DESIGNING TECHNOTHEOLOGIES: ETHICS, PEDAGOGIES, AND SPIRITUALITIES IN MAKER ACTOR-NETWORKS

by

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Abstract

The purpose of this study was to understand how religion and spirituality matter in the consumer use, design, and engineering of media and technology. Specifically, the research questions were: 1) What role do ethics and values perform in maker and hacker networks? 2) How are ethics and values integrated and manifested throughout the design process in maker or hacker networks? 3) What are the routines, rituals, and subjective well-being of participants in the maker or hacker design process? The research setting was the designers in the maker community in Vancouver and technologists associated with Code for the Kingdom in Seattle. All designers and technologists in Vancouver and Seattle have independent projects at various levels of collaboration. I recruited seven participants affiliated with the Vancouver maker community for in-depth analysis of their design process. In Seattle, I recruited two hackers who participated in Code for the Kingdom, a Christian organization that hosts hackathons for altruistic and religious purposes. Their focus on innovation, design methodologies, and critical making allowed me to discern their values and ethics through their design process. These participants have different perspectives on religion and spirituality, which make their technotheological networks complex. Case studies facilitated in-depth examination of makers and hackers as the main actors of our inquiry. The use of video in dialogue with ethnographic inquiry allowed for nuance, discerning complexities, and giving form to expression in designing technotheologies. Conceptually, the research is framed by actor-network theory (ANT) and value sensitive design (VSD), enabling the study of how participants discover, design artifacts, make meaning, develop values, and maintain a sense of the good life and well-being, emotional and spiritual. Findings indicate that among the makers and hackers, technotheological networks articulate specific values alongside technological creations, practices, and personal ways of being. In their own

unique ways, these makers and hackers inquire into the materialized morality and design phases of ethically responsible decision making processes. Conversely, the non-human actors express their own values within technotheological networks. My role as a techno-theologian helped facilitate competing value claims by positing a normative focus and by temporarily opening black boxes.

Lay Summary

The purpose of this dissertation was to understand how religion and spirituality matter in the consumer use, design, and engineering of media and technology. Specifically, the research inquired into how ethics, values, and spiritualities enacted in maker and hacker networks? The research setting involved the designers in the maker community in Vancouver and technologists associated with Code for the Kingdom in Seattle. The research studied how participants discover, design artifacts, make meaning, develop values, and maintain a sense of the good life and well-being, emotional and spiritual. Findings indicate that the makers and hackers have technotheological networks that articulate specific values alongside technological creations, practices, and personal ways of being. In their own unique ways, these makers and hackers inquire into the materialized morality and design phases of ethically responsible decision making processes.

Preface

This dissertation is an original and unpublished work by Yu-Ling Lee. The author was solely responsible for writing this thesis, under the supervision of the committee. Ethics approval for this research was provided by the University of British Columbia Behavioural Research Ethics Board: certificate #H06-80670. The research was partially funded by the Social Sciences and Humanities Research Council Insight Grant #435-2014-0510 (How We Learn Media & Technology Across the Lifespan), under direction of Dr. Petrina.

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List of Abbreviations

Actor-Network Theory (ANT)

Design-Based Research (DBR)

Do-It-Yourself (DIY)

Do-It-With-Others (DIWO)

Human-Computer Interaction (HCI)

Information and Communications Technology (ICT)

Participatory Design (PD)

Qualitative Data Analysis (QDA)

Science Technology Studies (STS)

Software Development Kit (SDK)

User-Centered Design (UCD)

Value Sensitive Design (VSD)

Video Design-Based Research (VDBR)

Glossary

Actant - A general term used to refer to both human and non-human artifacts that can be acted on and move the action on to some other. Actants are heterogeneous entities that form a network.

Actor – actors can be human or non-human and can be an individual through to a large institution. Each actor is part of a network. Any actor can acquire power through building networks.

Black box – An artifact, fact, or problem simplified within a network, which can be opened or destabilized at any time.

Enrollment - the means by which a set of roles is defined and accepted by actants or actors. These can be via — multilateral negotiations, trials of strength, tricks, etc.

Immutable mobile - An element or inscription that does not change or changes very little as it moves through space and time.

Obligatory Passage Point – An essential step or test, etc., made to be indispensable to the network, which actors must pass through.

Stabilized - A network is said to be stabilized if actors or actants have reached some kind of accommodation or agreement and become assimilated into a network.

Translation - A translation is the product of continual negotiation during which the actants or actors reach a set of compromises that allow them to become allies in the network.

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Finally, I would like to thank my family for their continued support throughout my doctoral work. My wife, Wai, and son, Elliott, have been sources of strength, delight, and joy through the adventure of graduate studies.

Dedication

For my wife, Wai, and my son, Elliott.

Chapter 1: Introduction

Through the twentieth century, the influence of religion or spirituality on public educational practice was increasingly marginalized or disregarded. This is perhaps best marked by the introduction of evolution in the first half and elimination of prayer in the schools in the second half of the century. Whether religion matters remains a contentious issue (Smith, 2009), yet one cannot deny that, like secular schools, it has traditionally affected family systems (Booth, Johnson, Branman, & Sica, 1995), health and well-being (Lim & Putnam, 2010), and cultural practices and rituals (Dawson, 2013; Foucault & Carrette, 1999; Hecht & Biondo, 2012). The underlying concern in this thesis is with ethics and values (Borgmann, 2003; Ellul, 1969; Friedman, 1997; Friedman & Kahn, 2003; Hauerwas & Pinches, 1997; Hauerwas & Wells, 2011; MacMillan, 2002), and particularly whether religion or spirituality matter in media and technology (e.g., consumerism, design, engineering, etc.) (Wyche, Hayes, Harvel, & Grinter, 2006). The problem is whether religion and spirituality matter to the ethics, responsibility, and values of novice designers within hacker and maker culture. To empiricize this problem, I researched hackers and makers actively hacking spaces and making things (Petrina & Wang, 2014; Rosner et al., 2014). These participants included artists, crafters, designers, engineers, programmers, and tinkerers. They gather in maker and hacker spaces to collaboratively produce, cultivate, and reconfigure media and technologies. Although the ethics of hacking and making vary quite considerably, there is a general ethos in maker culture that media and technologies should be modifiable by all users, knowledge should be open and freely shared, and creative tinkering will lead to a better future, particularly in education (Lamers, van der Putten, & Verbeek, 2014).

While some makers and hackers vigorously identify with atheism, there is an intersection of design and faith within various makerspaces. How, then, do religion and spirituality contribute to ethical know-how in the design, engineering, and use of media and technology? There is contestation as to whether religion and spiritualities matter in design (Wyche, Aoki, & Grinter, 2008). Yet, some studies demonstrate a prominent difference in how one would design technologies with theological intent (Gaver et al., 2010; Hlubinka, Beaudin, Tapia, & An, 2002; Walker, 2006a; 2006b). Questions about whether religion matters reflect a long, historical secularism versus religion debate. At this particular juncture, the questions could not be more important. Secularities and spiritualities are theological processes with different preoccupations, subjectivities, and intentionalities (Taylor, 2007, p. 3). In spite of media and technology's particular theology of progress, moral theologies are concerned with how designing and making things enable human flourishing and a quest for the good life. By researching this phenomenon, I am demonstrating the compelling influence of designing media and technologies with theologies, or rather, designing technotheologies.

1.1 Research Purpose

One purpose of this study is to understand how religion and spirituality matter in the consumer use, design, and engineering of media and technology (Brock, 2010; Franklin, 1999; Manders-Huits, 2011; Monsma, 1986; Schuurman, 2009; Walker, 2013). I aim to discern how religion and spirituality contribute to ethical know-how (Bell, 2006; van den Hoven, 2008; Varela, 1999) in the design, engineering, and use of media and technology. My research is situated in the DIY community (Halfacree, 1999), maker culture (Ames et al., 2014; Tanenbaum,

Williams, Desjardins, & Tanenbaum, 2013), and hacker space (Coleman, 2010), in order to discern ethics and values throughout the entire design process (Friedman & Kahn, 2003).

A second purpose is to understand how makers and hackers learn and teach, or educate. Some educational scholars (Bilandzic, 2013; Ratto, 2011a, 2011b, 2012; Santo, 2011, 2013; Sayers, 2012; Schrock, 2014) have connected making and hacking to theorizing and practicing curriculum via collaborative learning and tinkering (Hunsinger, 2011; Moilanen, 2012; Pettis & Schneeweisz, 2011). The participants in this study have an experiential base from which they comment on and critique curriculum reform and educational practices. In this way, they represent an interesting subset of critical educators (Ross, 2015, 2016a, 2016b).

Makers and hackers have differing technological expertise, networks, and practices as well as varying perspectives on religion, spirituality, and theology. Their networks have various actors that "define and distribute roles, and mobilize or invent others to play these roles" (Han, 2016; Law & Callon, 1988, p. 285). My focus was on specific cases of makers, hackers, and their networks of designs, ideas, technologies, and theologies.

1.2 Research Questions

Specifically, the research questions are:

1. What role do ethics and values perform in maker and hacker networks? What ethics and values are used within the design process?
2. How are ethics and values integrated and manifested throughout the design process in maker or hacker networks?
3. What are the routines, rituals, and subjective well-being of participants in the maker or hacker design process?

1.3 Research Setting

This research investigated case studies of designers in the maker community in Vancouver, and technologists associated with Code for the Kingdom in Seattle. All designers and technologists in Vancouver and Seattle have independent projects at various levels of collaboration. The Vancouver maker group has created networks based on common interests (i.e., Lego, robotics, 3D printing) and they tend to showcase their work at local events throughout the year such as library technology showcases or the annual Vancouver Maker Faire. I recruited seven participants affiliated with the Vancouver maker community for in-depth analysis of their design process. Their focus on innovation, design methodologies, and critical making allowed me to discern their values and ethics through their design process. These makers have different perspectives on religion and spirituality, which make their technotheological networks complex. In Seattle, I recruited two hackers who participated in Code for the Kingdom, a Christian organization that hosts hackathons for altruistic and religious purposes. Both hackers have designed online apps that have since been finalized and available to download on iTunes or Google Play. These two designers self-identify as Christian and intentionally incorporate their spiritualities and theologies into the design of technologies. In this way, these spiritual technologists form another network (or counter-network) to juxtapose with the maker networks from Vancouver.

1.4 Conceptual Framework

Conceptually, the research is framed by actor-network theory (ANT) and value sensitive design (VSD), enabling the study of how participants discover, design artifacts, make meaning,

develop values, and maintain a sense of the good life and well-being, emotional and spiritual. ANT is a framework to discover how non-humans in these systems, such as ideas, theologies, and technological artifacts, have agency and enact transformations within their complex networks. These networks emphasize the inseparability of humans and nonhumans. The research, therefore, follows the actants and actors in these networks and traces the contours of what they do in relation to each other. VSD frontloads ethics and values at all stages of design (van den Hoven, 2005). Both ANT and VSD are elaborated in Chapter 2.

Theology is used to extend the scope of design and technology and inquire into the materialization of morality and ethically responsible decision-making processes. This is a *thick morality* whereupon moral theologies problematize design processes using critical, empirical, hermeneutic, participatory, and pluralistic criteria for ethical design (Wong, 2013). Theology and VSD were used in data collection and analysis to challenge participants to deliberate about shared values for designing, engineering, and using media and technologies.

1.5 Definition of Key Terms

The following terms are briefly defined in this section and further elaborated in other sections of the dissertation:

1.5.1 Technology

The Greek *τέχνη* (Latin *technê* and *technologia*) was used extensively in ancient times. *Technê* meant art, craft, or technique and the skill an artist, artisan, craftsperson, or rhetorician possessed. In the *Gorgias*, Plato (449e) depicts Socrates and the sophist Gorgias having a conversation that connects *technê* and *logos* as discerning the underlying rhetoric or ordering

skill at hand. Aristotle, in *Rhetoric*, describes the "treatises on rhetoric" (*technas tôn logon*; 1354a12), which is literally translated as *technê* of *logos*. This phrase becomes a single word, *technologousin* (τεχνολογοῦσιν; 1354b19), which is not understood as "technology" in the way we use it today but rather as "rules of art" or "theorizing." Some scholars exaggerate in suggesting that Ramus more or less defined *technologia* as "the theory of arts or science, and expanded the use of 'technology' to describe the operating principles of any art or science" (Nordkvelle, 2004, p. 429). Specifically for education, Ong (1958/2004) believed Ramus employed *technologia* as the "art of arranging the contents of the curriculum" (Ong, 1958/2004, p. 197). This simplifies curriculum *and* technology as "instrumentalism."

