

Jun 25th, 12:00 AM

Research-Through-Design: Exploring a design-based research paradigm through its ontology, epistemology, and methodolog

C. Grey Isley
North Carolina State University

Traci Rider
North Carolina State University

Follow this and additional works at: <https://dl.designresearchsociety.org/drs-conference-papers>

Citation

Isley, C., and Rider, T. (2018) Research-Through-Design: Exploring a design-based research paradigm through its ontology, epistemology, and methodolog, in Storni, C., Leahy, K., McMahon, M., Lloyd, P. and Bohemia, E. (eds.), *Design as a catalyst for change - DRS International Conference 2018*, 25-28 June, Limerick, Ireland. <https://doi.org/10.21606/drs.2018.263>

This Research Paper is brought to you for free and open access by the Conference Proceedings at DRS Digital Library. It has been accepted for inclusion in DRS Biennial Conference Series by an authorized administrator of DRS Digital Library. For more information, please contact DL@designresearchsociety.org.

Research-Through-Design: Exploring a design-based research paradigm through its ontology, epistemology, and methodology

ISLEY C. Grey and RIDER Traci

^a North Carolina State University

* Corresponding author e-mail: cgisley@ncsu.edu

doi: 10.21606/drs.2018.263

Design research has risen in prominence over the past 20 years resulting in substantial discussion regarding its ontological and epistemological foundation, but there has been limited progression towards consolidation of the disparate views into a fundamental design paradigm. Design researchers continue to struggle to find a unified paradigmatic voice and move beyond a pre-paradigm state. Relying on the foundational support created by Sir Christopher Frayling's taxonomy of design-based research, many have proposed the creation of a new research paradigm. This requires critical discussion on how design differs from the existing realms of research, as well as establishing the ontology, epistemology, and methodology appropriate for this new paradigm. Through literature and an established philosophical framework, this paper will look at the foundational arguments that have been generated by scholars within the design disciplines for this new paradigm, synthesizing a proposal for the associated ontology, epistemology, and methodology.

research through design; design research; design paradigm; epistemology

1 Introduction

"Once you let go of the idea of a small set of formal criteria for what may count as "real research" you open the doors for a serious and much more interesting discussion about what should be considered good research." (Kjørup, 2012, p. 41)

Research Through Design (RtD) currently has multiple interpretations within design research. The term is derived from Sir Christopher Frayling's (1993) three categories: *Research for art and design*, *Research into art and design*, and *Research through art and design* and is referenced as a paradigm (Zimmerman, Stolterman, & Forlizzi, 2010), a methodology (Findeli, Brouillet, Martin, Moineau, & Tarrago, 2008), a method (Hatleskog, 2014), and at times an ambiguous theoretical process. With the absence of a formal classification, RtD is most often discussed in the context of a proposed



This work is licensed under a Creative Commons Attribution-NonCommercial-Share Alike 4.0 International License.

<https://creativecommons.org/licenses/by-nc-sa/4.0/>

methodology. These discussions do not, however, directly acknowledge the ontology and epistemology that this would-be methodology is founded in. It is therefore difficult to justify it without these paradigmatic foundations. For the purpose of this paper, RtD will be discussed at the philosophical level as an emerging paradigm addressing the position of Zimmerman et al(2010) in which, while including discussion of RtD as a methodology, also critiques it as a research approach that does not currently enjoy “the status of a well-defined research paradigm” (p. 316).

The multiple interpretations of RtD, and furthermore the lack of a unified paradigmatic voice, within design research is related to the relatively young age of the discipline. Clemente et al.(2017) credit the beginning of academic research in design with the conversion of The Design Research Department at the Royal College of Art to a postgraduate teaching department in 1976. This was a precursor to the larger movement in design research that started in the late 1990’s with the first PhD Design Conference at Ohio State University. The youthfulness of this movement has resulted in researchers adopting methodologies from established research paradigms as a means to validate their diverse research. These methods can often be inadequate for the design fields and as such demonstrate the necessity for the establishment of specific methodologies that contribute directly to design research. (Clemente et al., 2017)

