

# DESIGN ANALYSIS & SYNTHESIS: A PALETTE OF APPROACHES

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## INTRODUCTION

Over the past decades, significant advances have been made in increasing the influence of industrial design and designers beyond the traditional domains of form and visual aesthetics. Increasingly, designers are being called upon to provide input in the fuzzy front end of the design process. A key addition to the designer's toolbox has been the increasing application of user research. Much effort has been spent on defining research methodologies, and marketing them to the clients of design services. This increased focus on generating grounded input for the design process has increased the quality of design output and provided designers with a source or the rationale necessary to explain and defend design decisions. But, as we know, research does not equal insight. What do we do with all that data?

After the research is done, and before you really know what your solution will be, this is when the insights that lead to great design emerge. Developing insights about end users has proven as a invaluable part of a design process. Generating those insights is the work of design analysis and synthesis, but unlike design research, this part of the design process is often a bit of a black box. Analysis and synthesis are underrepresented in academic and commercial literature and discussion. This lack of formal definition means that analysis and synthesis activities, though immensely valuable to design work, are difficult to teach to students, explain to management, organize for team collaboration or defend to clients.

## KEY ISSUE

Discussion of analysis and synthesis often centers on description of methods or "tools." This method-based approach is useful for expanding our toolbox as practitioners, and explaining the expected activities and their output to clients and management. However, too much focus on the tools themselves has led to disproportional demand for well-known methods, increasing their marketability but adversely affecting the quality of their execution. The purpose of the design method or tool may be obscured by the popularity of the tool itself. User personas offers an example of this phenomenon, their popularity arguably has grown beyond the point of their useful application.

It is the purpose of this paper to expose the underlying purpose of common methods of design analysis and synthesis. This paper presents a framework for organizing the design analysis and synthesis process, and more easily identifying the purpose and function of the activities and methods designers' use. The intent of this framework is to equip practitioners to manage the complex arena of design research and analysis methods, to make it easier for educators and practitioners to identify and select methods that best fit their situation, and to modify or invent new methods when the existing ones don't fit.

## OVERVIEW OF SELECTED ANALYSIS & SYNTHESIS LITERATURE

Starting from Herbert Simon's definition of design:

*Everyone designs who devises courses of action aimed at changing existing situations into preferred ones.*

Analysis and Synthesis are crucial parts of the design process for both understanding the existing situations and projecting preferred ones. The investigation of these topics, though for years, left mostly unexplored, has been the subject of recent interest of a variety of respected investigators,

from Vijay Kumar in his recent book, *101 Design Methods*, to Jon Kolko and his *Exposing the Magic of Design: A Practitioner's Guide to the Methods and Theory of Synthesis*. Other key reference points for this paper include *The Analysis – Synthesis Bridge Model*, an article by Hugh Dubberly, Shelley Evensen, and Rick Robinson, from *Interactions Magazine* and a series of articles by Steve Baty on the website, Johnny Holland titled: *Deconstructing Analysis Techniques*.

## ANALYSIS SYNTHESIS PALETTE

Offered as an organizing framework for Analysis and Synthesis activities, the intent is not to offer methods for use by practitioners, but to offer a mechanism for better understanding the function of our methods, so that practitioners can more obviously select methods appropriate to their task, and more easily develop new methods if none exist that directly address their needs.

This framework is situated within Vijay Kumar's 2x2 model of the "Design Innovation Process." (Figure 1). This assumes that examination, or observation has already occurred and generated data to be analyzed. It also presupposes that the eventual outcome of the work will be to realize some new offering, through a design process.