Mitcham (1994) historicizes technology and notes that there are four primary manifestations: objects or artifacts, activities, knowledge, and volition (p. 160). In 2001, he defined technology simply as "the making and using of artifacts" and expanded on the four manifestations. For this research, I adopted Mitcham's four manifestations and definition.

1.5.2 Theology

Much like technology, theology has its origins in Greek as τεολογια. In the *Republic,* Plato (II, 379a) uses theology to refer to discourse about the gods whereas Aristotle, in *Metaphysics* (VI, 1026a19) claims theology as a theoretical science equivalent to math and physics. In the *City of God*, Augustine (VIII, i) defined theology as "rational discussion respecting the deity." Philosophy was thought of as 'handmaiden to theology' (*philosophia ancilla theologiae*) in medieval education and during the seventeenth century theology was called *Reginae scientiarum* (Queen of knowledge of the sciences) (Zakai, 2007). Ramus defined theology as "bene vivendi," meaning, "theology is the doctrine of living well" (Sprunger, 1966,

p. 136). For Ramus, to be theological, is to live well by following rituals and spiritual traditions. Modern curriculum scholars have also attempted to define curriculum as theological (Huebner, 1985, 1993; Moran, 1981; Purpel, 1989; Phenix, 1971/1975). In this way, a seemingly secular construct can be traced as theological. The *American Heritage Dictionary* defines theology as "the study of the nature of God and religious truth" ("Theology", 2000). For this research, theology is reflection on religion and spirituality, noting that one does not have to be a theologian to practice theology.

1.5.3 Religion

The word 'religion' remains a divisive and contentious word. Interestingly then, we do not hear much about how religion and spirituality matter in the consumer use, design, and engineering of media and technology. Instead, the fields of design and technology tend to dismiss religion altogether, claiming that technical objectives and functions do not require metaphysical or ontological constructs from the religious realm (Fisher, 1996). Smith claims that modern mind enacted a scientific cosmology, or scientism, wherein knowledge and reality are accessed through scientific accounts of the world (Smith, 2009, pp. 59-78). Similarly, the works of Berger (1967, 1980) describe a process of secularization of individual consciousness, society, and culture due to a "heretical imperative" (1980). Even if one claimed to be religious, the heretical path (i.e., path of choices) is set upon us through the plurality of modern consciousness. The religious person would have freedom to choose specific values or theologies and limit religion to the private sphere. Secularization, for Berger, is therefore a product of modern rationalization and scientific industrialization. It is noteworthy that Berger (1999) would, some thirty years after his secularization theory was put forth, admit that modernity did not necessitate

the loss of religion, but rather, there was empirical evidence that the world "is as religious as it always has been… [if not] more religious than ever" (Berger, 2000, p. 445).

Religion is difficult to define, since religious experience is so diverse across human life, and the definitions of religion are shaped by sectarian differences in some way. Griffith and Griffith (2002) offer an inclusive definition:

> Religion represents a cultural codification of important spiritual metaphors, narratives, beliefs, rituals, social practices, and forms of community among a particular people that provides methods for attaining spirituality, most often expressed in terms of a relationship with the God of that religion. In this sense, God personifies and objectifies the relatedness of spirituality. By working out a relationship with his or her God, a religious person can bring into proper focus other relationships. (p. 17)

Taylor (2007) conceptualizes religion as a network not merely of symbols, rituals, and beliefs symbolizing the sacred:

> Religion is an emergent, complex, adaptive network of symbols, myths, and rituals that, on the one hand, figure schemata of feeling, thinking, and acting in ways that lend life meaning and purpose and, on the other, disrupt, dislocate, and disfigure every stabilizing structure. (p. 12)

With Griffith and Griffith, and Taylor, for this research, religion means a codification and network of beliefs, rituals, and etc. for attaining spirituality.

1.5.4 Design

Like technology, design has a plurality of definitions:

- An art form
- An applied science

- A process with an input and an output
- A goal-directed problem-solving and decision-making activity
- A deliberately intended or produced pattern
- Creativity and imagination
- Satisfying needs
- Drawings, sketches, plans, calculations
- Foresight toward production, assembly, testing, and other processes
- Managing, learning, planning, and optimizing
- Collecting and processing data
- Transferring and transforming knowledge (Konsorski-Lang & Hampe, 2010, p. 4)

Pertinent to the discussion is another shift in design, which emphasizes issues of ethics and moral values (Albrechtslund, 2007; D'Anjou, 2004; Friedman, Kahn, & Borning, 2008). Simon's (1988) definition of design remains most universal: "devis[ing] courses of action aimed at changing existing situations into preferred ones" (p. 67). For this research, Simon's definition was adopted.

1.5.5 Making

Making can be traced back to the idea of *homo faber*, describing human beings as makers or poets. In antiquity, Hesiod (ca. 700 BCE/2006) brings about this theme of making in the *Prometheus* myth, whereby Prometheus gives fire, and by implication technology, to humankind. Similarly in ancient Rome, Ovid (ca. 8/1958) depicts Daedalus and Icarus as *opifex,* meaning artisans, may be "of the same order as the creation and the start of a better world" (Hoefmans, 1994, p. 143). More generally, we understand that humankind has a long history of making (*poiesis*), whether it be making things, making the world, or making of oneself. Cantrill and Oh (2016), Deleuze (1997), Heidegger (1982), and McLuhan and Carson (2003) emphasize the primal connections among making, language, and technology. As Sennett (2008) states most simply, "people can learn about themselves through the things they make" (p. 8). Humankind as

homo faber, makes itself by making things – language, poems, tools, and machines. For this research, I adopted Honey and Kanter's (2013) definition of making as "building or adapting objects by hand, for the simple pleasure of figuring out how things work" (p. 4). The work of "building or adapting objects" includes digital objects and "figuring out how things work" can refer to hacking. Specific to electronic systems, hacking "can describe the determination to make access to computers and information as free and open as possible" (Sterling, 1992, p. 49). Of course, hacking also means "intruding into computer systems by stealth and without permission" (Sterling, 1992, p. 51). For this research, hacking generally refers to "figuring out how things work" (Lee & Petrina, in press). In this research, making an app and coding an app refer to the same processes. Hacking an app refers to figuring it out. A review of maker culture, specifically literature on maker education, is found in Chapter 2.

1.6 Reflexivity and Positionality: The Task of the Moral Theologian

In addition to researcher, I acted as educator, ethicist, and moral theologian, or hopefully an active co-designer to help with value discovery and translation into design requirements. As theologian, in particular, I facilitated a deliberation of competing value claims by positing a normative focus. The theologian, from a theological perspective, believes that her or his work is important as it is a high calling, or vocation (Haughey, 2012). Vocation, having Latin roots (*vox)* in calling or summons, and within a religious framework, would center on the call from God. In this way, the term 'vocation' is a loaded theological category offering ancient ways of relating and profound sources of meaning. For example, Palmer (2000) meditated on his own vocation as a teacher in relation to the old Quaker saying, "Let your life speak." Initially, Palmer understood this to mean "let the highest truths and values guide you. Live up to those demanding standards

in everything you do" (p. 2). Some thirty years later, Palmer realized that vocation as he was interpreting it was an act of will he imposed onto his life. Instead, authentic vocation comes from listening to your calling. It does not consist of living by standards you *must* adhere to, but rather, listening for the truths and seeking values by which one cannot help but live. Within a long tradition, Huebner (1987/2008) explicitly links vocation to the act of teaching. In particular, he calls us to consider teaching as loaded with value considerations even though moral and spiritual values have been detached from common educational practice (p. 386).

One of the clearest statements of the positionality of the moral theologian is McCormick's (1983) "Bioethics in the Public Forum." "I am a moral theologian," McCormick states, "and a Catholic one at that. What does that mean?"

> To say that I approach these questions as a Catholic moral theologian means to suggest three things above all: 1) Religious faith stamps one at a profound and not totally recoverable depth; 2) This stamping affects one's instincts, imagination, etc., and hence influences one's perspectives, analyses, and judgments; 3) Analyses and judgments of such a kind are vitally important in our communal deliberation about bioethics. Thus, the more precise question is: How does a moral theologian (in the sense explained) play a role in the formation of public policy? (p. 114)

This positionality of the moral theologian in design and technology provides an effective basis on which I can position myself in this research.

1.6.1 From moral theologian to technotheologian

Within the discourse of designing, making, and hacking technologies, there is perhaps no more an important question than that of ethics or values (Takacs, 2003, p. 33). More specifically, in discerning differences between values in the design process, there is a need to explicitly reveal hidden or assumed ethical frameworks. In other words, we need to consider the moral theologian or *technotheologian* as designer and mediator with potential to reveal ethical values under negotiation.

In my case, the challenge was to act as technotheologian *and* reflexive researcher (Weber, 1930/2003). As technotheologian, I tried to listen to the many voices in the maker networks, and to 'let their lives speak.' This active act of listening entails sustaining discourse, deliberation, and discernment about ethical values (Verhey, 1990, p. 22), enacting a framework for moral reasoning, guided by a perspective informed by a particular theological tradition (McCormick, 1983, p. 125). Fully understanding the uniqueness of this tradition, the reflexivity of the technotheologian does not presume authority over value systems, but rather, adopts the position of a "servant of all" (Mark 9:35) to bring about ethical clarity.

In my research, I adopted the figure or role of technotheologian at optimal moments in interviews and other modes of data collection. This generally took a form of value discovery and helping participants articulate how they translate values into design requirements (van Wynsberghe & Robbins, 2013, p. 12). In this role as technotheologian, I was also entrusted with value conceptualization, helping participants identify their divisions between conceptualization, utilization, and unintended consequences of values. Using ANT concepts, I was helping to open the black boxes of their design processes. While primary discussions revolve around functional or technical values such as issues of usability, privacy, or universal accessibility of technology,

in the role of technotheologian I was particularly concerned with structuring conversations of designing technotheologies as this relates to justice, peace, and *shalom*. In effect, given my background and expertise in theology, I adopted the figure or role of technotheologian in conscious, explicit ways to inspire or provoke conversation and discussion about ethics and spirituality in design, media and technology.

1.7 Dissertation Overview

The dissertation is divided into five chapters. Chapter 1 was an overview of the background, questions, theoretical framework, key terms, purpose, and reflexivity and positionality. Chapter 2 provides a review of literature relevant to the conceptual framework. Chapter 3 outlines the methodological framework, practices, and use of research instruments for researching technotheologies. Chapter 4 reports the findings based on the maker and hacker case studies. The results are interpreted and focus is given to the interaction between technologies, theologies, ethics, and values. Chapter 5 concludes with a summary of my research, discusses implications, and offers recommendations for future research.

Chapter 2: Review of Literature

This chapter comprises a literature review of conceptual components that form the technotheological networks. It introduces maker and hacker culture, maker education, and employs a conceptual framework based on Actor-Network Theory (ANT) and Value Sensitive Design (VSD). ANT and VSD help address whether religion and spirituality matter in the design, engineering, and use of media and technologies. ANT facilitates analysis of non-human actors in technotheological networks such as curricula, ideas, media, and technologies. VSD accounts for human and technological values in designing technotheologies. ANT is largely associated with science and technology studies (STS), originating in the works of Callon (1986a, 1986b), Latour (1987; 2005b) and Law (2009). ANT has been prominent in STS (Barter & Bebbington, 2012; Oppenheim, 2007; Saito, 2011; Tatnall, 2010, 2011; Whittle & Spicer, 2008; Wright & Parchoma, 2011), and is beginning to have more prominence in educational studies (Fenwick & Edwards, 2010; 2012; Nespor, 1994; 2002). VSD is prominent in the field of Human-Computer Interaction (HCI) within the scope of technological ethics; it was developed to explicitly address the ethical nature of design. Developed by Friedman, Kahn, and Boring (2002), it affords conceptual, empirical, and technical investigations (van den Hoven & Manders-huits, 2009) into the value-design-technology network. In this way, the conceptual framework is uniquely situated to inform a detailed analysis of technotheologies. Following the review of ANT and VSD, this chapter provides a brief review of relevant literature regarding the interrelationships among ethics, religion, spirituality, technology, and design. I differentiate how theologies are transformed, negotiated, and translated. In the final sections, I depict technotheological networks by connecting makers, hackers, values, ethics, technologies, and theologies. In this way I am

stressing the embeddedness, relationality, and interactivity among actors within the makers' and hackers' technotheological networks.