This current state within design research demonstrates Kuhn’s(1996) discussion with regards to emerging paradigms. (Gaver, 2012; Kj rup, 2012) Until a research community has widespread adoption of an agreed upon paradigm, practitioners will draw upon different philosophical foundations that are oriented towards the field in varying ways. This borrowing of philosophy requires researchers to establish the rationale behind their approach every time they seek to make a contribution. This need to continuously justify methods would be greatly reduced with the establishment of a paradigm. Currently within design research, there are concerns that design does not have a theoretical tradition and that design research pertaining to the process and creation of objects currently does not have a shared paradigm. (Gaver, 2012; Koskinen, Zimmerman, Binder, Redstrom, & Wensveen, 2011)

As the design field begins to embrace academic research, there is a need to “build the epistemological and methodological foundations of a discipline that can be recognized and legitimated by other disciplines in the academic community” (Clemente et al., 2017, p. S792). The recognition of this need for a more defined and consistent methodology is the motive behind the discussion of the establishment of a new paradigm, but this is not possible without the backing of an epistemology. (Findeli et al., 2008) This epistemology is not agreed upon, however. While there is widespread acceptance that design projects have a place within academic design research, there are currently two fields of thought regarding the basis of the epistemology. (Clemente et al., 2017) The first considers that there is a wide range of current methodologies, and by association epistemologies, within established paradigms in which design research can find a fit for all questions. This is especially true when considering qualitative research.

The second school of thought argues that a new methodology must be established that accepts the process of design as a valid research method. This is the focus of this paper; positing that a new paradigm must be established first. In order for the paradigm to exist it must have an epistemology and ontology with protocols, principles and validating procedures. (Bolt, 2008) The latter of these will be outside of the scope of this discussion but they should still be noted as they are directly influenced by the paradigm’s theoretical foundation.

In consideration to this second position, the lack of a unified paradigmatic voice within design research, and Jonas’(2007) and Haseman’s(2006) call for the formation of a performance based paradigm, this paper focus on the development of the philosophical foundations of a design paradigm. This will begin with an examination of the historical foundation of RtD. The categories of design research will be reviewed following the work of Frayling(1993), Cross (1999, 2006), and Findeli (2008). Through this review it will be demonstrated, embodying Jonas’(2007) argument that

the foundations for design research cannot be found in the sciences or humanities, that research categorized within Frayling's(1993) *Research through design* category does not easily fit within existing paradigms. RtD will then be evaluated through literature as an emerging paradigm, with a focus on its foundational philosophy. This evaluation will be the basis for the synthesis of a proposed ontology, epistemology, and methodology for RtD, utilizing a framework based on discussions by Groat and Wang(2013) and Guba and Lincoln(1998). Finally, while it is not the intent of this paper to discuss the implementation of RtD within research, there will be a brief discussion of its implementation and the concerns associated with its current lack of philosophical foundations.

2 Historical Foundation

Discussion of RtD begins with Sir Christopher Frayling's(1993) three categories of design research: *research for art and design*, *research into art and design*, and *research through art and design*. These classification have been refined by others to include the following definitions. (Findeli et al., 2008).

- *Research for design*: highly relevant to the design practice, focusing on various parameters related to the output of design such as technology, ergonomics, and aesthetics. Performed in academics and in practice. Often builds upon previous knowledge, is at times done without rigor, and is not always intended to be published.
- *Research into/about design*: performed with rigor by various disciplines both inside and outside of design. Accepted by the scientific community but at times has a lack of relevance for the practice of design. Can be performed for the advancement of disciplines outside of design and focuses on the significance of the process and products of design for society or culture.
- *Research through design*: relevant to the academic advancement of the design discipline. It is rigorous, produces original knowledge, and has virtues of both research for design and research into design.

These categories do not establish the need for a design paradigm. They formulate the understanding of how research is conducted in design and where a design focused paradigm may be needed. *Research for design*, when conducted in practice, is routinely considered unscientific and is concerned with producing some form of tacit knowledge. (Clemente et al., 2017). When performed with rigor it draws upon several established paradigms. *Research into design* is frequently conducted by disciplines outside of the design field, such as the humanities, and uses paradigms associated with those disciplines. This leaves *Research through design* that is concerned with all aspects of the design process and is also concerned with new knowledge and scientific rigor. Therefore, the development of a new paradigm is based upon the third category.

