International Conference of Axiomatic Design 2019 Template: MATEC Web of Conferences

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Abstract. Your abstract should summarize the paper. It should not normally exceed 200 words.

README!

Template Author's Notes (2019–02–11): This version of the template has descriptive sections and examples for an Axiomatic Design/Product Design paper. If you are looking for the original MATEC LaTeX template, it can be found in `woc_2col.tex`. The original template has a lot of detailed instructions on formatting the paper, but most of that is already taken care of if you are using LaTeX.

This template takes care of formatting and placement of the citations, as long as you fill in the BibTeX file `references.bib` and `references-ad.bib` correctly. If you are using crossrefs (to fill in the conference proceeding information), they must go at the end of the `.bib` file.

If you have `woc.bst` it will ensure that the citations meet the formatting required by MATEC Web of Science with some modifications needed for the International Conference on Axiomatic Design. If you need the old citation format, just copy `woc-orig.bst` over the `woc.bst`. Enjoy!

LaTeX Hints

- Put one sentence per line. This makes it easier to debug errors (which are by line) and to do grammar checking with http://grammarly.com.

- Compile the document often and look for errors. If you find one, try commenting out the area to locate the source of the problem.

- Watch out for & and %. They have to have a left-slash in front of them.

1 Introduction

What is the idea? What is it called and why? Who is the target customer?

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Figure 1: Grey square.

1.1 Customer Needs

What would a customer need the item to do? Using Axiomatic Design theory, this is stated as a numbered list of Customer Needs(CN) [1]. The top level is CN_0. This is often (but not always) decomposed into CN_1, CN_2, etc. Here is an example of a top level:

> CN_0 A transfer bin for whole salmon, compatible with the SureTrack grader, cheaper and less prone to cracking due to skewing. The bin should be adaptable to a pure transfer task and be able to discharge anywhere along its path without accidental discharge. [2]

2 Prior Art

What exists that is similar? How is yours better/distinctive? Give at least two examples and quantify the differences (numeric values). If you say something is cheaper, you need to give the costs for both items.

An example of a figure is the grey square in Fig. 1.

Sources

You will want to cite all these similar concepts/products. As an example of a citation, Carryer et al. [3] is the text-book for T-411-MECH Mechatronics 1.

3 Design

As previously mentioned, using Axiomatic Design Theory is a good way to develop your design.

Here is a brief synopsis from Omarsdóttir et al.[4]:

> Rather, the focus was placed on developing comprehensive FR and DP lists, then evaluating the coupling between them. This coupling is symbolized in a design matrix, which is a Cartesian product of all FR and DP combinations [5, 6]. Where there is an interaction between an FR and DP, this is denoted by a non-zero coefficient, or in the case of the value being unknown, simply a placeholder variable X. Minor levels of coupling, often considered higher-order effects, are annotated with x to show their lessened effect. A diagonal matrix is "uncoupled" and satisfies the Independence Axiom: "to maintain the independence of the functional requirements (FRs)" [7]. Such a design can be easily optimized by adjusting a particular FR or DPs without affecting others. A diagonal matrix indicates a "decoupled" or "path-dependent" solution, which can still be optimized, but the ordering of parameter choice selection becomes important. All other design matrices are "coupled" and may have a usable local solution but usually resist modification and optimization [7]. Needless to say, the focus is on minimizing coupling wherever it may appear.
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> ADT's second axiom is "minimize the information content of the design." Simply put, ensure that the design has the highest probability of meeting the stated FRs. When systems are not able to meet FRs all of the time, this is denoted in ADT as "complexity" and is deeply explored in [8]. As will become apparent in the next section, this axiom became integral to the design of the interaction between the robot and its chess pieces. Finally, any factors to be considered that are not functional are categorized as "Constraints." These are often resource-focused and affect all of the design decisions; they need to be revisited often especially when choosing between otherwise equivalent implementations.

The first axiom is often called the Independence Axiom, and the second, the Information Axiom.

From the Customer Needs, we build a list of Functional Requirements.

Again, we start with a top-level FR_0: "Contain 25 kg of fish on SureTrack conveyor until release is triggered" From this, a top-level Design Parameter DP_0: Gable-reinforced stainless-steel locking bin with bi-directional discharge [2].

We continue a "zig-zag" procedure to decompose and map the FRs to the DPs as shown in Table 1.

From this mapping we develop a design matrix as shown in Equation 1 from [2].

$$\begin{Bmatrix} FR_1 \\ FR_2 \\ FR_3 \end{Bmatrix} = \begin{bmatrix} X & 0 & X \\ 0 & X & 0 \\ 0 & 0 & X \end{bmatrix} \begin{Bmatrix} DP_1 \\ DP_2 \\ DP_3 \end{Bmatrix} \qquad (1)$$

This matrix is de-coupled i.e. path-dependent, meaning it can be optimized, but the order matters.

4 Experiments

5 Results and Discussion

6 Conclusion

6.1 Future work

6.2 Summary

References

[1] N.P. Suh, *The Principles of Design* (Oxford University Press, 1990)

[2] K. Gerhard, J.T. Foley, *Redesign of the SureTrack grader transfer bin using Axiomatic Design*, in [9], p. 6

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[5] D.S. Cochran, J.T. Foley, Z. Bi, *Use of the Manufacturing System Design Decomposition for Comparative Analysis and Effective Design of Production Systems*, International Journal of Production Research p. 24 (2016)

[6] E.M. Benavides, *Advanced engineering design - An integrated approach* (Woodhead Publishing, 2012)

[7] N.P. Suh, *Axiomatic Design - Advances and Applications* (Oxford University Press, 2001)

[8] N.P. Suh, *Complexity* (Oxford University Press, 2005)

[9] A. Liu, ed., *10th International Conference on Axiomatic Design (ICAD)*, Vol. 35, Procedia CIRP (Elsevier ScienceDirect, Xi'an, China, 2016)

Table 1: First level FR-DP mapping. [2]

ID	Functional Requirement	Design Parameter
1	Contain product	Main weldment