2.1 Maker and Hacker Culture

Although maker culture draws on thousands of years of craft production, making as digital fabrication dates to 1952 at MIT, whereupon researchers "wired an early digital computer to a milling machine, creating the first numerically controlled machine tool" (Gershenfeld, 2012, p. 43). Hughes (2012) remarks that this particular manifestation of the maker ethos "ties together physical manufacturing skills with the higher end technical skills of hardware construction and software programming" (p. 3884). From the technical origins at MIT, this modern understanding of making derives from a "DIY ethic," evident in 1960s and 1970s counterculture, which involves self-directed projects requiring hands-on labor with different materials (Gauntlett, 2011; Knobel & Lankshear, 2010). Anderson (2012), then, distinguishes contemporary maker culture to prior eras of making and crafting by identifying three characteristics: use of digital tools for creating products, cultural norms of collaboration, and design file standards (p. 21). Lindtner and Li (2012) identify similar qualities whereupon maker culture is directed towards "technological and social practices of creative play, peer production, a commitment to open source principles, and curiosity about the inner workings of technology" (p. 18). Making, then, focuses on individual and communal relationships with the creative use of objects and tools. Makers engage with diverse materials such as fabrics, wood, metal, plastic, and electronics. Gauntlett (2011) suggests that creativity is the crucial element for maker culture, it is a "social glue" (p. 217) binding individual makers together.

Hacking, too, has origins within MIT and by 1959, students were taking apart computer systems to understand how they work and creating new technologies. The "hacker ethic" eventually emerged in the 1980s, which challenged rigid computer rules and resources with the following values (Lee & Petrina, in press):

- Access to computers and anything which might teach you something about the way the world works should be unlimited and total. Always yield to the Hands-On Imperative!
- All information should be free.
- Mistrust authority, promote decentralization.
- Hackers should be judged by their hacking, not bogus criteria such as degrees, age, race, or position.
- You can create art and beauty on a computer.
- Computers can change your life for the better. (Levy, 2010, pp. 28-34)

Hacker culture (Thomas, 2002) has more broadly referred to various groups involved with "hactivism" (Olson, 2013), free and open-source software (Kelty, 2005), or more nefariously, cyber warfare (Deibert, 2013). Hacking and criminality are often linked, however, hacking has become a generic term for customizing or figuring things out. The hacker moniker is applied to areas such as inventive use and reuse of IKEA products (Rosner & Bean, 2009), data-driven journalism (Lewis & Usher, 2013), or even medicine and health care (DePasse et al., 2014). More recently, hacker conferences, or hackathons enact processes of "ritual condensation and emotional celebration" (Coleman, 2010, p. 47) to hack together for altruistic purposes. Together, making and hacking culture values access, creativity, and freedom to tinker or hack technological systems. This democratization of technology use and innovation (Hatch, 2013) is

prompted by the freedom to participate in making for all. Making and hacking cultures extend from amateur computer hobbyists to broader social movements that present alternative approaches in design and technologies. Hacking and making have various definitions and manifestations but most generally refer to "creative mis-use and hands-on construction, respectively" (Schrock, 2014, p. 1). Making is the joyful process of building, designing, adapting and creating of any object (Honey & Kanter, 2013; Papavlasopoulou, Giannakos, & Jaccheri, 2017).

2.1.1 Maker education

Maker education has a history rooted in craft, and craftivism (Petrina, 2007), design theory (Konsorski-Lang & Hampe, 2010), experiential learning (Itin, 1999), open learning environments (Hannafin, Hill, Land & Lee, 2013) and project-based learning (Blumenfeld et al., 1991). Additionally it is derived from constructivism (Smith, 1993) and constructionism, which emphasize self-discovery of learners encountering objects (Cetina, 1997; Papert, 1993). Turkle and Papert (1990) extend the self-discovery conception to encounters with technical objects and systems, kinds of technical learning, which encourage "epistemological pluralism." Experiential learning is derived from Dewey and Piaget (Dewey, 1938; Kolb, 1984), and focuses on "learning by doing"— on finding meaning from direct experience and praxis. Design theories seek systematic approaches and development of design methodologies (Petrina, 2000) and designerly ways (Cross, 2006). Maker education, then, conceptualizes teachers and learners as makers of things. According to Bullock and Sator (2015):

> Maker pedagogy is an approach that utilizes the principles of ethical hacking (i.e., deconstructing existing technology for the purpose of creating knowledge), adapting (i.e., the freedom to use a technology for new purposes), designing (i.e., selecting components and ideas to solve problems), and creating (i.e., archiving contextual knowledge obtained through engaging in the process of making, as well as the actual tangible products) as part of an overall way of working with those interested in learning about science and technology. (pp. 76-77)

Maker curriculum is usually centered around projects in education that teaches various technical goals such as developing a knowledge of hardware and software, fluency in programming skills, and rapid prototyping skills. Halverson and Sheridan (2014) classify maker education into three categories: understanding making as designed learning processes and activities, examining makerspaces as communities of pedagogical and learning practices, and exploring identities of makers. Peppler, Halverson, and Kafai (2016a) problematize making in relation to schooling, noting that the typical standards-based curricula are incompatible with the pedagogical practices or ethos of making (p. 6). Making, at times, has a technological utopianism (Sivek, 2011) that can be at odds with the political, economic, and cultural realities of schools. Additionally, Halverson and Sheridan (2014) note that there is a fear that institutionalizing maker culture into school programs will repress the creativity and innovative spirit of the maker movement. For instance, educators may ask how are we to evaluate making? Should evaluation be based on completion of class projects, work methodology, or knowledge discovery? What is the end result or aim of making and how do we define a 'finished' state of making?

Yet for all intents and purposes within public schools in countries such as Australia, Canada, England, and the US, these questions are resolved within design and technology

education workshops, art studios, home economics labs, and graphics and information technology labs. These educators and their students have been making and doing in the schools for well over a century. For instance, the Bauhaus art school in Germany, which operated from 1919 to 1933, offers insights into issues of design and technology in education. Their school slogan was "art and technology: a new unity." Their curriculum for students consisted of training in craft, drawing and painting, and science and theory. This threefold curriculum structure of technology, art, and science showcased the myriad of ways that making, design, and technology are integrated in a particular school. Another example, in England during the 1970s, the craft, design, and technology (CDT) programs combined lab-based technology and workshop courses (Petrina, 2007, p. 388), emphasizing design and creativity. Schön (1988) describes the architectural studio model as a "reflective practicum in designing" whereby design education is a "reflective conversation with the materials of the situation" (p. 4). For Schön, design curriculum and pedagogy in the studios are marked by this kind of tacit learning characterized by his term, *reflective*. Sator and Bullock (2017), in turn, research teaching programs of maker pedagogy and demonstrate that maker projects enable reflective pedagogical practice. Papavlasopoulou, Giannakos, and Jaccheri (2017) conducted a comprehensive analysis of maker education literature and found making integrated into classrooms in positive ways, particularly in STEM subject areas (p. 63). Overall, research in design and technology education has found evidence for developing understanding of empathy (Klapwikj & Van Doorn, 2015), sustainable development (Pavlova, 2013), passion and enthusiasm in learning (Atkinson & Sandwith, 2014), and experiential pedagogy for design and problem-solving (Potter & France, 2016). Hence, fears about institutionalizing maker culture seem to overlook existing practices. What is new, however, are community centre, library, and pop-up makerspaces.

Critical questions about maker education remain. For instance, maker culture and maker education have been described as an "adult white, middle-class pursuit" (Barton, Tan, & Greenberg, in press; Rose, 2014). Vossoughi, Hooper, and Escudé (2016) hold a similar critique about maker culture through a lens of power, yet argue for an equity-oriented approach as response. They approach making for research and design as "critical analyses of educational injustice, historicized approaches to making as cross-cultural activity, explicit attention to pedagogical philosophies and practices, and ongoing inquiry into the socio-political values and purposes of making" (Vossoughi, Hooper, & Escudé, 2016, p. 215). Other critical research possibilities include Blikstein's (2013) call for FabLabs, and the wider maker education to have a Freirian framework for maker projects as a form of empowerment that address meaningful problems.

2.1.2 Critical making

One consideration in hacker and maker spaces is the notion of "critical making." Confluences of critical thinking and material production "reintegrate technical and social work and thereby innovate both" (Ratto, 2011b, p. 258). The intention is that substantive engagement of making with the material production will lead to valuable conceptualizations of the world beyond language and explored through embodied, material forms (Ratto, 2012; Ratto, Wylie, & Jalbert, 2014). What is emphasized is not the design, technologies, or technical knowledge; rather, critical making "shares an emphasis on values" (Ratto, 2011a) which focuses on "the constructive process as the site for analysis" (Ratto, 2011b, p. 253) emphasizing critique and expression in the shared act of making. Hertz suggests that critical making indicates "how hands-

on productive work – making – can supplement and extend critical reflection on technology and society" (Hertz, 2011, p. 256). The greater goal, then, is to use making with materials and technologies as a site of critical reflection to "reconnect our lived experiences with technologies to social and conceptual critique" (Ratto, 2011b, p. 253). DiSalvo (2009) further progresses the concept of critical making by analyzing user practices, their tracings and projections, which result in the design and construction of new publics. This allows the development of "adversarial design" (DiSalvo, 2012), which explores the political qualities and potential of technological design for rethinking social, economic, and cultural processes.

2.2 Actor-Network Theory

ANT originated in STS in the early 1980s at the Centre de Sociologie de l'Innovation (CSI) of the École nationale supérieure des mines de Paris. In hindsight, one might say that initial studies examined how scientific facts and technological artifacts are made within contexts such as labs, companies, or government agencies. ANT in this way originated as a way to study making, as developed by its progenitors, Callon, Latour, and Law. Callon studied scallops at St. Brieuc Bay (Callon, 1986a) as well as the electric car (Callon, 1986b), Latour explored the history of pasteurization (Latour, 1988), and Law examined the TSR 2 aircraft (Law, 1988). It may be considered a form of material-semiotics (Law, 1999, p. 4) with a focus on how socio-material relationships are made or come into being in the world. Researchers using ANT focus on how human and nonhuman entities assemble in systems or networks. These entities or actors are associated with one another through translation processes, which result in a range of networked possibilities (Callon, 1986b, p. 29; Callon & Latour, 1981, p. 280). ANT has figured prominently in studies published in the areas of technology (Wright & Parchoma, 2011),

sociology (Latour, 2005b; Saito, 2011), anthropology (Oppenheim, 2007), geography (Murdoch, 2006), business management (McLean & Hassard, 2004), feminism (Haraway, 1991a), and development studies (Resnik, 2006). Yet, within educational research, there has been limited widespread adoption of ANT (Edwards, 2002; Fenwick & Edwards, 2010, 2012; McGregor, 2004; Mulcahy, 2007; Nespor, 2002; Waltz, 2006). This is surprising as ANT advances important understandings for curriculum and pedagogy. For instance, elements such as learners, the mind, systems of learning, objectivity, subjectivity, and other categories common to educational analyses are not subsumed under various ideologies but rather form various actor-networks. Interestingly, proponents of ANT do not label it a theory or coherent framework (Mol, 2010, p. 253). It is rather much like the coyote or trickster figure (Haraway, 1991b, pp. 21-26), a "rich array of explorative and experimental ways of attuning to the world" (Mol, 2010, p. 265), a "sensibility, a way to sense and draw (nearer to) a phenomenon" (Fenwick & Edwards, 2012, p. ix), which assumes nothing has substance outside of its own networked relations (Law, 2009, p. 141). For our purposes, ANT allows for the exploration of new questions within complicated technotheological networks (Figure 1).