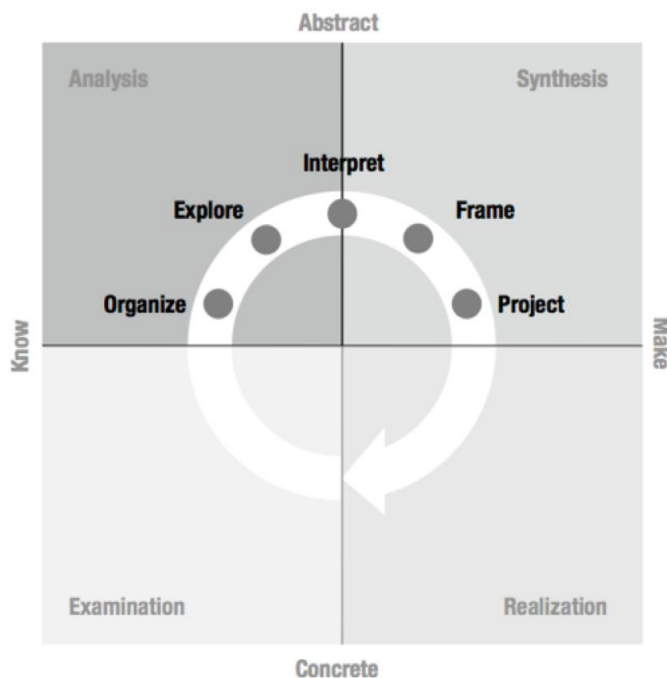


Figure 1. Kumar Model with Analysis Synthesis Palette overlaid

The framework consists of a series of 16 types of activities, offering nine distinct modes of analysis and seven of synthesis. Below, the types are outlined.

## OUTLINE OF ANALYSIS SYNTHESIS PALETTE

### 1. Design analysis

#### a. Organization

- i. Aggregation
- ii. Deconstruction
- iii. Categorization

#### b. Exploration

- i. Immersion
- ii. Manipulation
- iii. Association

**c. Transformation**

- i. Abstraction – generalization
- ii. Interpretation
- iii. Visualization

**2. Design synthesis**

**a. Framing**

- i. Summarization
- ii. Curation
- iii. Narration

**b. Projection**

- i. Situated solution
- ii. Prediction
- iii. Abduction
- iv. Ekphrasis

**DESCRIPTION OF ANALYSIS SYNTHESIS PALETTE**

**1. Design Analysis – what does it mean?**

One of the most critical, but least discussed part of any design process are the techniques of analysis, or breaking a topic down into its constituent parts to gain a better understanding. When it comes to analysis of the research data gathered to support a design process, the main goal is to identify the key features present in the data, determine what those features suggest, and explain why those features are present in the data.

**a. Organization - Cleaning and Normalizing raw data**

In order to make use of data gathered from any type of research, some preparation has to be done to ready the data for use. There are a variety of forms of organization that can be useful to the design analyst.

**i. Aggregation**

One of the first steps in preparing data for analysis is to aggregate the data into a useable form. A variety of strategies can be used to aggregate data. Most strategies rely on data normalization, i.e. a process by which a variety of data types, potentially from multiple sources are made semantically and functionally equal, or put into the same **format**. For instance, converting all video to the same format, or field notes taken in multiple languages being translated to a single one for later use. In order to prepare data for use, sometimes it also needs to be cleaned, or stripped of extraneous components that obscure the valuable components of the data in use. For example,

**ii. Deconstruction**

Another fundamental step of early design analysis is to deconstruct complex data into its constituent elements, and standardize those elements for use in later steps. For example, raw video being clipped into similarly sized segments, annotated and placed into a database to be retrieved with keywords, or audio being transcribed onto color-coded stickynotes for later manipulation. “There are a wide range of examples of the way in which deconstruction occurs, but our aim is always to reach a definite ‘atomic’ state (where the atom is defined by our research objectives).” (Baty) Deconstruction also requires a strategy; generally one that will render data in useful forms for the steps to come. Some research methods have imbedded deconstruction techniques, For example, a survey or photo-based self-documentation study produces data already deconstructed into usefully similar component parts, answers to questions or annotated photos respectively.

### iii. Categorization

The final step in data organization is categorization. This is the process by which data is labeled and organized into groups based on similarity, hierarchy, or some other set of relationships. Categorization can be accomplished by organizing data into pre-made categories brought to the research study prior to its execution, like steps in a process, or market segmentation, emergent categories found as repeating patterns in the data itself through the later phases of exploration, or categories identified through other research methods, like the identification of user types or personas. As alluded to, unlike deconstruction and aggregation, categorization may be accomplished before or after the later phase of data exploration, depending on the designer analyst's intent and the necessity to align data with an existing framework or the desire to develop a novel understanding of a data set.