Frayling's categories do not provide the strong foundational theory that is needed to guide design research. (Koskinen et al., 2011) For this reason, other scholars must be consulted to formulate the philosophical foundation of RtD. However, the placement of RtD within the spectrum of other research paradigms must be considered first. Figure 1 demonstrates how RtD, along with the other two categories, fit within academic research. This provides an understanding of how RtD overlaps the other categories, but it does not explain how RtD fits within established research paradigms.

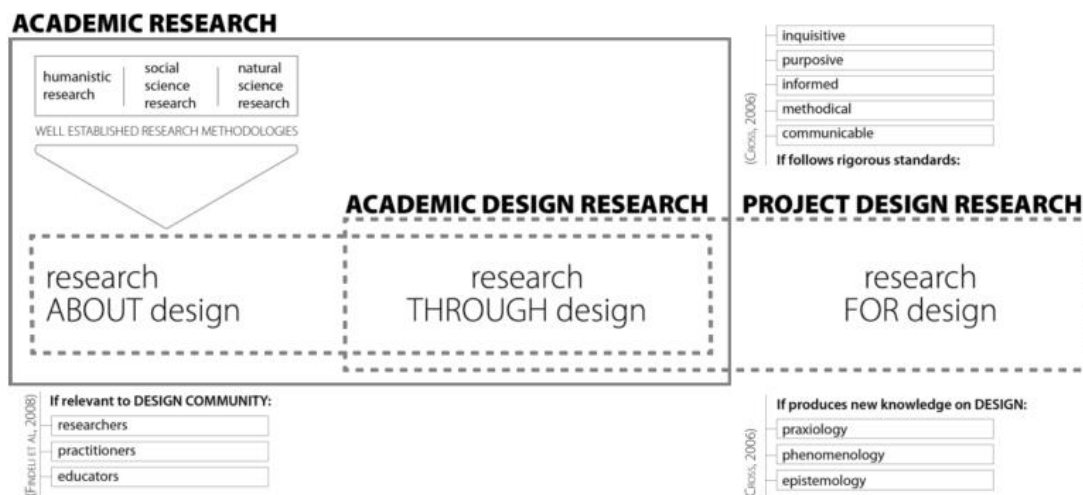


Figure 1: Frayling categories within research. (Clemente et al. 2017, p.5794)

Currently design research is in a pre-paradigm state and has used existing paradigms to justify research with mixed results. This is linked to the fact that design is associated with the divide between the objective and subjective worlds (Hawkins & Wilson, 2017). Figure 2 establishes the current spectrum of objective-subjective research paradigms. This spectrum suggest that scientists discover pre-existing objects embedded within the objective world and artists create artifacts from their subjective imagination (Hawkins & Wilson, 2017). The argument for the formal establishment of RtD outside of these conventional bounds can be made by eroding this spectrum (Cross, 1999, 2006). This process provides the foundation for the ontology and epistemology of the RtD paradigm.

	Objective ←			→ Subjective	
	Positivism/Postpositivism		Intersubjective	Constructivism	
Epistemology	Knower distinct from object of inquiry	Knowing through distance from object	Knowledge framed by understanding sociocultural engagement	Knowledge co-constructed with participants	Knowledge perpetually provisional
Ontology	Assumes objective reality	External reality revealed probabilistically	Diverse realities situated in socio-cultural context	Multiple constructed realities	Infinite realities

Figure 2: Continuum of research paradigms (Groat & Wang, 2013, p.76)

The objective and subjective spectrum applies to the current thought of artist and scientist. It can, however, be considered that there are "...forms of knowledge peculiar to the awareness and ability of a designer, just as the other intellectual cultures in the sciences and the arts concentrate on the forms of knowledge peculiar to the scientist or the artist" (Cross, 1999, p. 5). This ascertains that designers have a form of knowledge that does not easily fit within the objective-subjective bounds. This breaks from C.P. Snow's (1959) "two cultures" view of Western intellectual tradition in which there is a division between two factions, art and science. Therefore, there must be consideration for at least one other faction, design, as it can be articulated through comparison of the other two (Cross, 1999).

Within design Cross's (1999, 2006) classifies three areas of study: people, process, and product. These three areas form the foundation for Cross's taxonomies of design research.