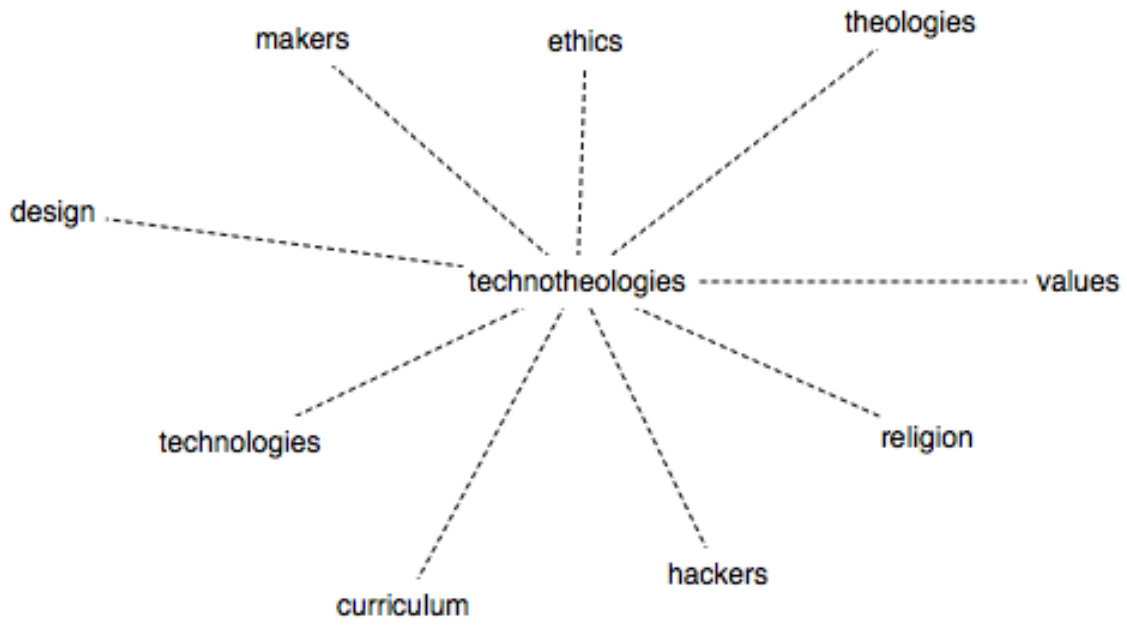

Figure 1. Technotheologies as actor-network.

2.3 What is Actor-Network Theory?

The challenge in defining ANT, as mentioned above, is that it is not a theory per se. The danger in limiting ANT to any single grand, unified theory is to misinterpret and constrain its strengths through reductive explanations. For instance, Latour describes four things wrong with ANT: the word actor, the word network, the word theory and the hyphen in between (Latour, 1999a). He was lamenting the dangers of using the technical metaphor of 'network' among other agency-structure clichés. Jokingly, Latour, following Lynch, suggested that "ANT should really be called 'actant-rhyzome ontology'" (Latour, 1999a, p. 19). Now, ANT is an anti-foundationalist approach built on a relational ontology (Law, 1999) in which human and nonhuman entities are treated as equal entities within a network. Latour (1987) called this "symmetry," whereupon human motivation and activity are decentered and we are afforded the

opportunity to better understand interactions of humans and non-humans (such as things, texts, curriculum) and resultant actor-networks (systems, school policies, teaching methods). In this way, all actants in a network, human and nonhuman, are able to exert force on each other, change and be changed by another actant, join together, and expand the networks through space and time. These actor-networks can also shrink, collapse, or become discarded due to various forces or transformations. The capacity of ANT allows researchers to discern how connections within networks can attract or enroll other actors, how these connections stabilize or destabilize, and ultimately how they negotiate these potential processes with one another. Thus, ANT does not focus on the meaning of any particular actant, but rather on what these actants do within the network. For instance, it takes a significant effort to mobilize and stabilize a school as a network of students, teachers, classrooms, desks, chairs, curriculum, computers, learning methods, etc. These various actors interact with others such as school policies, class rules, and parental expectations. ANT allows the careful tracing of these associations among actants. What are the different connections and associations created within a school or district? Are there counter-networks at odds with dominant networks? How stable are these networks? The following sections explain the more prevalent ideas from ANT: networks, translation, agency, black boxes, (im)mutable mobiles, and scale.

2.3.1 Networks

The concept ‘network’ used within ANT has been around for some time. Moreno and Jennings (1938) used network theory as a technique to observe structural processes and how chain-relations form in groups. Network theory soon led to network analysis whereupon researchers would observe individuals in a field of relationships, a social network, to discover

instrumentalities within a system (Prattis, 1978, pp. 383-384). This was a step beyond contextualism, allowing for interaction within the network approach (Hughes, 1986, pp. 281-282). While network theory continued to grow as a field, it wasn't until Callon (1986a) problematized the typical notion of networks that we begin to differentiate it for ANT. For Callon, a network begins to establish itself through a process called 'interessement:' different entities are brought to share interests and negotiate connections within the network. When this network becomes sufficiently stable, it begins to enroll other entities and spaces through a process called mobilization. Callon depicts a flat ontology in which all actors and actants continually shape the network through various processes. This is why Latour (1999) describes networks as "a series of transformations — translations, transductions" (p. 15), focusing on the connections and the processes of translation. Fenwick and Edwards (2010) consider the textbook as a primary example for a network in educational analysis. The textbook constitutes a variety of "meetings, voices, explorations, conflicts, and possibilities explored and discarded." In addition, the textbook would move across space and time, "shaping thoughts and actions and thus creating new networks" (p. xiv). As this is a flat ontology, all elements in the network are of equal substance and impact the network through their spatial integrity or position within the link of relations (Law, 1999, p. 7). Successful analysis of the textbook and its network would then allow us to discern the important actants associated.

There are several criticisms of the network metaphor that are particularly relevant for educational research. A major issue is that ANT focuses on describing the network and avoids providing explanations, critiques, and certainly does not suggest any alternative solutions (Latour, 1988, p. 159). Other challenges include privileging specific networks and rendering

unnoticeable other ones (Strathern, 1996), creating a greater sense of stability, or representing networks as less durable, or a risk of reducing all things to semiotics.

2.3.2 Translation

ANT has been described by Callon and Latour as a "sociology of translation" (Callon, 1981; Latour, 2005b, p. 9). One of the most important functions within ANT, translation is the process where entities are joined, impact each other in some way, and form links in the actor-network. Translations occur between entities, in which the active entity is called the 'actor' or 'actant.'

> Actant means both 'action' and 'behaviour.' This term from semiotics is useful in spite of the criticisms because it does not oblige us to discriminate between humans and non-humans, and because it defines an entity only by the list of actions in which it is engaged. (Latour, Mauguin & Teil, 1992, p. 55)

Actors and actants undergo a translation process that provides them "with their actions, with their subjectivity, with their intentionality, with their morality" (Latour, 1999, p. 18). The actor or actant thus assumes a proper role within the network, defined through its trajectories of associations and substitutions; it is defined by what it does within the total structure of the actor-network. Translations happen through an emergent process and are therefore neither a linear or predictable function. They are negotiations between entities, actors, and actants, whereby connections are produced through various forces, coercions, pressures, and resistances. Part of this negotiation process of translation involves defining obligatory passage points (OPP) in which key actors stabilize a network. As actor-networks undergo various processes of

translation, they settle into a stable system, or become destabilized. A destabilized network offers ample opportunity to study the various effects of translations and why there was a breakdown in connections. Yet, a seemingly stable network potentially hides the many translations necessarily for cohesion. It would be up to the researcher to follow the various trajectories of entities, the resulting translations, and exactly what kinds of connections and networks are formed. For instance, the disagreement between the provincial government of British Columbia and its teachers in 2014 can be interpreted using ANT to discern the various translations surrounding the proposed teacher contracts (*Huffington Post*, 2014). Hidden from the public debate about the teacher strikes and binding arbitration are the various translations found within the network of the teacher contracts. Fenwick and Edwards (2012) describe teacher contracts as technologies that embed knowledge from networks that produce, establish, and constrain them (p. xiii). In addition, there are counter-networks that challenge the existing network of the teacher contracts. In the case of the BC teacher contracts, the various actors such as the provincial government, BC Teacher's Federation (BCTF), teachers, parents, and students are in negotiations with one another. By adding another entity to the network, the B.C. Supreme court ruling that teachers' charter rights were violated by the province (Keller, 2014), we can follow how translations are processed through forces of adoption, or resistance, depending on the various actors. These actors in ANT are always interacting with one another, being both resistant and available to other entities.

2.3.3 Actors and agency

All entities, actors and actants, and their agency, "are postestablished, not pregiven" (Miller, 2013, p. 56). This means that each entity is "defined by its associations and is an event created by the occasion of each of these associations" (Latour, 1999, p. 165). This is perhaps a 'weak' concept of agency, in that individual entities are not the source of it, but agency is rather found within the transmitted forces translated into the networks. The notion of actants and actors was first distinguished in semiotics whereupon actants had to do with narrative syntax and actors were situated in particular discourses (Griemas, 1987, p. 106). ANT utilized the term, actants, to emphasize the representation of non-humans in the network. This differentiation between actant and actor would soon collapse, however other complexities in ANT remain such as framing entities as both actor and network, individuals and collectives, everything is, indeed, an actor-network (Callon & Law, 1997, p. 169). Callon describes it this way: "reducible neither to an actor nor to a network… an actor-network is simultaneously an actor whose activity is networking heterogeneous elements and a network that is able to redefine and transform what it is made of" (Callon, 1987, p. 93). Perhaps one way to frame ANT is to follow the actors in constructing networks. In this way, ANT is effective for opening the black box of various educational systems through the traces and translations of actors and actants. ANT in particular allows non-humans to have agency, giving them opportunity to speak, to exercise power, even to mobilize other entities within a network. There is, however, a pointed critique of ANT which "opens discussion by problematizing the nonhuman and leaving the question of human agency itself unasked" (Lee & Brown, 1994, p. 772). For example, consider the issue of student agency within the educational system of a school. The student is at the center of many networks, including other actors such as teachers, learning materials, educational technologies, motivation,

and other human and nonhuman entities, which consist of a typical day in school. Student agency would not emerge solely from the subjectivity of the student, but is negotiated through the various translations among all the other actors in the network. Now, Leander and Lovvorn (2006) add to the critique proffered by Lee and Brown, by warning that "removing the agency of texts and tools in formalizing movements risks romanticizing the practices as well as the humans in them; focusing uniquely on the texts and tools lapses into naïve formalism or technocentrism" (p. 301). These criticisms of actors and agency within ANT are somewhat valid and still require further study.

2.3.4 Black boxes, scale, and immutable mobiles

Perhaps the strongest analytical position of ANT is opening black boxes. A black box makes the complex networks invisible, or opaque, thus reducing the focus solely to its inputs and outputs rather than its inner intricacies (Latour, 1999). In the sociology of science, the black box referred to presupposed acceptance of the scientific method as objective truth. This continued until Kuhn (1962) described periodic scientific revolutions, via paradigm shifts, which changed discourses on scientific knowledge. Latour's (1987) studies involving scientists and engineers found the construction of scientific facts black boxed. The work of the scientist is to show a fact as a single, coherent object void of experimentations and negotiations left in the lab. Thus, even a single entity, a scientific fact can be "a closed file, an indisputable assertion, a black box" (Latour, 1987, p. 23). Another concept related to the black box is punctualization (Callon, 1991), whereby networks are black boxed, then coupled to others, thereby creating a larger network. Through this process, various networks are simplified, juxtaposed, and scaled to become an actor

or actant within another network. This is how we can empirically state that an actor is a network, is an actor-network.

As mentioned previously, ANT allows various networks to scale up and down quite easily. Yet it is not quite interested in the traditional spatial notions of small and large scale. Instead, "it shows how spatial scales are distinguished from one another in line with the priorities of the networks or the network builders" (Murdoch, 2006, p. 78). Murdoch continues, "size and scale are nothing more than the end product of network extension processes" (p. 71). If this is true, then ANT problematizes scale, stating that it does not solely reflect the networks, but rather it is constituted by them, whereby the networks manipulate multiple scales simultaneously. The notion of scaling is replaced by a metaphor of connections whereupon networks are not necessarily 'bigger' than each other, but are more intensely connected. ANT allows the researcher simultaneous local and global analyses of scale, having the opportunity to follow actors and their connections through the shape of the actor-networks.

One final concept that is distilled through ANT is the idea of an immutable mobile. As actor-networks shift and grow, transform or destabilize, the focus has always been on the actors and actants and their relational effects. All networks require immutable mobiles, objects that are durable, transportable, and produced by actors to move information to other actors and actants, yet do not necessarily change. For example, a map allows mobility (over the actual depiction of the land) and is immutable (whereas a drawing of the same land may be prone to changes of design or aesthetics). The map thus transports the concept of the land across space and time allowing for information to pass on to another actor. McGregor (2004) describes how certain objects, "these things that act at a distance — buzzer, database, textbooks" in a science classroom act as immutable mobiles by functioning as delegates of the various networks in the

classroom. They extend their own power, and help actors translate other actants to behave in particular ways (p. 366), such as distilling particular teaching ideas, ways of learning, or modes of being in the classroom. Yet, Fenwick and Edwards (2012) note that in this particular example, the immutable mobiles actually "break and shift, grow and adapt and mutate as they travel" (p. xvi). Again, we see that the amorphous nature of ANT allows for further complications and questioning of just how exactly actors enact the translation process within the networks. More specifically, how does ANT speak to the subjectivity of the students or teachers, the human actors, who possess emotions and intentions that impact pedagogical concerns in the study of educational phenomena?

