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Producing the Rigorous Design Case

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Producing a rigorous design case, and producing a case that holds utility for designers are not always one and the same act. The differences between rigor and utility in design cases are discussed in this article, as well as the position of the design case in the broader realm of naturalistic research. Drawing from naturalistic and action research, possible standards of rigor for cases emerge. These are presented and related to the representation of design knowledge. The article then presents issues observed among authors of traditional research in producing design cases of rigor.

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Producing the Rigorous Design Case

In order to establish a body of rigorous design cases (see Boling, this issue) we in the several fields of design must examine the dimensions along which such cases might be developed, and according to which their rigor may be judged. Criteria drawn from naturalistic inquiry (Lincoln & Guba, 1985) and action research (Argyris, Putnam, & Smith, 1985) may be used to frame a discussion regarding the qualities of rigorous design cases. We must also discuss the ways in which these dimensions apply in creating specific representations of the product(s) of design and the process by which the product(s) are developed.

Before examining specific criteria which might be applied in achieving and judging rigor, it is important to stress that design cases do not need to follow a formulaic approach in order to be deemed rigorous. Rigor is actually judged along a continuum, rather than as a binary condition. The time and effort required to produce a design case dictate that there be some reason for creating one. Those producing the case, or those who request that it be produced, will have determined that there is some element of the case that renders it particularly interesting. The reasons will be variable, and so will the elements of the case that are emphasized, or covered in detail. This, in turn, will affect the dimensions of rigor in play for that case.

A design case does not necessarily need to be rigorous in order to be useful. The utility of a case is determined by those who use it. For example, an architect interested in exploring new ways of directing daylight throughout an exhibit space might find a simple photograph of a similar space to have great utility in the sense that it provides information or inspiration that might inform decisions regarding the new design. The photograph serves as a limited design case – not necessarily rigorous, but in this particular context, still very useful. The same photograph might not be useful at all to an individual who is not already sensitized to the issues and constraints associated with this type of design problem. He or she might need additional text or explanation to direct their attention to the key features in the photograph before the visual representation could be useful to them.

It is assumed here that design case utility is not contingent on its rigor, but that increasing rigor heightens the likelihood that it will be useful across a broader range of contexts. And if there is merit in developing some design cases which can be judged to one degree or another as “rigorous,” then a working operationalization of this concept is needed. Over time more nuanced understandings of “rigorous design cases” will emerge as more of these cases are developed, disseminated and evaluated by interested scholars and practitioners. Negotiated standards of excellence may be developed eventually which are customized to design cases (or even to specific types of design cases). In the meantime, we examine useful criteria to guide initial development of such cases, and to spur discussion of the appropriate considerations in play when creating and evaluating design cases.

The validity of inferences drawn and the reliability of data upon which such inferences are based are fundamental considerations in the design and evaluation of research (see for example Fraenkel & Wallen, 2003). Depending on the research paradigm to which one adheres, different methods and criteria might be applied when judging validity and reliability. In applying these standards to developing and judging design cases, the traditions of naturalistic inquiry and action research provide useful guidance.

Even though design cases are a substantially different type of scholarship than are traditional naturalistic inquiry studies or action research, they do share some common features which make these established approaches to knowledge building potentially fruitful precedents in exploring criteria for rigorous design cases. Specifically, naturalistic inquiry and action research provide methods for approaching situations to which a priori frameworks are often not applicable, in which the researcher is often a participant (instead of an outsider), and in which the applicability of the warranted assertions of the research is left to the reader's judgment. Similarly, in the design scenarios at the heart of design cases, the specific combination of contextual features often makes it impossible to strictly adhere to the kinds of pre-established frameworks which often govern laboratory research, since unpredicted, complex phenomena often emerge in the process. It is anticipated that the authors of design cases will often be deeply involved in the design process as a member of the design team (or as a solo designer) and the applicability of any given case to a new design situation will have to be judged by the reader of the case.

In naturalistic inquiry, the term trustworthiness subsumes the traditional questions of validity and reliability. Lincoln and Guba (1985) define trustworthiness as follows.