- Design epistemology: study of designerly ways of knowing

- Design praxeology: study of the practices and processes of design
- Design phenomenology: study of the form and configuration of artifacts

These categories do not reclassify Frayling's (1993) categories but further refine research conducted within RtD and its overlap of *Research into design* and *Research for design*.

The expression of a thought process outside of the objective-subjective spectrum and the conventional thought of scientist and artist provides argument for the development of a design paradigm. When this is coupled with the design research taxonomies, the foundation for RtD is established. Using this framework, a set of theoretical assumptions will be used to synthesize the ontology, epistemology, and methodology of RtD.

3 Philosophical Foundations

A theoretical framework is needed to aid in the discussion of the ontology, epistemology, and methodology of RtD. Findeli et al (2008) state that the formation of the philosophical basis for the RtD paradigm is difficult and must determine: 1) the relationship between theory and practice; 2) support the claim of practice is important and necessary for theory building; and 3) explain how this contribution of practice to theory is to be contrived and operationalized. These three items correspond to the organizing questions that Guba and Lincoln (1998, p. 201) used in their discussions of paradigms.

What is the form and nature of reality and therefore what is there that can be known about it?

What is the nature of the relationship between the knower or would-be knower and what can be known?

How can the inquirer go about finding out whatever he or she believes can be known?

These questions relate respectively to ontology, epistemology, and methodology and frame the remaining discussion regarding the philosophical basis for the RtD paradigm.

This considered, these questions need to be framed within design. This begins with a summary description of current RtD practitioners:

... researchers make prototypes, products, and models to codify their own understanding of a particular situation and to provide a concrete framing of the problem and a description of a proposed, preferred state...Designers focus on the creation of artifacts through a process of disciplined imagination, because artifacts they make both reveal and become embodiments of possible futures...Design researchers can explore new materials and actively participate in intentionally constructing the future, in the form of disciplined imagination, instead of limiting their research to an analysis of the present and the past. (Koskinen et al., 2011, p. 5)

This description provides the underpinning for a design paradigm and can be expanded to provide insight into the qualities of the researchers and process within RtD. 1) Research founded in RtD embodies the qualities of design by building, exploring and creating new things (Jonas, 2007). 2) Ideas originating from the imagination of the researchers are made tangible through the process of design. 3) This process is as equally important to the research as the created artefact. 4) The creation of knowledge is grounded in imagination but keeps a distance from the pure practice of building objects. 5) The design explored within the research should offer alternatives rather than try to alter reality directly. (Koskinen et al., 2011). 6) A successful research design should change the way people think about material and social reality, open possibilities, and prepare for action. 7) This should lead to hypothetical discourse that strives to enrich the imagination and open new ways of seeing and discussing opportunities from those who the research targets (Zimmerman et al., 2010).

This context along with additional resources can be used to create a philosophical foundation. In Figure 3 Groat and Wang's (2013) table of quantitative and qualitative paradigm assumptions has been modified to include a third category, design. The ontology, epistemology, and methodology of RtD has been added and will be explained through the following sections.

Question	Quantitative	Qualitative	Design
Ontology: 'What is the nature of reality?	Reality is objective and singular, apart from the researcher.	Reality is subjective and multiple as seen by participants in a study.	Reality is practical and imaginative as seen by the designer through the process, and from the objects created
Epistemology: 'What is the relationship of the researcher to that being researched?	Researcher is independent from that being researched.	Researcher interacts with that being researched	Researcher and the objects created are entwined and cannot be separated, the process of inquiry is as important if not more important than the final product
Methodology: 'What is the process of research?	Deductive process: cause and effect.	Inductive process: Mutual simultaneous shaping of factors.	Design process: reflective synthesis of the creation of material objects

Figure 3: Paradigm Assumption, based on (Groat&Wang, 2013, p.71)

4 Ontology

The proposed ontology of RtD is derived from a consolidation of views. This begins with Koskinen et al.'s (2011) description of design researchers,

...researchers [within RtD] do not try to analyze the material worlds..., nor do they see designs as an exercise in rational problem solving. Rather, they imagine new realities and build them to see whether they work. (p.42)

Here, the existence of an imaginary and real world is established. This link is not dissimilar to the perspective of subjectivism, but one must consider that in the case of RtD there is a duality of worlds. This is perceived through the acts of researchers which are

...intended to alter reality, pushing it in the direction of order and logic. Instead the project is an act of invention that creates something to be added on to existing reality, increasing its depth and multiplying the number of choices available (Koskinen et al., 2011, p. 44).