2.4 Value Sensitive Design

Zimmerman, Stolterman, and Forlizzi (2010) identity different types of design research and design theory, and propose the need for further development and refinements (p. 310). Similarly, technology companies typically incorporate some facet of design research, such as Microsoft labs (Thompson, 2007) or A/B testing model at Google (Christian, 2012). The question of whether there is a difference between VSD and other forms of design research is perhaps misplaced. Instead, the definitions allow for just enough permeability of interpretation in order to better suit the methodology. VSD was developed by Friedman, Kahn, and Boring (2002) as a "theoretically grounded approach to the design of technology that accounts for human values in a principled and comprehensive manner throughout the design process" (p. 1). It is an attempt at creating an "overarching theoretical and methodological framework" (Friedman, Kahn, & Borning, 2008, p. 70) to make "moral values part of technological design, research and

development" (van den Hoven, 2005b, p. 4; cf. Friedman, 1997; Friedman & Kahn, 2000; Friedman & Nissenbaum, 1996; Tang, 1997). By "frontloading ethics" (van den Hoven, 2005b), these values are embodied by the designers, users, ethicists, and other stakeholders, to which the design process will be committed (Flanagan, Howe, & Nissenbaum, 2005, p. 753). While VSD emerged from the general field of computer ethics, its early work can be traced to the ACM CHI Conference panels in 1994, 1999, 2001 and an edited book, *Human Values and the Design of Computer Technology* (Friedman, 1997). Other computer ethical approaches such as computer-supported cooperative work (CSCW) mainly focus on technical functional values, whereas VSD addresses moral values "that centre on human well-being, human dignity, justice, welfare, and human rights" (Friedman & Kahn, 2000, p. 163). This indicates that VSD requires our technological assessments to include human values as well as functional values. These various values have an interactional relationship with the design of technologies, as new technologies can be used or applied in different ways than the intended values or design (van den Hoven & Manders-Huits, 2009, p. 478; cf. Friedman & Kahn, 2003). For van den Hoven, Lokhorst, and van de Poel (2012), this interactional relationship between values and technological design in VSD alleviates the typical depiction of ethics as "moral overload" (p. 143) in designing technology. For "in discussions about technology… [it is] usually treated as the source of ethical problems, and ethics is treated as a constraint on engineering and technological development" (van den Hoven, Lokhorst, & Van de Poel, 2012, p. 154). Instead, VSD entails importing ethics into technological design, development, and assessment. Technology, in this interconnection, can entail moral progress, in that it enlarges "the opportunity set, i.e. by changing the world in such a way that we can live by all our values" (van den Hoven et al., 2012, p. 150).

Friedman et al. (2002) identified seven features, many adopted from previous ethical approaches, to establish the framework of VSD. First, VSD is proactive, in that it frontloads values from the beginning and throughout the design process of the technology. Second, VSD widens the domain of values to include spaces at home, work, online, social, technical, and educational. Third, all moral values are considered important in the VSD framework, not just operative values of design such as privacy, universal usability, and autonomy (Friedman et al., 2008, p. 90). Fourth, the methodological framework of VSD is integrated with a tripartite focus involving conceptual, empirical, and technical investigations. Fifth, as mentioned by van den Hoven et al. (2012), VSD is an interactional theory in which people's values and social systems affect technologies and are in turn shaped by them (Friedman & Kahn, 2003). Sixth, VSD employs moral epistemology (van den Hoven, 2005a) for design, stating that certain values, such as human welfare, rights, and justice, are paramount, independent of whether one upholds these values. This relates to the seventh feature, whereupon VSD maintains that certain values such as the aforementioned ones are universally held, but may be articulated in unique ways given the cultural systems in which they are established.

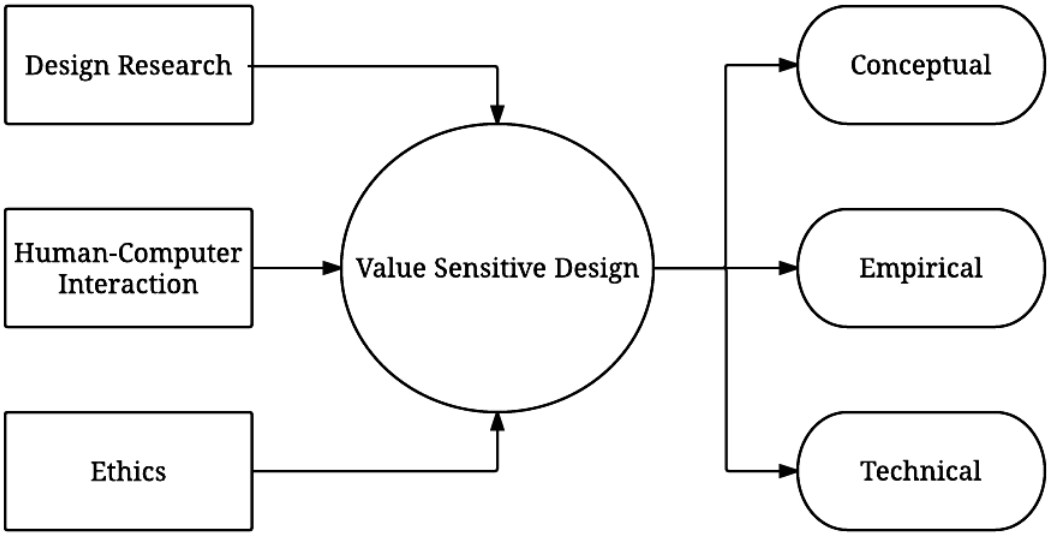

Figure 2. Progression of Value Sensitive Design: From design research and ethics to investigating values.

2.4.1 VSD methodology: Conceptual, empirical, and technical

VSD utilizes a tripartite methodology that combines conceptual, empirical and technical investigations. These are not a linear progression of stages, moving from one to another, but rather "attention to three different modes… of investigation must be maintained and balanced for successful implementation" (van den Hoven & Manders-huits, 2009, p. 478). Much like Design-Based Research (DBR), VSD undergoes iterative processes as it integrates conceptual, empirical, and technical investigations.

2.4.2 Conceptual investigations

This aspect of VSD investigates questions relating to values. We ask, what are values? Whose values (stakeholders) are we implementing in the design? Which values are implicated,

supported, or diminished through particular designs? How do we deal with value conflicts, reasoning about values, and diversity of values (van de Poel, 2009)? In what way do we grant greater significance to moral values in comparison to functional values? VSD allows all stakeholders of the technological design, to ask these sorts of questions using philosophically informed analyses. For example, consider Friedman, Kahn, and Howe's (2000) work on trusting online. Their philosophical investigation on trust began with the moral philosopher Annette Baier. From her work, they advanced a concept of trust as defined "when we are vulnerable to harm from others yet believe these others would not harm us even thought they could" (Friedman, Kahn, & Howe, 2000, p. 34). Trust, then, depends on three types of assessments: harm that may occur to us, the impact of others' good will towards us, and whether harm occurs to us in spite of the trusted relationship. This type of conceptual investigation, accompanied with philosophical analysis allowed Friedman et al. to establish their unique understanding of trust as it applied to cyberspace.

Conceptual investigations involve stakeholder analysis, discerning all parties directly or indirectly involved with the technological design. By locating these various stakeholders, we are also able to identity their values, both implicit and explicit, that are necessary for the design process. The identification of values necessitates a philosophical investigation via literature review to discern the network of values that will form the ethical component of the design. Through this process, the stakeholders are able to debate their moral opinions concerning various values, and offer justification and proposed solutions in the design process (van den Hoven, 1997, p. 234).

2.4.3 Empirical Investigations.

Empirical investigations form the second principle of VSD's tripartite framework. This kind of research is classically based on experimentation with observable and measurable phenomena. For VSD, empirical investigation is held more loosely, depicting both qualitative and quantitative methods, using any kind of research design instrument in order to gain greater understanding of values used in the design process. At this stage, VSD recommends conducting research into practical questions concerning the value-technology connection. Research questions focus on praxis, such as: How do stakeholders understand the values throughout the design process? How does prioritization of values work out when there are different levels of capacity or influence among stakeholders? On what basis do some values nullify others in the technological design? Additionally, what is the prioritization of competing values and usability considerations? Usability, in particular, warrants special consideration in VSD. Friedman and Kahn (2003) "identified four pair wise relationships between usability and human values with ethical import" (p. 1244). First, a design can possess 'good' human values as well as 'good' design sensibilities. For instance, using recycled materials for the construction of highly usable tablet computers. Second, a design can have good usability but at the cost of unethical reasons. Consider the case of Google, a highly usable search engine and tech company, which collects personal information about all its users. The value of user privacy, then, comes to the forefront in the design and ethical use of the search engine, particularly as Google continues to have discussions about privacy laws with governments and other third party companies (Crowe & Al-Hamdani, 2013; Piper, 2008). Third, a technological design that is entirely focused on promoting good human values but is largely unusable. Imagine a search engine in parallel with Google, championing user privacy at all costs. This search engine would be impractical as it demands all

its users to consent to each individual web browser cookie. Last, a good, usable design, ought to support values of ethical importance, such as the web sites, hospital technologies, and government technical systems needed to support the delivery of medical services. The situation in 2013, involving the US government and its flawed health insurance website (healthcare.gov) (Webster, 2013), demonstrates the complexities of usability and values within VSD.

2.4.4 Technical Investigations

VSD asserts that technological designs, especially information and computer technologies, exhibit values conforming to the characteristics of the technology, meaning, a particular technology is more appropriate for certain functions, reinforces particular values while obscuring other activities and values. Technical investigations, then, focus on the technological properties to perceive whether the foundational technologies support or hinder the values in the design process. For example, in Video Design-Based Research (VDBR), the use of video as a medium is used for intervening in and improving educational practice (Derry et al., 2010; Voithofer, 2005). Depending on the type of video technologies used, for instance, pre-installed low-resolution office security cameras or high-resolution camcorders, there is a value trade-off between an individual's privacy and the group's awareness of individual members' presence and activities. In this case, researchers who value an individual's privacy may prefer high resolution recording, and can therefore proactively alter the design process by using less obtrusive high definition cameras such as the GoPro camera. Technical investigations have similarities to empirical investigations, yet their units of analysis are different. While empirical investigations

focus on the stakeholders, and other large systems of analysis, technical investigations focus solely on the technology.

2.4.5 Examples of VSD

VSD affords thoughtful consideration about human values beyond the typical functional considerations in designing technologies. The theoretical and moral justifications based on different value systems often culminate in very different means of integrating ethics into design problems. Van Wynsberghe (2013) demonstrates how VSD allowed health care workers to construct a caring ethic, by discerning the design, use, and evaluation of 'care robots' in hospital settings. Vermaas, Tan, van den Hoven, Burgemeestre, and Hulstijn (2010) considered the meaning, roles, and use of trust in designing IT systems by a Dutch governing agency. Other active VSD projects are found at the VSD research lab at the University of Washington including investigations into multi-lifespan information systems for justice and peace building in Rwanda (Yoo et al., 2013), and the development of *envisioning cards* for attending to human values during design processes (Friedman & Hendry, 2012). At times, ethical frameworks will clash with one another in the VSD process. Yet, the following case study, at the very least, exemplifies the ways in which different stakeholders negotiate the design process through VSD's framework of conceptual, technical, and empirical investigations.

Consider Cummings' (2006) study of the "development of a command and control supervisory interface for a military cruise missile" (p. 701), the U.S. Navy cruise missile, the 'Tactical Tomahawk.' This case is particularly complex, as it addresses whether it is ethical to design weaponry and how human values of health, safety, and welfare are supported or

diminished by the design (Cummings, 2006, p. 704). During the conceptual phase, the designers and engineers held professional codes of ethics that seemingly were at odds with designing weapons. Ultimately, they situated their ethical framework on 'just war theory', which asserts that war is morally justifiable under certain conditions. The underlying conditions, speak to conducting a just war by limiting warfare through the principles of proportionality and discrimination. Thus, the Tactical Tomahawk was "designed with the intent to limit warfare to highly specific military targets" (Cummings, 2006, p. 706), as compared to other weapons of mass destruction that do not consider proportionality and discrimination, such as using nuclear weapons. The technical investigation involved research into the Tomahawk control system to determine what happens during system failures or human errors. This phase of the VSD resulted in the creation of a discriminatory decision support tool to understand the targeting system, predict potential failures, enable automation levels of decision making, and allow interventions in a time sensitive manner (Cummings, 2006, pp. 707-709). The empirical investigation into the decision support tool found it promoted faster decision making, yet also increased greater levels of error due to automation bias. The decision support tool was therefore further refined, resulting in a lower-level automation design and greater human agency in utilizing the Tomahawk control system. In spite of the controversial prospect of war and creating weapons, the VSD framework enacted in a real world situation, demonstrated an integrated, iterative process, which incorporated an approach to ethics at all stages of design.