> "The basic issue in relation to trustworthiness is simple: How can an inquirer persuade his or her audiences (including self) that the findings of an inquiry are worth paying attention to, worth taking account of? What arguments can be mounted, what criteria invoked, what questions asked, that would be persuasive on this issue?" (p. 290)

These questions are equally relevant in creating and judging rigorous design cases. How can the author of a design case convince readers that the case has been conceptualized and reported in such a way that it is worth consideration and that it can be trusted? The text below lists key methods for establishing trustworthiness in naturalistic inquiry. It is important to note that the usefulness of each of these methods will be highly dependent on the specific case, and that not all cases will be equally strong along every one of the listed dimensions.

Establishing Trustworthiness in Design Cases

Prolonged Engagement with Phenomenon under Investigation

In naturalistic studies when the researcher is an outsider observing a chosen phenomenon she is encouraged to spend extensive amounts of time with the phenomenon in order to develop deep understandings of what is being observed. In the design case, the author will often be part of the design team (or the sole designer) and thus is likely to have had prolonged engagement with the design, but this is not always true. A viable design case may be produced by an author outside the project being documented, although this author must find a way to become immersed in the project either while it is happening or via other means, which may include study of artifacts and records, discussions with stakeholders and participants in a project, and experiencing what has been designed. In either situation, the author's degree of involvement must be disclosed in a design case. If she or he was not directly involved in the design process, details should be provided to explain how information regarding processes and artifacts was obtained.

Persistent Observation of Salient Elements

Design cases are constructed to highlight salient elements of the project and the design resulting from it. While some of these may be common across many cases (the presenting problem or the brief, detailed description of the design itself, discussion of resources and constraints), each case will present elements salient to that particular situation. These will either have to be observed directly or determined via the author's judgment based on investigation of the case. Again, the case needs to include a discussion of how the author has come to her knowledge of these elements and convince readers that those methods provided sufficient observation to allow informed judgment of their salience.

Triangulation of Data

The notion of triangulating data is based on the assumption accounts of a phenomenon drawn from multiple sources provides a dimension of trustworthiness missing from accounts drawn from one source only. This suggests that data informing a design case should be of multiple types and drawn from multiple informants. Data sources might include (but are not limited to) real-time documents (meeting notes, process drawings, email communications), early prototypes, usability studies, and retrospective verbal accounts (interviews). By gathering, analyzing, and presenting data from multiple people, in varied formats, and at different points throughout the process, the design case author increases the likelihood of identifying key elements of the case, and of presenting to the reader a more comprehensible view of the design process and outcomes. If the case is written by a single

author about a design for which he was the sole designer, it will be important to reflect on his biases and avoid making categorical claims.

Negative Case Analyses

In design cases, negative case analyses may take the form of descriptions of interim decisions or solutions which were ultimately abandoned or radically modified. These are often petite analyses focused on the normal adjustments in decision-making during design, not necessarily on abnormal or avoidable error. The design case should not be a sanitized account of events, highlighting only those decisions which were ultimately deemed appropriate or successful. Much of the potential knowledge dissemination in a design case is likely to come from careful descriptions and reflections on the starts and stops which helped shape the ultimate design decision, often times because they helped better structure the design problem if not the design solution.

These analyses can be some of the most difficult for designers to capture and discuss if they are not recorded during the process, or if the designers have not been in the habit of viewing this aspect of design as a critical source of knowledge. There may also be some reticence on the part of designers to reveal decisions which might be seen as “errors” or prototypes that were found to be unsuccessful, particularly in design practice that centers primarily on process and/or principles, both of which are presumed to reduce or eliminate error in designing. However, such reticence is entirely counter-productive to establishing a rigorous and maximally useful account of designing and the products of designing. The judgments made regarding process, application of principles, and synthesis of the overwhelming complexity involved in designing are only partially revealed in accounts that present final outcomes and smooth process alone.

Peer Debriefing

The qualitative researcher must often achieve a difficult balance between involving themselves enough with the phenomena of investigation to establish a deep understanding of events, and remaining distant enough from conditions to resist “going native.” This might particularly be a concern in the types of design cases being described here, where the “researcher” (or author of the case) is often a direct participant in the design process. While there is no failsafe way to eliminate bias (nor is there necessarily an expectation that this can or should be accomplished), one way to mitigate such threats is through peer evaluation of the design case. It is anticipated that this can be accomplished both informally (through formative reviews of the design case while in process of development) and formally (through the peer review process when a design case is submitted for publication).