In such, the dual nature of reality is established thorough the design process. One reality is the researcher's imagination. This is where the design originates. The other reality is the physical world in which the design manifests and is interacted with during and after the design process. By acknowledging that design objects and their intended function initially exist in the imaginary form, researchers in RtD recognize that the design artifacts in both the imaginary and physical state has function; therefore, it exists in two realities. Founded in this concept, RtD in its most basic form can be viewing reality as the real that "will be" (Godin & Zahedi, 2014).

The nature of this reality can be further derived from Cross' (1999) three fields of knowledge: the natural world, the human experience, and the artificial world . These are directly linked to science, the arts and humanities, and design respectively. Their 'ways of knowing', while also tied to epistemology, can be used to refine the ontology of RtD. The 'ways of knowing' are as follows:

- Science: rational and objective
- Humanities: reflection and subjective
- Design: imagination and practicality.

Through this, the reality that "will be" is bound to a plane of practicality. As such the ontology for RtD is not only concerned with the reality associated with the imagination but it must also maintain some form of perceived practicality.

The creation of the proposed ontology is a synthesis of the discussed concepts. 1) The recognition of dual realities, the imaginative and the physical. 2) The understanding that these realities manifest

themselves through the design process. 3) The realities may only be perceivable in some instances by the researcher. 4) The physical reality is tied to practicality. Therefore, the ontology is stated as: Reality is practical and imaginative as seen by the designer through the process, and from the objects created.

5 Epistemology

The epistemology of RtD is easier to derive than the ontology as it is found in an array of discussions either directly or indirectly. Within RtD, the researcher and the objects created are entwined and cannot be separated, establishing knowledge through this relationship. This is in part due to the inherent nature of design but also lies within the assumption, like those listed under qualitative paradigms in Figure 3, that knowledge established through research is influenced by the researcher. In the case of RtD, this relationship goes further and is only fully perceivable when looking at the design process and objects created in unison. For this reason, the process of inquiry is perceived as important, and by some more important, than the final product. This is most simply derived from Kozel (2012),

I practice, and I reflect upon practice in infinitesimal loops. This is the nature of my perception and my embeddedness in the world. It is not that the doing is the practice, and the mode of reflection is the theory. Both are reflective practice and, taken together, both make up research. (p.208)

Cross's (2006) 'designerly way of knowing' provides a framework to this concept. Designerly knowledge is unique and not simply 'a ragbag of all the things that science and humanities leave out' (Cross, 2006, p. 6). Similar to science and humanities, it has its own inner coherence. Demonstrated through the 'ways of knowing', designerly knowledge differs from the sciences and humanities through the perception of how it is gained. This way of knowing is in part associated with a relationship with artifacts and is associated with the constant realignment of artifacts based on trial and error to learn about design problems (Godin & Zahedi, 2014).

Jonas (2007) and Koskinen et al. (2011) agree that designerly knowledge is generated through the process of creation and the "...functional and symbolic fit of artefacts and their human, social and natural contexts of use" (Jonas, 2007, p. 1363). Learning occurs through the process where the "aim cannot be a final "true" representation of some external reality, but rather a process of (re-) construction for the purpose of appropriate (re-)action" (Jonas, 2007, p. 1368). This emphasizes the link between the process, artifacts, and unique knowledge associated with the design discipline.

There is a systematic relationship between the designer, process and product (Hatleskog, 2014). Knowledge is created through the designer and the process of creation. This relationship between the designer and process is indistinguishable. There is an "embodied cognition view of knowledge, knowledge is a process of inquiry rather than a final product" (Johnson, 2012, p. 145). This indistinguishable nature is the reason that the role of the designer must be considered and evaluated through the process (Hatleskog, 2014). The process includes the identification of the acts or techniques required to first determine the issues and then solve problems.