### b. Exploration - "Playing" with the data

Data exploration is a critical step of any analysis. To some it may seem like a smaller scale research endeavor in its own right. The mechanics are the same. A design analyst engages with the now-semi-organized data to identify patterns and relationships that may present themselves and help improve the understanding the phenomena under study.

#### i. Immersion

A good first step in data exploration is immersion. Simply engaging directly with the normalized data, reviewing, re-reading, and reflecting. A valuable strategy is to prepare the data into categories that can be understood visually, which will speed the recognition of patterns and relationships between elements. Beyond pattern and structure finding, Immersion also enables an analyst to understand the language and context inherent to the data, to get the flavor of the subject of study and identify other inherent characteristics that may suggest later strategies for understanding, or identify gaps or holes in the data gathered. Immersion gives a sense of the quality and comprehensiveness of the data set, an impression of whether the data meets the needs of the study or additional research must be done.

#### ii. Manipulation

Once you have gained an understanding of the data through immersion, you may want to start moving that data around. Data manipulation enables an analyst to begin to make and evaluate relationships among data elements through simple physical or visual manipulation. "Manipulating data is that process of re-sorting, rearranging and otherwise moving your research data, without fundamentally changing it. This is used both as a preparatory technique – i.e. as a precursor to some other activity – or as a means of exploring the data as an analytic tool in its own right." (Baty) A common manipulation technique is affinity mapping, representing data on movable elements like index cards or sticky notes, and placing those notes in spatial proximity with each other to identify relationships. Sometimes the simple juxtaposition of data elements will be the trigger to see a pattern or identify a characteristic that can be of use to the coming design synthesis phase.

#### iii. Association

Another critical step to data exploration is defining associations of data elements. In some cases, this step may be the means of creating categories within the data. This step may also be brought about by manipulation, but the differentiating factor between manipulation and association is an active construction of meaning. While manipulation is a method of identifying potential patterns and structures through relationships, association is the act of making meaning about those relationships, as data elements are grouped, they are named, defined, and prepared for further description. Associations may take a variety of forms, combinations of data is one approach, resulting in a smaller number of data elements that each contain more

data than the normalized elements that the analyst started with. Other associations may result in the emergence of defined hierarchical or other relationships that will serve to uncover structures or patterns in the data. Some typical representations of association are organizational charts, process flows, or venn diagrams.

c. **Interpretation** - Creating meanings and models from the data

Transformation of the data is an interim step in the analysis and synthesis process—a step with one foot in each camp. Working from an analytical understanding of the data gathered, the analyst now processes that data to change that data into some new form, one that begins to suggest meaning or be instrumental in identifying the structure or mechanics of the phenomena under study.

i. **Abstraction**

One key transformational approach for the design analyst is to abstract the data, potentially to change it to isolate key characteristics of the data element and take those forward while eliminating many other component parts of the data elements. Other useful approaches to abstraction is to create an archetypical representation of a data element, or to shift the focus of inquiry and further work to the categories of data that have been derived, and deal primarily with those categories only in synthesis activities. most distinctive features or characteristics. Abstraction is similar to generalization, the capture of the essence of the data elements, sometimes leading to the creation of rules, principles, truisms, about the object of study.

ii. **Transformation**

One of the most critical components of the interpretation process is the creation of meaning from the data; some call this sense-making, some definition, here we will refer to it as transformation—specifically the transformation from data into meaning. A key element of transformation is the thoughtful definition of the elements in play, or insights—a crisp articulation of the meanings inherent in the data. The work of the design analyst here is to take a point of view, to make persuasive arguments for what the data means, why that is important for us to know, now. In order to make a convincing argument, evidence must be presented that supports the analyst's claims. This evidence can come from the earlier steps of the process, but should not be simply the presentation of one data element as a "finding." Anecdotes are not insights, though insights can be built from them. These insights are often the core components of a model, or simulation, of how data elements interact or how some component of our topic of study "works." (Dubberly)