Member Checks

Design is rarely a solitary activity. A design case is more likely to be an accurate reflection of the entire design team’s experience if the major players in

the design process participate in the development of the design case by either co-authoring the case, or verifying and providing feedback on a draft of the case. Again, the case should disclose the roles played in the design process by the various key players, as well as their participation in the development of the design case.

Thick Description

When it comes to questions of generalization, naturalistic inquiry is based on a wholly different paradigm than are randomized, experimental studies. Whereas these latter studies are explicitly designed to enable generalization from a randomly selected sample to a population, in naturalistic inquiry, the decision of whether it is appropriate or useful to generalize from the research to a novel situation is left with the reader. In order to help the reader make an informed decision, it is necessary for the author to provide a thick description, or accurate and thorough account of conditions in the studied phenomenon. Based on this information, the reader can evaluate the degree to which the described case does or does not match their own situation, and the degree to which the study findings may or may not be applicable.

In a design case, a thick description might be achieved in a number of ways, but the ultimate goal is to provide the reader with as thorough an understanding of pertinent parts of the design process and the finished artifact(s) as is feasible. In almost every situation, it will be helpful to the reader to have a narrative describing the background of how the design project was initiated. In describing the design process, the case should answer questions such as the following:

- What key decisions were made?
- At what points in the design process did these decisions arise?
- Who was involved in the making of these decisions?
- What was the rationale or reasoning behind these decisions?
- How were key design decisions judged to be useful or not?
- What key changes were made during the design process?
- Why was the proposed design solution believed to be the best ?

The most effective means of describing the design solution(s) will be highly dependent on the nature of the design. Whether the artifact is an experience or an artifact, verbal or pictorial representations at multiple stages of development will help demonstrate how the design was iterated and the proposed solution achieved. For a designed experience, a careful description of a participant's anticipated experience might be provided in the form of text or through still photography or videos. In the case of a designed artifact, images of the actual product would be needed. Depending on the complexity of the object, multiple views at different ranges might be needed to best describe the artifact.

This component of the design case is a critical dimension of rigor and in cases reviewed so far the one least likely to be presented coherently and completely. Sometimes this seems to be a problem related to the difficulty of deciding what to present first when elements of a design are intertwined. In others, authors seem to have been accustomed to describing the products of their designing in generalizations ("a collaborative, technology-supported lesson," for example) rather than experiential particulars ("two students start a project based on a one-page scenario in which a scientist presents a problem and asks for their help to solve it using a wiki-based tool for recording their ideas, collecting information and reporting their solution").

Audit trails

The idea of an audit trail is based on the practice of financial auditing (Lincoln & Guba, 1985). Just as a business produces and maintains records of financial dealings to be reviewed in a financial audit, the researcher can produce and maintain a record of the resources, processes, and decisions involved in the development of a case for possible review in the form of peer debriefing or member checking. Protocols for developing audit trails, as presented in Lincoln & Guba (1985) may provide guidance to the potential design case writer in developing personalized methods for documenting not only the design phenomenon, but also their own reflections on the process of translating that experience into a rigorous design case.

There are a few key points that should be emphasized here. First, these criteria are being applied to the design case, and not necessarily to the design process whereby the products or experiences were developed. A design process does not necessarily have to be rigorous in order to be the basis of a rigorous case. However, it will be difficult to develop a rigorous case if there are not artifacts and records in some form from the design process, whatever the process may have been.

Second, the necessary level of descriptive detail will vary from case to case. If a design case centers on the production of an artifact that is already very well known, or that is very similar to a product in wide circulation, it might not require as much descriptive text to make clear to the reader the design problems which motivated its development and the context in which it might be used. In the case of a less-well known product or design, a great deal more explanation might be provided to help the reader understand the uses and context of the project, thus enabling her or him to recognize the degree to which the case parallels design scenarios which have been, or in the future might be, part of the reader's experience. Ultimately, the degree of detail necessary will depend on the intended uses of the case and the anticipated experience of the one using or interpreting the case.