This emphasis on the process does not supersede the importance of the final object and its own ability to provide knowledge. Building upon Cross's statement, "Objects are a form of knowledge about how to satisfy certain requirements, about how to perform certain task" (Kimbell, 2009, p. 3), the importance of the created objects is identified through the consideration that

someone has designed them a particular way, for some reason. It may not be a good reason, but for designers, objects offer information about the purposes of their designers, manufacturers and users. (Kimbell, 2009, p. 3) (p.3)

Zimmerman et al. (2010) reinforces the concept that the ideas of the design researcher are made tangible through designed objects. Further, the complexity of the process and problems to be resolved can be found embedded within the objects.

The knowledge contained within the objects is not always transferrable through numbers or words (Carless & Douglas, 2013; Haseman, 2006). Carless and Douglas (2013) state that “knowledge or understanding is not always reducible to language...we know more than we can tell” (p. 55) With this acknowledgment, it must be considered that “artefacts other than the written word are considered sufficiently powerful in their own right to carry the force of the academic argument” (Hawkins & Wilson, 2017, p. 82). Given these perspectives, a RtD epistemology must address that knowledge is imbedded in and created by all aspects of the design process, from the designer to the process to objects; the inseparability of these components drives how knowledge is derived in RtD.

The proposed epistemology is synthesized from understanding; 1) design knowledge is unique to the discipline, 2) knowledge is generated through the design process and its artifacts, 3) the researcher and process are interrelated due to the process of design, 4) the process and the resulting artifacts contain knowledge. As such, the epistemology is proposed as: Researcher and the objects created are entwined and cannot be separated, the process of inquiry is as important if not more important than the final product.

6 Methodology

Referencing the previously outlined epistemology, the methodology associated with RtD must be directly linked to the design process and, with respect to Kozel (2012), Hatslekog (2014), and Cross (2006), embody reflective synthesis of the creation of material objects. This proposal of RtD’s methodology, is closely associated with Cross’s (2006) “ways of finding out”. It draws directly from his classification of appropriate methods for design paradigms, which includes the process of modelling, pattern-formation and synthesis.

This methodology is heavily associated with the process and artifacts of design. The design process will both define and drive the research (Forlizzi, Stolterman, & Zimmerman, 2009; Hatslekog, 2014). The associated methodology leverages the design process of repeated problem reframing to create a scholarly method of inquiry that allows researchers to engage in wicked problems and become active constructors of possible futures. (Forlizzi et al., 2009) Again, the discussion of the methodology connects back to the epistemology and ontology, as it should. In such, it reinforces the concept that the designers are creating knowledge that has the potential for hypothetical discourse that enriches and opens ways of seeing and discussing opportunities (Koskinen et al., 2011). It should be noted, however, that it is this exact concept of using the design process for the creation of academic knowledge that Haseman (2006) attributes to difficulties of design and performance based paradigms being accepted.

A newly defined process-based methodology may not be the only acceptable methodology for a RtD paradigm. If RtD is to be considered a paradigm, multiple methodologies may be associated with it, as long as they align with its ontology and epistemology. Methodologies do not have to be exclusive to RtD and similar to Gioia and Pitre’s (1990) discussion of multiparadigm perspectives, it may be found that existing methodologies could be appropriate for use within RtD. In this case, the chosen methodology must reflect the importance of the process in the RtD paradigm.

According to Haseman (2006) and Findeli et al.(2008), the existing methodology must associate with research through practice and can include practice-led research, action research, project-grounded research, studio research, research through practice and others. This listing is heavily associated with intrinsically experiential and iterative practice, but the concept of action research is repeated throughout several discussions. Zimmerman et al.(2010) emphasizes that the methodology should consist of iteratively planning, acting, observing and reflection.

Summarily, the process and practice of design is a significant component of the any methodology used within a RtD paradigm. This is founded in the significance placed upon process in the outlined ontology and epistemology. The methodology does not have to be solely bound in practice as described by Hatleskog (2014) but should act as a starting point and should be processed based. Through this approach it is critical that any methodology chosen reflects this importance of the process. As such there is a need to potentially refine and develop new methodologies that better reflects this stance.

7 Employing RtD in Design

After discussion of RtD's philosophical foundation, it is beneficial to briefly review the application of RtD within design research and potential concerns. RtD is directly tied to the discipline of design and research questions will be framed solely for the study of design. For that reason alone, it is a strong perspective to use when looking into design questions. It is not, however, the only perspective that can be used in design research. As demonstrated through discussion of Frayling's three categories, design is an expansive discipline with many areas of focus, ranging from social factors to physical sciences. Other perspectives could effectively handle the research question depending on its focus. For example, if the research focuses on architecture's impact on the perception of societal structures, then the research could be conducted under constructivism. Conversely if the study looks to determine the energy reduction associated with parametric optimization, then a positivist or post-positivist approach may be more appropriate.