iii. **Visualization**

Another transformational approach is the creation of visual representations of the data. In addition to the visual interpretation of the data elements themselves, visualization can specifically focus on representing the relationships, structures, and associations between data that the analyst has found through their exploration of their data set. This visualization can be instrumental in revealing the meanings of the analysis and in representation of a model of how those data elements interact. One of the most valuable items of any analysis, a good model describes the structure of an experience, and offers a repeatable theory for analyzing similar experiences, and evaluating how changes to an experience, such as the introduction of a product or service, could affect it. By leveraging an audience's visual acuity, visualization techniques like size, color, position, groupings can aid in understanding how insights relate to each other and help to reveal the mechanics of a model.

2. **Design synthesis – how do we respond?**

Unlike analysis, synthesis refers to the process of combining elements to form something new, combining pieces of knowledge into a meaningful whole. In the case of design synthesis, elements combined include the understandings developed from the analysis itself,

and provide a useful context for development of the solution-oriented ideas that are more often associated with design. The best design synthesis offers the ability to build rationale grounded in the observations made, but with opportunity for originality, creative expression, and disruptive innovation. Synthesis can refer to the creation of designed objects, products, services, environments, communications, etc. but for the purposes of this paper, we will confine our definition of synthesis to the creation of ideas or concepts that draw upon the design analysis.

a. **Frame** - Describing selected features in the data

A description of the data captured is by definition, an synthetic frame, useful for beginning the process of constructing the contextual meaning of any solutions. Describing features present in the data can support an analyst's thesis, or deliver an understanding to an audience directly. Engaging in the act of framing is to select elements from the data with intent, but then elucidating them without making value judgments.

i. **Summarization**

The identification of themes or common features among the research data can be called summarization. Summaries of research data tend to identify what the synthesist feels are the most critical meanings present in the data set, isolate those meanings and present them together to an audience. In summarization, a synthesist attempts to make explanations for selected collections or sets of data they may have determined through association. A summary characterizes the key elements of those data sets and begins to shift from the investigation of the data to a communication of what an synthesist finds vital or simply interesting. An executive summary is a good example of a typical deliverable from this synthesis technique.

ii. **Curation**

Curation as a strategy for framing relies on the identification of evocative data elements from the analysis that can "stand for" the whole. There are two key approaches for a curatorial strategy to design synthesis. These selected data can work to provide evidence for specific statements that a analyst is attempting to convey, or can provide an overview of the data set as a whole, usually without a strong statement of intent by the synthesist. The first of these strategies requires a summary or understanding of the key features that are necessary to convey. In order to communicate the synthesist's desired meaning, archetypical examples from the data are then selected to represent these key features. The second curatorial strategy is to provide a set of examples that represent a holistic survey of the research data. In this way, the selected data elements can work together to evoke an understanding of the whole, without requiring specific statements from the analyst.

iii. **Narration**

The third approach to framing is the creation of a narrative account. Stories or anecdotes are easier than some other descriptive methods for an audience to engage with and appreciate. A narrative description combines elements of summarization and curation, and places them into a personal account with a topic of interest. In order to produce a narrative, the most important (or interesting) meanings imbedded in the data need to be identified, as done in summarization, then representative data elements for each identified as in curation. Finally, specific anecdotes for each are created, leaving out extraneous detail and focusing on the critical points that either carry the story along or support the synthesist's thesis. These are organized into a compelling order, or plot, chronological or otherwise. Development of characters can be useful way to

help the audience more directly understand the story from an emotional perspective.

b. **Projection** – Determining potential responses to analysis

In the case of design synthesis, projection is used to refer to the design activity of extending the model of understanding developed through analysis into the future, and responding to the resulting imagined situation with appropriate design solutions.

i. **Situated solutions**

Situated solutions refers to a method of synthesis whereby an idea is developed that is can be directly substantiated by the analysis. The most common form of synthesis, and the simplest, a situated solution directly addresses an observed user need or market opportunity. For example, in our observations we may have determined that a call center operator needs quick access to three key functions. If a feature of our design solution is to forefront access to these three key functions then we have developed a situated solution. Situated solutions rely on direct observation or self-reported needs, and do not rely heavily on the quality of the design analysis. Though situated solutions can be quite innovative, particularly in design environments where little observation was done in the past, they may not be capable of disruptive innovation.

