International Conference of Axiomatic Design 2025+ Template

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Abstract. The abstract should summarize the contents of the paper using at least 70 and at most 150 words. It will be set in 9-point font size and be inset 1.0 cm from the right and left margins. There will be two blank lines before and after the Abstract. . . .

Keywords: Axiomatic Design, LaTeX Template, Demonstration

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> For citations of references, we prefer the use of square brackets and consecutive numbers. Citations using labels or the author/year convention are also acceptable. The following bibliography provides a sample reference list with entries for journal articles [1], an LNCS chapter [2],

a book [3], proceedings without editors [4], as well as a URL [5]. *Text from: [6]*

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LaTeX Hints

- Rename this file to something unique with the year and topic like: `icad2025-sharklasers.tex` so you can find it more easily.
- 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.
- Underscore "`_`" is only usable in math as a subscript. Don't put it in normal text.

1 Introduction

The Introduction section expands on the background of the work (some overlap with the Abstract is acceptable). The introduction should not include subheadings.

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

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) [7]. 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:

> $\mathbf{CN}_0$ 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. [8]

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 four Axiomatic Design domains in Fig. 1.

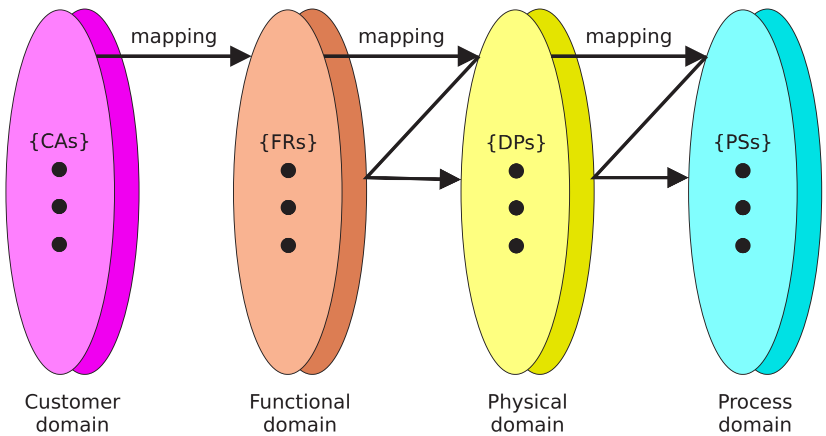

Fig. 1: General progression between the Axiomatic Design domains employing the zig-zag approach

2.1 Sources

You will want to cite all these similar concepts/products. As an example of a citation, Carryer et al. [9] is the textbook 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.[10]:

> 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 [11,12]. 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)" [13]. 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 [13]. Needless to say, the focus is on minimizing coupling wherever it may appear.

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 [14]. 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 [8].

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

Table 1: First level FR-DP mapping. [8]

ID	Functional Requirement	Design Parameter
1	Contain product	Main weldment
2	Move product	Support system
3	Discharge product	Discharge system

From this mapping we develop a design matrix as shown in Equation 1 from [8].

$$\begin{Bmatrix} \mathrm{FR}_1 \\ \mathrm{FR}_2 \\ \mathrm{FR}_3 \end{Bmatrix} = \begin{bmatrix} X & 0 & X \\ 0 & X & 0 \\ 0 & 0 & X \end{bmatrix} \begin{Bmatrix} \mathrm{DP}_1 \\ \mathrm{DP}_2 \\ \mathrm{DP}_3 \end{Bmatrix} \tag{1}$$

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

4 Results/Experiments/Prototypes

5 Discussion

6 Conclusion

6.1 Future work

6.2 Summary

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