Therefore, an understanding of the phenomena of focus is necessary for the use of RtD. RtD will typically include questions regarding phenomena in the process, the use or properties of artifacts, or the relationship between the two. It can look at a variety of aspects, ranging from how internal or external phenomena influence the design process to how an artifact's embedded knowledge informs others to its use. Studies under these conditions would potentially look at a variety of scenarios. They would compare results between multiple processes or artifact conditions. This creates extensive possibilities for the use of RtD in design but does not properly relate some of its concerns.

There are still several issues that must be considered prior to RtD being recognized as a valid research paradigm. At its basis the RtD paradigm is not well documented and has not been fully formalized or developed. This is directly seen thorough the discussion of the ontology, epistemology, and methodology. Several sources were required to derive the definitions of the philosophical foundations. This is not due a lack of individuals discussing these concepts, rather there is no consolidated stance on its position within the philosophical framework. This is a critical component of implementing RtD. There is a need for an understanding and agreement on its theoretical platform, its link to design practice, and of utmost important its placement within a paradigm, either its own or existing. It is these concerns that cause issue with its acceptance within the academic community and gives initial concerns as to its ability to effectively be implemented with wider academic acceptance.

Additionally, RtD needs an understanding regarding the ability of the artifact to stand alone and suffice as research output. As stated by Zimmerman et al. (2010), the knowledge gained can be implicit in residing almost entirely within the resulting artifact. The community must decide if this is a valid measure or if the research must follow more traditional standards with a written output. Accepting the artifact as knowledge leads to the potential issue when the transference of knowledge is a research goal. This would require individuals to gain knowledge through usage as proposed by Haseman(2006) or the researcher to disseminate the knowledge gained through the artifact's use via a written paper or presentation. This can create concerns regarding the ability to widely and accurately distribute the knowledge gained from the research. This is part of the ambiguities that the community as a whole must address and define for this paradigm.

Finally, there is concern with regards to the physical ability to conduct research under this paradigm. The research can be cumbersome due to its nature. This resides in the focus of research and the size

of the artifact. This concern does not apply uniformly across all design disciplines. Projects that are conducted primarily within a studio or similar area, pertaining to small scale items or confirmable through scale models, will have very different requirements for space and cost than ones that are fully implemented and consist of large scale human interaction. Therefore, RtD may be more inclined to be used under disciplines such as industrial design rather than architecture.

These concepts result in major reflection regarding the appropriateness of RtD for all design research. It is not the argument of this paper that all design research should use RtD, rather RtD is a paradigm specific to design that can help unify design research. To employ RtD, these issues must be taken into consideration and are part of the larger philosophical discussion of this paper. Implementation of RtD as a research paradigm will be dependent on resolution of these concerns and widespread acceptance of its philosophical foundations within the design community.

8 Conclusion

Zimmerman et al. (2010) summarize the usefulness of RtD through the statement that it “allows researchers to rely on designerly activities as a way of approaching messy situations with unclear or even conflicting agenda; situations that are not well suited to other methods of inquiry.” (p.310) This usefulness towards design research can only be fully realized, however, once RtD has been fully established and recognized by the research community at large. Currently RtD is not well established and lacks any agreed upon system or focus (Zimmerman et al., 2010). In order for RtD to progress forward it needs an understanding within the design community about its philosophical foundation.

This exploration used established literature to propose that these foundations reside in the design process and an understanding of designerly knowledge. This allowed for the synthesis of proposed ontology, epistemology, and methodology. Further exploring these concepts and establishing a unified paradigmatic voice can move the design discipline forward from Kuhn’s pre-paradigm state. This cannot occur until there are open discussions regarding the design disciplines philosophy and establishing its ontology, epistemology, and related methodologies. For this reason, the design community must continue to have these discussions and move design research towards an accepted field of rigorous academic research.

