development process

3. Result and Discussion

Beginning with processing occupational health and safety questionnaire data relating to product design results from respondent workers who have been classified and according to the level of need. Step then entered into the concept development phase which is mandatory for designing a product, then obtained a mission statement that is to make cassava-booster products that have been obtained from the identification of customer needs and the degree of importance of customer needs. The next step is to determine the target specification list which is a technical description of the needs to be realized, a comprehensive list of target specifications is made and a set of metrics for the criteria and target specifications are determined. [11]

The next step enters conceptualization which consists of the process of clarifying the problem described in a *black box*, determining the solution classification tree and the solution combination table. In the combination table there are 3 subproblems, namely design framework with iron, wood and plastic plate solutions. Energy thrust with iron and hydraulic solutions, and energy transformation with iron solutions *hollow* and *bearing*. [11,12]

Table 1. Combined table concept

Design Framework Design	Push Energy	Energi Transformation
Iron plate	Per iron	Iron <i>Hollow</i>
Wood		
Plastic	Hydraulic Hydraulic	<i>Bearing</i>

At the drafting stage the concept has 12 available concepts, then evaluating and filtering out concepts from 12 concepts using the method *pugh* to assess the best concepts. Concept screening is done with several selection criteria prepared and compared with 12 concepts to be developed, after which the values are added +, -, 0, final grade, ranking and proceed ?. [11]

Table 2. Screening of Concepts

Selection Criteria	Concepts					
	Concept 1 (Reference)	Concepts 2	Concepts 3	Concepts 4	Concepts 5	Concepts 6
Safe when operated	0	0	0	0	0	0
Easy to operate	0	+	+	+	0	0
Easy to repair	0	0	-	-	-	-
Strong tools	0	0	-	-	-	-
Attractive tools	0	0	+	+	-	-
Ergonomic tools	0	+	+	+	0	0
Convenience when made	0	0	+	-	-	-
Ease of assembling	0	-	+	-	-	--
Ease of care	0	+	-	-	-	-
Amount (+)	0	3	5	3	0	0
Amount 0	9	5	0	1	3	3
Amount (-)	0	1	4	6	6	6
Final Value	0	2	1	-3	-6	-6
Ranking	2	1	2	4	6	7
Continue?	Yes	Yes	Yes	No	No	No

Table 2. Concept Screening (continue)

Selection Criteria	Concept					
	Concept 7	Concept 8	Concept 9	Concept 10	Concept 11	Concept 12
Safe when operated	0	0	-	-	-	-
Easy when operated	+	+	-	0	+	+
Easy to repair	-	-	-	-	-	-
Strong tools	-	-	-	-	-	-
Attractive tools	+	+	-	-	-	-

Table 2. Concept Screening (continue)

Ergonomic assistive devices	0	0	0	0	0	0
Convenience when made	-	0	-	-	-	-
Ease of <i>assembling</i>	-	0	-	-	-	-
Ease of maintenance	-	-	-	-	-	-
Amount (+)	2	2	0	0	1	1
Amount 0	2	4	1	2	1	1
Amount (-)	5	3	8	7	7	7
Final Value	-3	-1	-8	-7	-6	-6
Ranks	5	3	11	10	8	9
Continue?	No	No	No	No	No	No

The results of the concept evaluation and concept screening produced 3 concepts which will be continued in the last step, namely the concept evaluation. The chosen concept is concept 1 which is used as a reference or comparison, concept 2 and concept 3. In the assessment of the concept there are several selection criteria, the value weights will be used for the 3 concepts multiplied by the rating value so that there is a weight value. Then there are the total values, rank and proceed ?. [11]

Table 3. Concept Evaluation

Criteria Selection	Weight	Concept					
		Concept 1 (Reference)		Concept 2		Concept 3	
		Rating	Value Weight	Rating	Value Weight	Rating	Value Weight
Safewhen operated	20%	3	0.6	3	0.6	3	0.6
Easy to operate	5%	3	0.15	4	0.2	3	0.15
Easy to repair	10%	3	0.3	3	0.3	2	0.2
Strong tools	10%	3	0.3	3	0.3	2	0.2
Interesting tools	15%	3	0.45	3	0.45	4	0.6
Ergonomic aids	10%	3	0.3	3	0.3	3	0.3
Ease when made	10%	3	0.3	3	0.3	3	0.3
Ease of <i>assembling</i>	10%	3	0.3	3	0.3	3	0.3
Ease of maintenance	10%	3	0.3	3	0.3	2	0.2
Total value		3		3.05		2.85	
Ranking		2		1		3	
Continue?		No		Yes		No	

Concept evaluation results in 1 concept selected from 3 concepts that have been selected, and the concept is concept 2 with a total value of 3.05. and below is a selected image from concept 2. The concept 2 combination table combines the design framework with the iron plate solution, combined with the thrust energy with the per iron solution and the energy transformation with the solution *bearing*. [11]

Table 4. Concept Combination Table 2

Design Framework Design	Push Energy	Energi Transformation
Iron plate	Per iron	Iron Hollow
Wood		
Plastic	Hydraulic Hydraulic	Bearing

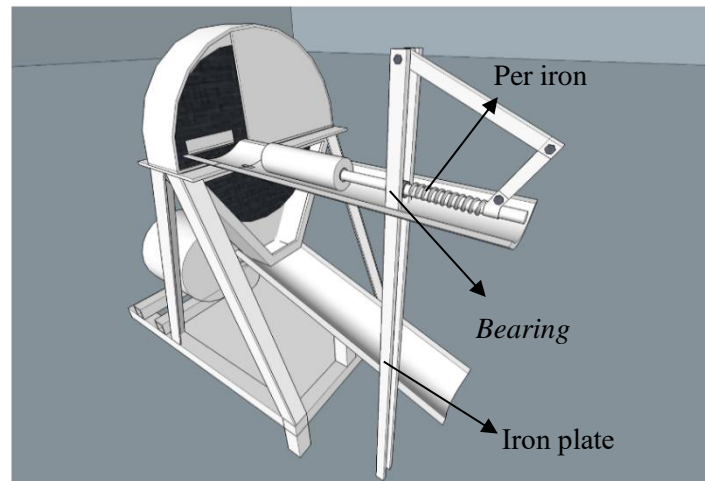


Figure 2. Selected Concept Design

4. Conclusion

Conclusion of this study is the achievement of the initial purpose of the study which is to propose health improvements and work safety on the CV. KHARISMA production floor is achieved with the proposed cassava booster products that can be used by workers. The process begins with the selection of 12 concepts given, after which it is screened until 3 best concepts are selected, concept 1 is used as a reference, concept 2 and concept 3 then a narrowing of concept is assessed to determine the best concept to be made and the second concept is selected consisting of an iron frame coupled with iron per thrust and combined with bearings as impulse transportation.

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