2.4.6 Challenges for VSD

While VSD offers a nuanced framework for incorporating ethics and values in all phases of design research, there are a number of questions and challenges that warrant further investigation. For instance, Dechesne, Warnier, and van den Hoven's (2013) paper on reconfigurable sensor technology argues that contextuality is the central design issue for VSD. As they analyzed sensors, and its reconfigurable capabilities, they note that such technologies aim for flexibility in serving different goals and values. Reconfigurability brings up epistemological challenges due to value pluralism or conflicting value demands of the same technology. These kinds of value trade offs were discussed earlier, however, through the prompting of Dechesne et al. (2013), the ethical assessment of the technology becomes dependent on its contextual usage (p. 180). The sense of having a pluralistic conceptualization of values (Borning & Muller, 2012), or a commitment to universal values, should still allow anyone to employ VSD. For instance, Cummings' (2006) example of the Tomahawk control system, should allow even pacifist designers to participate in VSD. The question is how do stakeholders with vastly different ethical ideals have meaningful conversations about choice and evaluation of values? A final consideration brought forth by Manders-Huits (2011) is that VSD "lacks a complementary or explicit ethical theory for dealing with value trade-offs" (p. 271). In discerning differences between values, Manders-Huits suggest the process of VSD is still implementing an ethical starting point, albeit, a hidden foundational framework that governs our sense of right and wrong. In this way, there is a need to explicitly reveal this obscured ethical framework. In other words, VSD needs to consider the ethicist or technotheologian as designer and mediator to reveal the ethical values under negotiation.

2.4.7 VSD and the technotheological values

VSD enables the ethicist, or in our case, the technotheologian to become a co-designer. Hence, the technotheologian is tasked with value discovery, and translating values into design requirements (van Wynsberghe & Robbins, 2013, p. 12). Value discovery entails explicating the stakeholder's values, disclosing value conflicts, and examining intended design values with respect to the wide range of ethical literature. The technotheologian is also tasked with value conceptualization, translating values into design process, identifying division between conceptualization, utilization, and unintended consequences of values. Friedman and Kahn (2003) identify twelve values with ethical import that have a direct bearing on designing technologies: human welfare, ownership and property, privacy, freedom from bias, universal usability, trust, autonomy, informed consent, accountability, identity, calmness, and environmental sustainability (Friedman & Kahn, 2003, pp. 1251-1257). Several of these values are commonly associated with technological design, such as privacy, autonomy, and universal usability. Other values, such as calmness, allow the opportunities for new design elements to be introduced into technical systems. For instance, Friedman, Freier, and Kahn (2004) studied whether large video displays, acting as "windows" in office spaces displaying natural scenery, would promote calmness and stimulate psychological restorative effects. Schoenebeck (2014) investigated social media and why religious users refrain from active usage during the period of Lent, which has design implications for user agency, self-awareness, and self-control. By extension, the incorporation of technotheologies into VSD enables the consideration of religion, spirituality, and theology for the ethical design, engineering, and use of technologies. These technotheologies are grounded in the diverse contexts, yet possess a "principled moral means to adjudicate competing value claims" (Friedman & Kahn, 2003, p. 1260). As various stakeholders

in the design process bring forth competing values, moral conflicts, or perhaps even moral relativist positions, VSD recognizes theologies with its directional focus on charity, piety, generosity, and a concern for Being and being-ness. These are human values, as well as spiritual values of tremendous ethical import that warrant further inquiry.

2.4.8 Making and technotheology materiality

Walker (2006a, 2013) notes that utilitarian interpretations of sustainability have become *de facto* for our conversations about making, involving a triple bottom line of economic, ethical, and environmental accountability (p. 90). However, he proposes for the inclusion of spirituality in order to create a material culture that helps cultivate inner development:

> Imagine an object that is used today by rich and poor, young and old, healthy and sick; an object that fulfills a prosaic, utilitarian role, and has a deeply spiritual significance; that can be decorative and highly aesthetic; and has for its owner a profoundly personal value independent of price, quality, or materials but is inherent to that particular object. Imagine, too, that such an object has a wide variety of designs and manifestations; that it can be mass-produced for a few pennies or, for a similar cost, made at home. Perhaps the failings of our contemporary, rather limited approaches to product design and production, offer some pointers for a more sustainable and more inclusive future. (2006a, p. 24)

This object that Walker envisions is the prayer-beads. Prayer-beads are used for tracking chants and prayers. They are commonly made as spherical beads or knots on a string, closed with a religious symbol or tassel. They originated In Hinduism three thousand years ago, adopted by Buddhists early on, Muslim renditions were appropriate in the ninth century, the Catholic rosary

was adapted by the fifteenth century, and there are even secular interpretations known as 'worry-beads' (Walker, 2006a, p. 25). The user of these prayer-beads has a profound sense of meaning that is attributed to the artifact which surpasses the generic, utilitarian good. Most design, then, is aimed at this utilitarian level to fulfill an identifiable human need. Good design, however, bridges the aesthetic and the utilitarian, maintaining a functional, social/positional, and inspirational/spiritual relationship with its users (Walker, 2006b, p. 43). Artisans who make the prayer beads are consciously designing an object where dichotomies can meet: subject and object, secular and religious, and technology and theology.

2.4.9 Examples of the making and design of technotheologies

Design and technology offers several examples, including the use of YouTube, for meditative purposes (Buie & Blythe, 2013a). Sterling and Zimmerman (2007) researched whether mobile phones could support religious participation in a Soto Zen Buddhist community. Zen philosophy with its prioritization of presence offered a design challenge to the disruptive technology of mobile phones (Sterling & Zimmerman, 2007, p. 3). In consultation with the religious group, they were able to design three concepts into the use of mobile phones: shared religious experiences, precept training, and remote meditation. In this way, the Buddhist community was able to incorporate the design elements into their use of mobile phones in conjunction with shared practices at their Zen centre. Hallnäs and Redström (2001) used soniture and informative art to help explicate slow technology, or designing for reflection. Slow technology allows designers to reconsider the importance of aesthetics, reflection in the basic interface design in using technologies. Similarly, Petrina and Feng (2009/2014) incorporated a

Slow Online and Ubiquitous Learning (SOUL) ethic in instructional design practices. The ethic of slowness designed into a Learning Management System (LMS) can certainly inspire meditative or spiritual practice for students. Odom, Banks, Durrant, Kirk, and Pierce (2012) expanded on the ideals of slow technology in three constructive ways: designing for slowness, solitude, and mental rest, designing systems for use across multiple generations, and designing for less consumptive lifestyles and practices. The conceptualization of a phone application to support Muslims' prayer practices resulted in the design of the Sun Dial (Wyche, Caine, et al., 2008). Prayer as a religious activity was identified as the crucial ritual, which differs from traditional design concerns of efficiency and productivity. During the research phase, they discovered that prayer takes place during a "window of opportunity" (Wyche, Caine, et al., 2008, p. 3414), rather than exact times throughout the day. This fundamental finding became the essential design element of their Sun Dial. Instead of denoting precise prayer times with alerts, it featured a graphical design where the background lights up or dims, like the sun passing through the sky. There are also subtle bursts of light that fill the screen indicating the start of a prayer time. In this study, the use of sacred imagery was conceptualized through the window of opportunity, becoming the dominant focus for the design process (Wyche, Caine, et al., 2009, p. 58). Hlubinka, Beaudin, Tapia, and An (2002) created AltarNation, a digital augmented interaction space for meditative communities. The interface design is centered on an altar niche, whereupon users light a candle and share a "virtual community of users represented by a field of stars, each associated with a sound sample of a prayer, song, joy, or concern of another user" (Hlubinka et al., 2002, p. 612). This field of stars is projected onto fine copper mesh showing the population of users in the co-present virtual meditative community. To submit a song, a prayer, or reflection for other users to access, a user shines candlelight on her own star. Other users can

then shine their own candles on individual stars to hear the meditations from the virtual community. In this way, each user designed their own personal meditative experience. Upon leaving, the user blows out the flame, which triggers the function of logging off AltarNation. AltarNation was designed for shared meditative experience but did not get pass the prototype phase. Uriu and Odom (2016) designed Fenestra, a Japanese home altar which serves as memorializing departed loved ones. They used a wirelessly connected mirror, photo frame as activated by a candle to display these photos for meditation and prayer.

2.5 Ethics, Religion, Spirituality, Technology, and Design

The prevalence of media and technology in designing curriculum has been marked by historical and philosophical critiques (Apple, 1991; Feng, 2003; Ross, 2000; Petrina, 2002) but there is a void in a philosophical and historical understanding of designing curriculum and technology (Petrina & Rusnak, 2010). For the most part, the interdependence and co-emergence of curriculum, technology, and theology have not been adequately addressed. For example, historically, technology, theology, and education have more in common than we might think. Ramus incorporated ancient and early modern senses of *curriculum* in 1551, *technologia* in 1563, and *theologia* in 1566 into his work (Hamilton, 1989; Ong, 1958/2004). While Ramus proves vital in the historical tracing of curriculum and technology, the historiography is problematic due to the legend of Ramus (Petrina, Lee, & Feng, 2016). At the very least, Ramus's conceptualization of curriculum began within a technological and theological framework (Friesen, 2011, 2013; Petrina & Rusnak, 2010). *Curriculum* and *technologia*, used by Ramus, were coincidental with his writings on Christian *theologia* and *metaphysica*. Instead of opposing or juxtaposing curriculum, technology, and theology, as became common in the 1960s and

1970s, my conceptual framework integrates the three. One purpose of this research was to rethink the language (Huebner, 1985) commonly used in a technology-theology-curriculum network. By integrating historical and philosophical conceptualizations and common usages of these terms, this dissertation, in part, outlines the complexities of their meanings to the participants.

2.6 Tracing the Technotheologies

The influence of religion or spirituality in ethical practice has often been marginalized or even disregarded in technological discussions and practices. The maker and hacker spaces are no different, in that the prioritization is creating and designing technologies. Functionally, these are presumed to be secular spaces. Yet, the idea that we are in a secular age or that religion is an antiquated notion seems itself anachronistic (Taylor, 2007). Instead, there is a resurgent discussion about religion in relation to politics (Berger, 1999), globalization (Sullivan & Kymlicka, 2007), education (Arthur, Gearon, & Sears, 2010; Block, 2007), ecology (McGrath, 2011), architecture (Radding & Clark, 1992), and media and technology (Hoover, 2006; Hoover & Clark, 2010). Additionally, there continues to be sizeable population groups in Canada and the United States that actively participate in one of the major world religions (Bibby, 2013; PFoRPL, 2008). For example, StatsCan reports a diverse range of religions reported and embraced by immigrants and citizens in the 2011 Census in Canada. The question on religion is asked only every 10 years in the Census. A Reid poll in 2015 indicated that about 30% of the sample embraces religion while 44% are "somewhere in between" embracing and rejecting religion (Hutchins, 2015).

My research participants have a diversity of religious perspectives. Some self-identified

as Christian, agnostic, raised religious-but-no-more, or atheistic. Yet within the discussions of creating, making, designing, and the processes therein, the language used had religious connotations. Religious matters remain contentious for several of my research participants (Smith, 2009). Pope Francis (2014) asserted in the *Lumen Fidei* that "Faith is no refuge for the fainthearted, but something which enhances our lives." The current Synod is a major effort to work through the challenges of how religion matters at this moment in people's everyday lives (see *Instrumentum Laboris*, 2014). While for these makers and hackers, everyday work with designs and technologies may not be a religious matter, it is a theological matter.