9 References

- Bolt, B. (2008). *A Performative Paradigm for the Creative Arts?* (Working Papers in Art and Design 5).
- Carless, D., & Douglas, K. (2013). An Invitation to Performative Research. *Methodological Innovations Online*, 8(1), 53–64.
- Clemente, V., Tschimmel, K., & Pombo, F. (2017). A Future Scenario for a Methodological Approach applied to PhD Design Research. Development of an Analytical Canvas. *The Design Journal*, 20(sup1), S792–S802. Retrieved from <https://www.tandfonline.com/doi/full/10.1080/14606925.2017.1353025>
- Cross, N. (1999). Design Research : A Disciplined Conversation. *Design Issues*, 15(2), 5–10.
- Cross, N. (2006). *Designerly Ways of Knowing*. London, UK: Springer.
- Findeli, A., Brouillet, D., Martin, S., Moineau, C., & Tarrago, R. (2008). Research Through Design and Transdisciplinary: A tentative Contribution to the methodology of Design Research. In *Swiss Design Network Symposium* (pp. 67–91).
- Forlizzi, J., Stolterman, E., & Zimmerman, J. (2009). From design research to theory: Evidence of a maturing field. In *International Association of Societies of Design Research* (pp. 2889–2898).
- Frayling, C. (1993). Research in Art and Design. *Royal College of Art Research Papers*, 1(1).
- Gaver, W. (2012). What should we expect from research through design? *Proceedings of the 2012 ACM Annual Conference on Human Factors in Computing Systems - CHI '12*, 937–946.
- Gioia, D. A., & Pitre, E. (1990). Multiparadigm Perspectives on Theory Building. *Academy of Management Review*, 15(4), 584–602.
- Godin, D., & Zahedi, M. (2014). Aspects of Research through Design : A Literature Review. *Proceedings of DRS 2014: Design's Big Debates*, 1667–1680.
- Groat, L., & Wang, D. (2013). *Architectural Research Methods* (2nd ed.). New York, New York: Wiley.

- Guba, E. S., & Lincoln, Y. S. (1998). Competing paradigms in qualitative research. In *The Landscape of Qualitative Research: Theories and Issues* (pp. 195–220). Thousand Oaks, California: Sage Publications.
- Haseman, B. (2006). A manifesto for performative research. *Media International Australia Incorporating Culture and Policy*, 118(1), 98–106.
- Hatleskog, E. (2014). Research Through Design: An Architectural Response to Practice-Led Research. *Arhitektura, Raziskave*, 2014(2), 5–14.
- Hawkins, B., & Wilson, B. (2017). A Fresh Theoretical Perspective on Practice-Led Research. *International Journal of Art and Design Education*, 36(1), 82–91.
- Johnson, M. (2012). Embodied Knowing Through Art. In M. Biggs & H. Karlsson (Eds.), *The Routledge Companion to Research in the Arts* (pp. 141–151). New York: Routledge.
- Jonas, W. (2007). Research through DESIGN through research. *Kybernetes*, 36(9/10), 1362–1380.
- Kimbell, L. (2009). Beyond design thinking : Design-as-practice and designs-in-practice. *CRESC Conference*, (May), 1–15.
- Kj rup, S. (2012). Pleading for plurality: artistic and other kinds of research. In M. Biggs & H. Karlsson (Eds.), *The Routledge Companion to Research in the Arts* (pp. 24–43). New York, New York: Routledge.
- Koskinen, I., Zimmerman, J., Binder, T., Redstrom, J., & Wensveen, S. (2011). *Design Research Through Practice*. Waltham, MA: Morgan Kaufmann.
- Kozel, S. (2012). The virtual and the physical: a phenomenological approach to performance research. In M. Biggs & H. Karlsson (Eds.), *The Routledge Companion to Research in the Arts* (pp. 204–222). New York, New York: Routledge.
- Kuhn, T. S. (1996). *The Structure of Scientific Revolutions*. Chicago, IL: The University of Chicago Press.
- Snow, C. P. (1959). *The Two Cultures and the Scientific Revolution*. New York, New York: The Syndics of The Cambridge University Press.
- Zimmerman, J., Stolterman, E., & Forlizzi, J. (2010). An analysis and critique of Research through Design: towards a formalization of a research approach. *Proceedings of the 8th ACM Conference on Designing Interactive Systems (DIS '10)*, 310–319.