In providing thick description, evidence of triangulated data, and negative case analyses, the design case author clearly will have to be selective in choosing which aspects of the design process to describe, and which aspects of the design solution to represent. This process might be usefully informed by

looking to sampling strategies recommended by Polkinghorne (2005) for selecting participants to participate in studies based on language data. These strategies include selection based on maximum variation sampling, typical sampling, extreme (or deviant) sampling, critical case sampling, criterion sampling, confirmatory or disconfirmatory sampling, and convenience sampling. Table 1 examines how each of these sampling techniques might be applied when selecting aspects of the design process to be represented in the design case.

Table 1. Strategies for selection of design case content (Based on Polkinghorne, 2005)

Selection Strategy	**Strategy as it might be applied in a design case**
Maximum variation sampling	Describing and representing decisions and features which present the widest possible range of events and aspects of the design
Typical sampling	Highlighting aspects of the design process and artifacts which demonstrate the most common events and types of moves within the design; Intended to provide a high-level understanding of the main themes or common occurrences throughout the project
Extreme (or deviant) sampling	Selecting events or artifacts that diverged substantially from others during the project
Critical case sampling	Purposively including some part of the process or artifact because of its importance or its impact throughout the project
Criterion sampling	Selecting an event or aspect of the design because it coincides with some pre-determined criterion; useful in cases were some particular aspect of the design process or artifact is anticipated to be of particular significance or usefulness
Confirmatory and disconfirmatory sampling	Identifying aspects of the project which might confirm or disconfirm commonly held beliefs, support or contradict common practices; In a design case, might also help illuminate decisions which ended up being more or less fruitful
Convenience sampling	Selecting aspects of the design project based on ease of access and representation; May also be based on availability of records / artifacts, or clarity of participants' memories of events

Naturalistic inquiry has been the source of methods described above for enhancing trustworthiness. Action research is also a source of useful insight when framing criteria for rigorous design cases. Specifically, action research emphasizes the importance of making private reflection public for the purpose of publicly testing knowledge claims. In action research, as may be likely in many

design cases, the researcher / author is often a direct participant in the situation under study (Hinchey, 2008). Such direct participation by the investigator stands in direct opposition to traditional, experimental approaches to knowledge development which stress the importance of the researcher standing apart from the phenomena of study.

Action research proposes that the public testing of knowledge claims helps minimize the risks inherent in permitting the researcher to be an active participant. This public testing of knowledge claims performs a similar role to that of the peer debriefing discussed in the context of naturalistic inquiry, though the public testing of claims in action research goes well beyond a relatively small group of peers or reviewers. Public dissemination and testing of knowledge developed in and from design cases permits a reciprocally beneficial relationship – design case authors are able to test their own understandings while design case readers gain access to precedent which may prove useful or insightful in their own work. One implication of this insight is that standards and expectations for rigorous design cases are likely to evolve over time, as a larger body of design cases become available, and as more individuals create and respond to such cases. Public testing is necessary for testing knowledge claims, but also sets an expectation for what will be considered rigorous in the future.

Particular Difficulties for Traditional Researchers in Producing a Design Case

Based on experiences in writing and editing design cases written by traditional researchers, it is possible to discuss some of the difficulties these authors face adjusting from other forms of knowledge building to producing design cases.

Difficulty forcing the case into the tradition categories for a research report

It makes sense that a design case would need a different structure than a report of experimental research, and many naturalistic studies are, indeed, reported in unconventional formats. Some authors find themselves describing students in a learning experience as “participants,” or discussing the “methods” used in a project when they might be better off describing the evolution of a project through the lens of critical incidents in decision-making.

Difficulty providing a rich description of the design

In reports of scientific research the closest analog to a rich description of a design might be the discussion of study materials, instruments or procedures. However, these segments of the report can be condensed in such a report to ensure enough room for reporting data, analyses, findings and conclusions. The materials for a study are also typically discussed in a section of the report separate from a description of the participants, and these are again separate from procedures for carrying out the study. In a design case, the central concern is to convey the designed artifact and/or experience in a coherent way so that the reader can store a vicarious, episodic memory of it. If

the parts of this description are divided and subdivided too far, they do not cohere into a mental image sufficient to form this vicarious memory.