2.7 Religion and Theology

Progenitors of modern religious studies offer a good starting point in clarifying the religious. Durkheim contended that the representative feature of all religious beliefs is that "they presuppose a classification of all the things, real and ideal, of which men [and women] think, into two classes or opposed groups, generally designated by two distinct terms which are translated well enough by the words profane and sacred" (Durkheim, 1912/1995, p. 52). Additionally, James (1902/2002) defined religion as the feelings, acts, and experiences in relation to the divine (pp. 29-30). This relation may be ritual, physical, or moral, out of which our beliefs and ecclesiastical organizations may secondarily grow. Moreover, Weber (1930/2003) conceived that religion helps define human motivation, and Protestantism specifically, advanced modern capitalism due to its sacred calling and work ethic. In consideration to these varied notions of religion, I am defining *religion* using the demarcations of transcendence and immanence. While there are complications, contradictions, and reformations in these terminologies of religious speech (Latour, 2013), the transcendent/immanent distinction

has become a foundational element of religious debates. The public consciousness of the transcendent as belonging in the realm of religion warrants the discourse around these demarcations (Taylor, 2007, p. 16). Following Taylor, I define *religion* as a way of transcendence, which includes particular narratives regarding transcendent agency or power, supernatural reality, and a sense of good beyond human flourishing (Taylor, 2007, p. 20). *Secular,* is also a theological distinction that privatizes transcendent experiences, redefines belief, making unbelief in religion a possible reality (Taylor, 2007, p. 3). The secularization predicament is therefore a theological construct with its own conditions of belief, as one among many new religious subjectivities in the modern world that Taylor characterizes as individual quests for spiritual fulfillment of the self (Taylor, 2007, pp. 508-510). Eliade (1959) adopted Durkheim's use of the words, sacred and profane, and complicates this dichotomy in his depiction of humanity as *homo religious* whose worldview constitutes a sacred modality, in that "sacrality is a full manifestation of being" (p. 138). Following Tse (2014), 'religion' and 'the secular' represent a critical return to *homo religiosus*, which performs "the boundary between the public and the private as a grounded theology" (p. 205), meaning, theologies (including secularities) can be investigated empirically as theological processes.

Makers and hackers have varying networks of technologies, theologies, and curriculum. The tracing of technotheologies begins with interpreting the religious, or the secular, via the analysis of specific theologies emerging from a traditional Christian framework. Initially, this may seem incongruent with an expansive definition of religion; however, Asad offers an appropriate response:

> If my effort reads in large part like a brief sketch of transmutations in Christianity from the Middle Ages until today, then that is not because I have arbitrarily confined my

> ethnographic examples to one religion. My aim has been to problematize the idea of an anthropological definition of religion by assigning that endeavor to a particular history of knowledge and power... out of which the modern world has been constructed. (Asad, 1993, p. 54)

Theology, in the use of this dissertation, does not refer to doctrinal propositions to delimit religious affiliations; instead, it reveals the *a priori* sacred character of the world through a lived narrative of the transcendent in relation with the immanent (Hauerwas & Pinches, 1997; Hauerwas & Wells, 2011). Secularism is arguably theological, as it interprets transcendence, albeit, for the purposes of limiting it to the private realm or to regard it as false consciousness. Perhaps the dichotomy between transcendence and immanence, between the sacred and the profane is artificially induced. Instead, it serves us well to investigate the contested spaces of grounded theologies as enacted by the makers and hackers and their religious subjectivities. In this way, religion is not solely the study of transcendent phenomena rejecting or succumbing to secularization. Rather, both 'religion' and the 'secular' are reconstituted as different translations of theological processes (Tse, 2014, p. 209). Theology serves as the beginning point, a key actor in technotheological networks among makers and hackers. It is a non-human actor, and yet it has just as much, if not more impact to the network than the human actors. From here, we witness theology's *interessement*, the recruiting of other primary actors for a network.

2.8 Spirituality

The term 'spirituality' is the more recent term compared to religion and theology. In many ways, it has now been pitted against the aforementioned terminologies where people popularly declare, 'I'm spiritual but not religious' (Marler & Hadaway, 2002). This attitude hints

at the familiar contrast between religion (institutionalized tradition) and theology (academic philosophy). Popular definitions of spirituality, then, refer to interior, subjective experience and personal growth, which may or may not reference the transcendent. Modern notions of spirituality can be traced back to Madame de Guyon (1648-1717) who used *spiritualité* and *mysticisme* synonymously to indicate "direct interior knowledge of the divine or supernatural" (McGrath, 2001, p. 146). Spirituality, in this sense, is a kind of mystical theology, focusing on experience of the transcendent and transformation of the self. Merton, a Trappist monk, explains the relationship between spirituality and theology:

> Dogmatic and mystical theology, or theology and "spirituality," are not to be set in mutually exclusive categories, as if mysticism were for saintly women and theological study were for practical but, alas, unsaintly men. This fallacious division perhaps explains much that is actually lacking in both theology and spirituality. But the two belong together. Unless they are united there is no fervour, no life and no spiritual value in theology; no substance, no meaning and no sure orientation in the contemplative life. (Merton, 1961/2007, pp. 254-255)

Much like the previous distinctions of religion and secular, or sacred and profane, the false divergence among spirituality, theology, and religion can find commonality in the subjectivities of grounded theologies. The makers and hackers do not make explicit claims using the word 'spirituality.' Yet their aims in designing technologies reflect an underlying spirituality, which connects their values and ethics to their technologies. Discerning their unique theological processes, whether one labels it spiritual, religious, secular, or atheistic, is the aim within the discourse of ethics, design, and technology. In this way, assembling technotheological networks purports to address what does religion have to do with ethics? How does theology matter with

issues of technology? How does design adopt values as expressed through these theological processes?

2.9 Ethics

Aristotle (ca 349 BCE/2004) sets out a philosophy of ethics, contemplating the virtuous life and how to go about creating the good life. Aristotle clarifies two intellectual virtues, *techne* and *phronesis*. While *techne* has been explicated as art and craft, *phronesis* emphasizes practical knowledge, judgment, or wisdom. Pakaluk (2005) translates this as "sagacity" (p. 215) while Kinsella and Pitman (2012) depict it as concerning practical judgment "informed by reflection" (p. 2). Polkinghorne (2004) relates *techne* to the intellectual activity of producing and making and *phronesis* becomes the reflection on the making for the good (p. 114). While ethics practiced as *phronesis* has a longstanding treatment throughout history, my focus is on how theology and ethics negotiate sets of definitions and meanings for different paths of understanding. One example of this negotiation process is demonstrated by the biblical scholar Origen (185-254), author of the oldest systematic theological book on record, *De Principiis* (ca. 225), the head of the catechetical school of Alexandria, and probably the earliest 'Christian seminary.' Origen had many students, among them was Gregory Thaumaturgus, who would later be a bishop of Caesarea, then canonized as a saint. Gregory recounts how Origen's primary concern for his pupils, was not bestowing theological knowledge, but rather to love them as friends. Origen's concerns were not solely on theories about morality and the divine, but its very praxis. For Origen, scholarship and piety, or theology and ethics, were partners not rivals (McClendon, 2002, pp. 41-42). We see, then, that within the oldest seminary, ethics was taught and modeled by the teacher, ethical development was expected from students, and was articulated in the

ordering of curriculum. Ethics and spiritual formation were actualized since the beginning of theological education at the catechetical school of Alexandria (Wilken, 1984, pp. 15-30). The etymological roots of the word 'ethics' is traced by Lehmann (1963), a Christian theologian, arriving at the image of a barnyard (i.e., a sense of place to which both *ethos* and *cultura* refer). The barnyard is a gathering place that provides safety and nourishment, away from the elements, which allows for the flourishing of animal life (Lehmann, 1963, pp. 23-24). Similarly, the proper ethos for human beings is to provide such a space for human life to flourish. For Lehmann, Christian ethics entails "the human situation of what God is doing to make and to keep human life human" (Lehmann, 1963, p. 99). Christian ethics, then, not only requires such a sacred context or space, but it also necessitates this space to be good, true, and beautiful, allowing human flourishing to happen.

This understanding of ethics can be interpreted as moral theology. This theological emphasis is a return to 'classic' religious ethics. A deontologist would argue that killing is morally wrong, even if it was done in self-defense. Utilitarianism, on the other hand, derives its ethics from consequences, demanding the greatest amount of utility for the greatest number of people. Yet, we cannot anticipate all possibilities or outcomes (Spielthenner, 2005). In spite of the various performative narratives of the different world religions, Christianity, Judaism, Islam, and Buddhism, among others, share a common ethical directedness among their religious subjectivities. In Judaism, mitzvot are opportunities or vehicles for devotion to God as well as ethical practice and building and maintaining society, but are not driven by extrinsic rewards. Jewish ethics are rather intrinsic and dependent on awareness of right and wrong in the world. Similarly, Aquinas, a Christian theologian, speaks about the theological virtues having their end as loving God and sharing in God's knowledge (Keenan, 1992, p. 95). Faith, hope, and charity

(loving God) are the primary virtues, whereupon charity directs the ethical virtues towards human flourishing in our loving of God. Islamic ethics is a reverent response to God's benevolence and mercy through 'God-fearingness' or 'piety' (Rahman, 1983, p. 176).

> It is not piety (*birr*) that you turn your faces to the East and the West. True piety is this: to believe in God and the Last Day and the Angels and the Book and the Prophets, to give of one's substance however cherished, to kinsmen and orphans, the needy, the traveler, beggars, to ransom the slave, to perform the prayer, to pay the alms. And they who fulfill their covenant when they have engaged in a covenant and endure with fortitude misfortune, hardship and peril; these are they are who true in their faith, these are the truly godfearing. (Qur'an, 2:177)

The ethical vision of the Qur'an points to a state of piety in both interior contemplation and exterior actions. The Buddhist doctrine of *dharma* also has similar praxis, with its emphasis on purpose in the universe. For the Buddhist, a life lived within the teachings of *dharma,* emphasizing the moral virtue of generosity (MacMillan, 2002), leads to the *teleos* of reaching enlightenment or *Nirvana* (Wade, 2010, p. 320). While these religions, Judaism, Christianity, Islam, and Buddhism, have their own unique religious beliefs and practices, their moral theologies converge at the praxis of charity, piety, and generosity. These religions demonstrate that within the plurality of their religious narratives, the ethical dimension of human flourishing is enacted as it orients towards the theological.

2.10 Technology

What place does moral theology have within technology? How do actants become part of a technotheological network, which is in a continual state of becoming? While these question can

be traced back to the Greek philosophers and their explications of *techne* and *theos*, or perhaps even further back to the story of humanity constructing the Tower of Babel (Genesis 11:4-9), we shall limit our discussion to modern technology, which is itself, a "technological pursuit of salvation" (Noble, 1999, p. 208), or rather, a theology of progress. This technological theology of progress finds discourse with the moral theologies of the religious amidst technotheological networks. Within this crossing, we ask what is this technology (artifact, process, knowledge, volition) good for, meaning, what is its aim for the good life? Likewise, how does technology enact human flourishing and enrich human life? (Borgmann, 2003; Higgs, Light, & Strong, 2000)

Heidegger's case represents a lesson on ethics and technology (Petrina, 2016). While his philosophy of technology (Heidegger, 1949/1977) derives from his early studies of Luther, Augustine, and the apostle Paul (Heidegger, 2004), which is indicative of his concern for Being (Heidegger, Macquarrie, & Robinson, 1962), he was unable resist the lure of Nazism.

Perhaps a more relevant philosopher of technology expressing moral theology is Ellul. Ellul uses a term, *technique*, to encompass all machines, technologies, and systems, which then "is the totality of methods rationally arrived at and having absolute efficiency" (Ellul, 1967, p. xxv). This results in a technological morality, which brings "human behaviour into harmony with the technological world, to set up a new scale of values in terms of technology, and to create new virtues" (Ellul, 1969, p. 185). The virtue of the technological morality consists of efficiency, normality, and success (Ellul, 1969, pp. 185-198). In response, Ellul advocated a 'lived morality' versus the 'theoretical moralities' advocated by philosophers who do not contribute to ethical praxis (Ellul, 1969, p. 129). This lived morality, for Ellul, centers on Christian ethics, specifically the example of Jesus Christ. Ellul observes that while humankind "always looks for

a good which will determine a 'deed' — whereas in Jesus Christ it is always a matter of 'being'" (Ellul, 1969, p. 29). For Ellul, Jesus Christ mediates the moral theological construct of being-ness, which acts as the appropriate response for technology. Technology, therefore, as a theology of progress, confronts traditional moral theologies "as a potential rival or partner in ethical self-formation" (McKenny, 2005, p. 459).