ii. **Prediction**

The magic bullet of design synthesis, for many business people anyway, is the act of making predictions based on design analysis. Prediction takes observations from the data and asks the synthesist to make new observations about what will happen in the future. There are, of course, no guarantees about predicted outcomes; therefore making multiple predictions is often a better approach than a single one. An example of a useful form of prediction for design environments is Scenario Planning (Schwartz). This form of prediction seeks to reduce the risk associated with single predictions by deriving a variety of plausible futures from knowledge about current situations and trends—current knowledge like the sort of information present in a design analysis. Once these possible futures are described, a series of potential responses, or scenarios, can be created which address what could or should be done in response to those situations. Prediction may offer opportunities for disruptive innovation in environments where the future is highly unsure, but the solutions are highly dependent on the quality of the analysis and the range of potential futures outlined.

iii. **Abduction**

Abduction means to adopt “a hypothesis as being suggested by the facts . . . a form of inference.” (kolko). Abduction makes generative leaps to solutions not directly supported by evidence in the analysis. Essentially, abductive reasoning is a specific sort of educated guess. Abduction is important to design synthesis because it is the mechanism by which we can derive solutions from features in the data when those features do not directly suggest the solutions. An abductive solution is found when a synthesis develops a “hypothesis that makes the most sense given observed phenomenon or data and based on prior experience.” (kolko) Consider an example from my own life. If my design problem is to purchase gifts for parents at my child’s school, I may conduct some informal observations. I may have observed that a neighborhood coffee shop is often crowded and the service slow in the mornings. I may also have observed that some parents need to rush to the subway after dropping off their children, in order to make it to work on time. Using abductive reasoning, I may consider that parents who may have control over their morning schedule would appreciate a gift card to this coffee shop, but perhaps another gift should be made to those

who have corporate 9-5 employment. In that statement there are a series of inferences or abductive leaps. Abductive reasoning gives the synthesis the ability to establish rationale for design ideas, but license to make connections between unrelated observations. With higher potential for disruptive innovation, an abductive approach relies both on the quality of the analysis and the creative spark of the team to make useful associations between these unrelated observations.

#### iv. Ekphrasis

Borrowing a word from the arts, ekphrasis refers specifically to literary a description of a visual work of art. Drawing on a broader concept of ekphrastic responses (Walker), this form of design synthesis refers to the creation of a something that articulates a response to a phenomena or topic in an entirely different form of media—quite literally the notion of “dancing about architecture.” By this definition, a performance, video, a prototype, or even a critical review or even a can be considered an ekphrastic response to the topic under study. Judging an analysis topic critically may giving it rank in relation to other topics of potential design synthesis, judging its originality, and taking a point of view on the value of any potential solutions. (Barrett). The characteristics of ekphrasis are partially derived from the creator’s desire to create an independent response, and partially on that response’s derivative relationship to the original creation. Ekphrasis depends on a robust understanding of the original phenomena and seeks not to explain it, or to redesign it, but to use it as a reference point for a new and different creation in a new form of media. Ekphrasis has the benefit of referencing the familiar for it’s audience, but relies heavily on the ability of the team to conceptualize a response that is original in it’s own right and not too obviously derivative in order to enable disruptive innovation.

### PLANS FOR THE FUTURE

Initially developed through a survey of related literature (in 2009) and presented and refined through the contribution of a generous group of workshop attendees at EPIC (the Ethnographic Praxis in Industry Conference) that same year, this line of investigation offers rich possibilities for the future. This paper, while offering a framework for design analysis and synthesis, represents only snapshot in time of the developing perspective. A variety of possible future investigations aimed at the individual types of analysis and synthesis would add greatly to the exploration of this topic, as would concrete examples and figures for illustration. I hope to continue the investigation and refinement through critique and iteration with likeminded designers, editors, and contributors.

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