

# Conceptual design on slurry pouring mechanism using integrated Morphology Chart (MC) and Analytical Hierarchy Process (AHP)

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**Keywords:** AHP, Morphology Chart, Slurry pouring mechanism

**ABSTRACT** – Pouring slurry into the mould is one of the main activities in making part in the ceramic process. Unappropriated design of slurry pouring mechanism will increase cost and development time. The paper aims is to determine the best conceptual design of slurry pouring mechanism using integrated Morphology Chart (MC) and Analytical Hierarchy Process [AHP]. At the early design stage, various solution parameters for the specific design characters were determined using the morphology chart. Five (5) innovative design concepts were proposed and AHP was utilized to determine the best conceptual design. The result showed that Conceptual Design 4 with a weight of 0.418 (41.8%) was the best conceptual design. The integration enables designers to evaluate and determine the best conceptual design at the early stage of product development process.

## 1. INTRODUCTION

Determining the best conceptual design is one of the main design stages in the product development process. Cost and development time of making products will increase if the wrong selection was made at the early stage of design process [1]. In this study, a conceptual design of slurry pouring mechanism was developed and selection process was conducted based on an integrated morphology chart (MC) and analytical hierarch process (AHP). The conceptual design of slurry pouring mechanism was initiated to reduce human fatigue, increase safety in pouring process and enhance the functionality performance and allowed the different sizes of mould to be handled. MC [2] and AHP [3] methods were applied in the development of the conceptual design of slurry pouring mechanism.

The MC a method to list essential aspects that must be incorporated in the product [2]. In this study, MC method was implemented to generate various alternatives of the overall structure of slurry pouring mechanism. AHP is one of the decision-making techniques which has been widely used for more than 20 years recently and it has also been used in product development activities. The use of AHP is not only limited to the AHP itself but can be integrated with other design tools [4]. This paper explores an integrated approach for the decision-making problem that combines the MC and the AHP.

There are few papers presented the integration of both methods in the literature review. Fahrul et al. [5] presented an integrated approach by combining the MC

and the AHP for evaluating the product sustainability at the early stage of product development process. Hsiao and Chang [6] employed MC, AHP and PUGH methods to generate and evaluate design alternatives of electric scooter. Mansor et al. [7] presented the development of conceptual design of composites automotive parking brake lever using the integration of Theory of Inventive Problem Solving (TRIZ), MC and AHP methods.

Despite some works have been carried out in terms of integration MC and AHP in product development process but there is still very limited information or study for determining the best conceptual design of slurry pouring mechanism using integrated MC and AHP in the literature review. Thus, the paper illustrates the use of MC and AHP in determining the most suitable conceptual design of slurry pouring mechanisms at the conceptual design stage.

## 2. METHODOLOGY

Figure 1 shows the flow of process in generating and evaluating the best conceptual design of slurry pouring mechanism at the early stage of product development process.

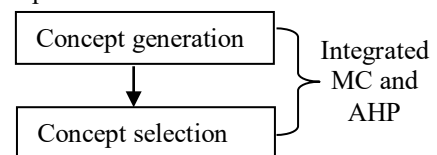


Figure 1 Research methodology

The MC was implemented to generate ideas in designing conceptual design of slurry pouring mechanism as depicted in Figure 2. More than 50 conceptual designs (CD) can be carried out from this method and however, there are five main conceptual designs of slurry pouring mechanism have been selected in this study as depicted in Figure 3. The best conceptual design was determined based on the AHP method. In AHP steps, the selection of the best conceptual design depends upon the variety of factors which include performance (P), weight (W), material cost (MtC) and manufacturing cost (MfgC). Pairwise comparison begins with comparing the relative importance of two selected items. Using pairwise numerical comparisons provided by Expert Choice 11 software. Table 1 shows the main pairwise comparison with respect to the main goal

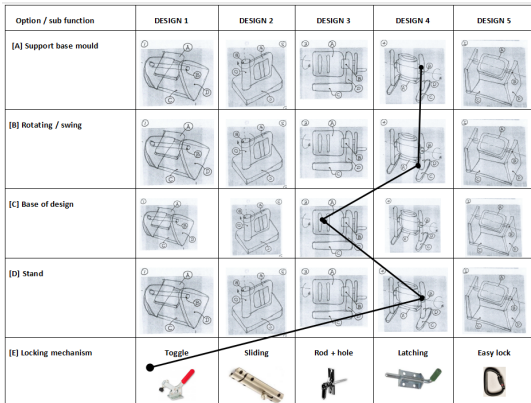


Figure 2 Morphological chart of generating ideas

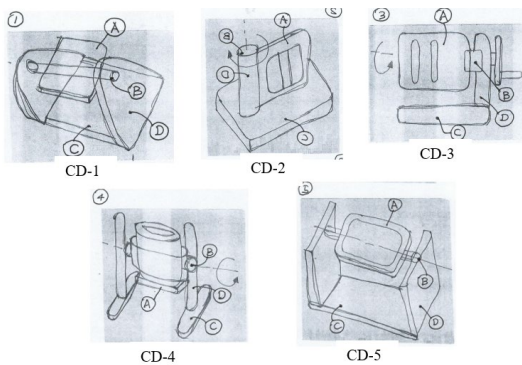


Figure 3 Five (5) new conceptual designs

Table 1 Pair-wise comparison of the main criteria with respect to the goal

Goal	P	M	MtC	MfgC
P	1	7	5	3
W	1/7	1	1/3	1/5
MtC	1/5	3	1	1/3
MfgC	1/3	5	3	1

Figure 3 Schematic of RTP installation analysis

### 3. RESULT AND DISCUSSION

The AHP analysis reveals that the conceptual design 4 (CD-4) is the most appropriate for further development because it has the highest weight 0.418 (41.8%) among the other design conceptual design as shown in Figure 4.

Figure 4 AHP analysis using expert choice software

The second highest is the conceptual design 5 (CD-5) with a weight of 0.187 (18.7%), and the lowest value or last choice is the conceptual design 2 (CD-2) with a value of only 0.091 (9.1%). In general, the judgements for all levels are acceptable due to the fact that consistency ratio (CR) is less than 0.1. If it is found that the consistency ratio exceeds the limit, the designers should review and revise the pairwise comparisons. Figure 4 is also showed how important between among the criteria. For instance, performance (P) shows the highest to the goal with a priority vector of 56.5% (P: 0.565). It is meant that performance (P) is

the most important consideration with respect to the goal criterion compared to the other criteria.

### 4. CONCLUSIONS

Five (5) conceptual designs were developed and evaluated using the integrated MC and AHP methods. Conceptual Design 4 was selected as the best conceptual design of slurry pouring mechanism with a weight of 0.418 (41.8%) at the early stage of product development process. The integrated MC and AHP demonstrated ability to be practiced in achieving idea generation concept and design selection processes that provide systematic approach to assist designers in generating and determining the best solution of conceptual design at the early stage of product development process.

### ACKNOWLEDGEMENT

Authors are grateful to Universiti Teknikal Malaysia Melaka (UTeM) for supporting this research.

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