Difficulty expressing design rationale and judgment as intentional design

Whether it is the concern that objectivity is expected in scientific knowledge building, a desire to make the design process appear more rational than it may actually have been, or some other impulse, it seems to be difficult for many authors to express directly that they, their design teams, or someone they are observing has carried out individual design moves or made particular decisions. Phrases like "it was decided that the device would be flat and smooth" and "the materials were presented in lecture format" convey the impression that design decisions are both automatic and unproblematic. There also seems to be a reluctance to address form in detail and to provide plain descriptions of the reasons for decisions. This may be due in part to the mandate in scientific research to base every bit of knowledge on a firm basis of previously proven, and documented, facts. When decisions are made based on prior experience, speculation regarding outcomes, synthesis of affordances perceived in a personal store of precedent, and other non-scientific bases, many authors have been taught, however implicitly, to gloss over the point using indirect language. However, the basis for and reasoning behind these decisions is at the heart of the design knowledge often lost through not being documented or discussed, incompletely conveyed via less rigorous cases, or even presumed not to exist by those to whom it has never been made explicit.

Difficulty reflecting on designs and design processes without generalizing

When design knowledge is not valued in its own right or seen to be created in the *use* of precedent rather than created *a priori* by the author of a case, the pressure to generalize one's design experience—however cautiously, and ultimately inappropriately—seems to be overwhelming. Authors seem compelled to derive lessons from their experiences and present these to readers of a case as if they were the outcomes of research. Close reading of these "lessons learned" reveals them to be a mix of design rationales that should have been discussed as part of the critical decision-making that occurred during designing, contextual factors that influenced *this* design and how it developed, and reflections on aspects of this case that illuminate it to readers in greater depth than could be achieved through unadorned reporting of facts. Attempts to state these as generalities, or to imply that they are generalizable, is quite obviously poor science and, perhaps less obviously, a detriment to the overall rigor of the case being presented. Every so-called "lesson learned" that does not appear in its rightful relationship to the rest of the case reduces the clarity and transparency of the case.

Difficulty valuing the design knowledge in a case as separate from the proven quality of the design, or of the design process

In a rationalized view of design, right process inevitably results in right design and right design results in expected and desired outcomes. In this scientific view, there is little value in examining or describing a case unless its goals were both clear and achieved, or unless it is to serve as an object lesson in avoiding mistakes as evidenced by proof that it did not achieve its goals. However, for a design case which is to serve primarily as a form of precedent for other designers, there are other compelling reasons to invest in the effort of documentation as a rigorous case. The project may have taken place in extraordinary circumstances, included an unusual set of functional requirements, prompted innovative design moves, exhibited particular elegance, been carried out in a high profile situation, or presented a cluster of problems not easily amenable to a coherent solution. The resulting artifact or experience may have been a measurable success, an indisputable failure, or too new at the time of the design case to have been tried at all, but in any of these situations the potential value of the design case is not necessarily contingent upon the success or failure of the design. The case is not produced in order to discover which decisions and processes result in successful designs, but to contribute to the body of design precedent available to the design community and do so in full recognition of the complex uses to which that precedent may be put. A designer who springboards from the affordance in a precedent design to an innovative move in another design situation will not inherent the full outcome of the precedent design by virtue of having synthesized an element from it into another situation. When measurable outcomes are salient in a design case, they are entirely appropriate, but authors do not need to try and justify a design case primarily on the basis of such measures and should not discuss a case as though the outcomes were its primary claim to value.

It remains to be seen what difficulties may arise for authors who have extensive experience producing less rigorous cases and strive to produce more rigorous ones. One might anticipate difficulties obtaining resources, particularly time, required to document a case rigorously; difficulties in some situations with exposing conflicts or unflattering incidents that might be salient; difficulties with attending to the content of the case in addition to the forms representing the case; and so on. However, these problems are likely to come from the effort to extend or enrich a practice already in place and may be easier to resolve than the difficulties for authors who are struggling to move from the scientific mold to a more appropriate, yet unfamiliar, representation of design knowledge.

Conclusion

This paper draws from the traditions of naturalistic inquiry and action research to propose criteria to be applied in developing and identifying rigorous design cases. By adopting methods developed to enhance trustworthiness and by subjecting knowledge claims to public testing, design cases may become

increasingly rigorous. Over time, these methods might be adapted in ways that prove to be more suited to the demands and content of design. If based on these initial criteria, a critical body of design cases is amassed, and if from such a body of cases additional or different criteria emerge as being the most useful in fostering rigorous design cases, this initial set of suggestions on producing the rigorous case will have served its purpose.

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