2.11 Design

One of the primary matters of design consists of designing new languages, and new ways of being in the world (Petrina, 2000). Consider Homer's *Iliad*, which, an epic conveying the story of Achilles and the other characters. The *Iliad* is in dactylic hexameter, a kind of rhythmic mnemonic (*mnēmonikos*) designed with verse and modes of description, aiding the memory of the orators and rhapsodes. Fast-forwarding, this idea of design of language has a direct connection to our modern technology of computers, for which language is designed and programmed (Crespi-Reghizzi, Melkahnoff, & Lichten, 1973). These programming languages, in turn, are translated or compiled and assembled into binary code, controlling the way a computer is utilized or applications function. Designing programming languages, compilers, and assemblers that become nearly one with the physical components of a computer is a core matter of technological design.

Design has been in contestation from at least the time of Aristotle, until present day educational discourse about instrumentation of curriculum (Doll, 2002/2013, 2006). For Aristotle, the craftsman or craftswoman, who is a technician that designs and makes craft, would not possess true knowledge compared to the philosopher who contemplates and discerns the true essence of knowledge at hand. For example, a potter who kneads the clay, designs the shape, and

fires the kiln to glaze the pot, would not, according to Aristotle, understand the essence of the pot. Instead, it would be the philosopher who possessed knowledge of essences, who would truly comprehend the causes or purpose of the pot, and what makes it a good pot. Dewey's (1938) pragmatism criticized this devaluing of practical and technical knowledge that viewed contemplation as substantive knowledge. Dewey lamented that this was categorizing different forms of knowledge, in which pragmatic knowledge was relegated to a low rank in the "hierarchy of Being and Knowledge" (p. 58). Pragmatism was therefore one way to frame knowledge as being gained by doing or designing things. Learning would involve acts of doing, rather than just telling and thinking. The design of technologies, and technical designing more generally, is concerned with creating theories, experiments, systems, and machines, to fulfill some technical function. Armstrong (2008) distinguishes engineering from science based on this technical sense of design, which involves processes of imagination, creativity, knowledge, and skills.

Within the field of architecture, we are offered classic examples of how design, technology, and theology stabilized into technotheological networks. For instance, St. Peter's Basilica in Rome, designed in 1547 by Michelangelo and others, was created with a cruciform floor plan in the shape of a cross. The Sagrada Familia designed by architect Antoni Gaudi began construction in 1882 as an interpretation of Gothic architecture. It has three grand façades, depicting the gospel stories of Jesus' birth, death, and glorification. The Cathedral of Notre Dame de Paris, completed in 1250, was designed with multiple groupings of large stained glass windows featuring various biblical stories and Christian saints. These cathedrals have soaring ceilings, creating an atmosphere of mystery, awe, and wonder, rendering the physical reality as sacred space. Libraries as well, were designed as sacred spaces. For instance, Trinity College

Library in Ireland was designed with a grand 'long room' that matches the grandness of religious buildings. Now, Robinson (2013) argues, some of the most ambitious modern buildings are Apple stores, "shrine[s] to the modern media technologies" (p. 2). Consider the Apple stores in New York City and in London, which have cubicle glass structures with the glowing Apple logo. For Robinson, these Apple stores resemble La Grande Arche in Paris, which is a "massive cube built to honour the secular humanitarian ideals of postwar France" (Robinson, 2013, p. 2). Whether the Apple stores were purposefully designed with ideals of secular theologies is of interest, but not the point. Instead, we perceive that the public identification of iconic designs has gradually shifted away from the sacred space of the cathedral, to the library, and now to a technotheological consumer space designed by Apple.

2.11.1 Design co-optation of ethics

Design and ethics seek to have their individual objectives become agreed upon by one another to define a technotheological network. Design and ethics have unique goals, solutions, and trajectories, forming commitments to an emerging network. A process of cooptation begins with the major consideration of design involving the evaluation of its inherit 'design-ness.' What makes design good, and how do we distinguish the criterion for judging the goodness of a design? While a field of study such as engineering may have basic principles of design for evaluative purposes (Armstrong, 2008), how do we discern the goodness of design within the realm of art? Even within architecture, the quintessential merging of art and engineering, experts and pundits alike may have a hard time evaluating whether a building has good design. The evaluation of design, therefore, is dependent on the values of the different stakeholders involved

with the designed object. Feng and Feenberg (2008) utilize critical theory to take on the project of evaluation a step further. They argue that "the process of resolving technically underdetermined choices should be the focal point of a philosophy of design" (Feng & Feenberg, 2008, p. 117). Design, for them, is a complicated process with a blurring of lines between designers and society-at-large. Critical theory brings to the forefront, hidden assumptions, offering alternative goals and values, and asks for a more comprehensive design process from conception through evaluation.

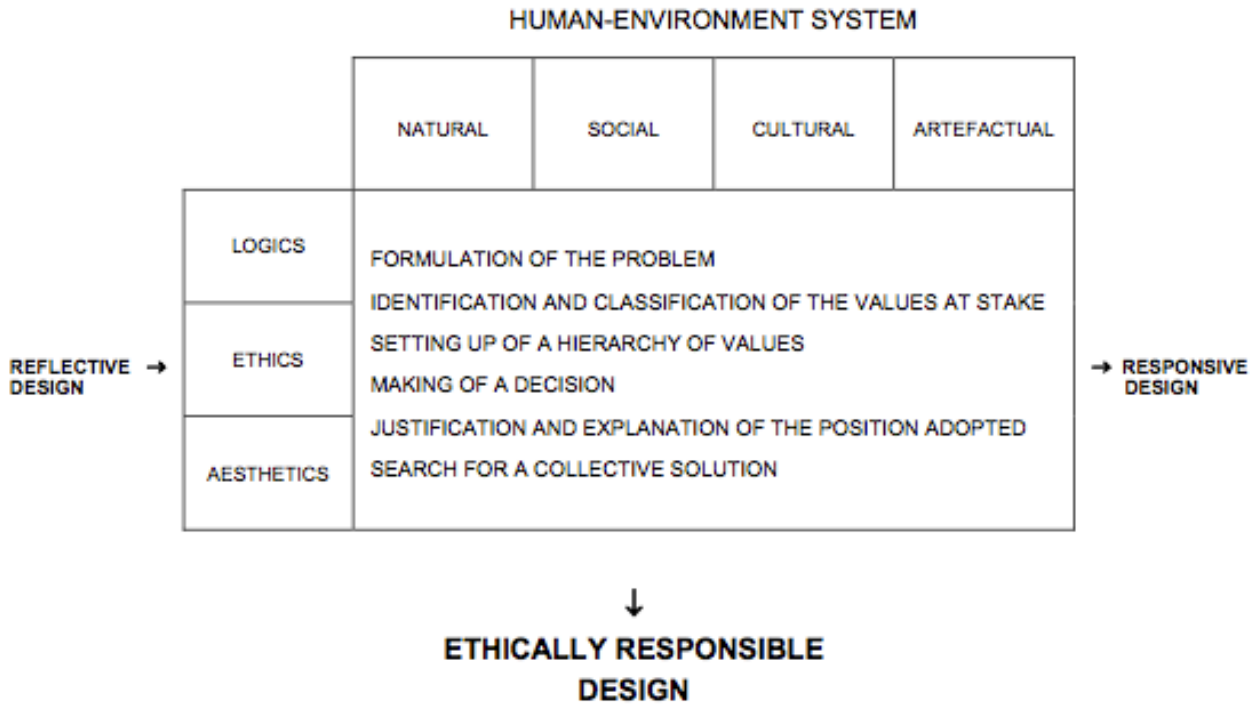

Figure 3. General model of ethically responsible design (d'Anjou, 2004, p. 216).

To speak about ethics in design, is to encounter a value-laden activity with factors as varied as economic interests, theological considerations, cultural assumptions, and environmental

sensitivity. D'Anjou (2004) reframes the design process in that there are deliberate phases of ethically responsible decision-making process (Figure 3). Petrina (2000) demonstrates the importance of methods and models derived from political ecology, which "represents a change in ethics and the way we in the west understand the meaning of life" (p. 212). Designers can attempt to ensure that these concerns are explicitly deliberated during the design process through participatory design (PD), political ecology, and user-centered design. These practices can provide users with "a critical role in *designing* it" (Schuler & Namioka, 1993, p. xi).

Recently, in the area of computer ethics emerged a "design shift" (Albrechtslund, 2007, p. 65). This design turn in applied ethics began probing designs of institutions, infrastructure, and technological systems, asking how certain problems came into being, and what are the decisions leading up to the design process. This burgeoning concern of ethical design issues asks how we can orient our thinking, practice, and implementation of technology using moral values as a basis? How, then, can we design institutions, infrastructures, technological systems, and technical applications that conform to our moral framework (van den Hoven, 2008, p. 59)? Latour (1992) begs the corresponding question, arguing that technologies are bearers of morality. Technical artifacts, then, "materialize morality" (Verbeek, 2006a) through the very process of designing.

2.11.2 Design considerations for stabilizing a technotheological network

Wyche, Aoki, and Grinter (2008) conducted design-oriented fieldwork in United States and Kenya into discourses around "designing technology for religion" in order to understand "how users' faith could inform and inspire concepts for speculative ICT" (p. 11). They asked,

whether there were issues "so specific to the religious use that entirely new systems would be required?" and "can current technology be extended in relatively straightforward ways that would make them suitable for religious appropriation" (Wyche, Aoki, & Grinter, 2008, p. 17)? Their findings revealed three themes about design-relevant aspects of religious life: mindfulness of faith, watchfulness in technological consumption, and the embeddedness of technology into all spheres of life, including religious identity and practice. Using design sketching as a technological probe, they conclude that there are weak distinctions between designing for religious versus secular purposes (Wyche, Aoki, & Grinter, 2008, p. 19). Another related study by Wyche, Hayes, Harvel, and Grinter (2006) asked how technology is used for spiritual formation and as computer mediated religious communication. In their study of different religious groups, they observed many churches following popular technology trends such as blogging, e-mail newsletters, online access to sermons, and broadcasting live services to other satellite locations via streaming technology (Wyche et al., 2006, p. 202). Again, Wyche and her fellow researchers discovered no difference between religious and secular use of ICT. Some religious uses of technology seemed similar to workplace practices, such as pastors sending out email communications to the laity. While these religious leaders use technology for religious purposes such as researching, writing, and delivering sermons, the use of technology is not fundamentally different compared to other areas of life.

In another case, Alsheikh, Rode, and Lindley (2011) studied eleven Arab individuals and their use of communication technologies for long-distance romantic relationships. They used technology as a way of enacting Arabic gender roles as it relates to Islamic values of supporting and protecting women. The religious women in this study who observed the Qur'an, adhered to the precepts of *ikhtilat*, the ethics of mixing between genders in order to act virtuously. Other

women were able to use various instant messaging technologies to reinterpret their cultural values for their own sensibilities. Alsheikh et al. (2011) found that all women had agency in the relationships and the same communication technologies could both support or usurp the cultural and religious norms in the relational process. This general ambivalence between design and theology was apparent in some cases, yet others demonstrate distinguishing features in the theological contribution for design and ethical use of technologies.

In 2013, Buie and Blythe observed that the iTunes App store contained over six thousand apps related to spirituality and religion. Yet, their research into the ACM Digital Library, an online repository for design and technology related journals and magazines, contained only 98 works within the field of HCI (Buie & Blythe, 2013b, p. 2315). Similarly, Bell (2006) observed that for the most part, religious relationships or usages of ICTs, what she calls 'techno-spiritual practices,' are marginalized in technological studies (Bell, 2006, p. 142). Or, as Buie (2014) points out, the HCI community has little knowledge of the design space of techno-spiritual experiences (p. 337). Due to the paucity of studies related to design, technology, and theology, Bell articulates the need for this conversation in this way:

> I argue that we need to design a ubiquitous computing not just for a secular life, but also for spiritual life, and we need to design it now! In no small part, this sense of urgency is informed by an awareness of the ways in which techno- spiritual practices are already unfolding. (Bell, 2006, p. 143)

Bell had begun articulating this challenge of religion to technology in 2000, with a special interest group session at the annual conference on HCI. The session was framed around the question 'can we have spiritual experiences online?', resulting in a short communications paper about spiritual life and information technology (Muller, Christiansen, Nardi, & Dray, 2001). This

paper remarked that the dominant design framework in HCI such as "command-and-control; constant updates and interruptions of new information; fast-action games; denotative, explicit clarity rather than connotative, exploratory ambiguity… worked against what we called the 'inner stillness' of spiritual life" (Muller et al., 2001, p. 82). While there is seemingly continual trepidation between design and theology in HCI, Gorman (2009) draws our attention to five ways design relates to religion. First, design is particularly established as religious when designing traditional objects used in religious rituals such as rosaries, prayer rugs, and menorahs. Second, the design and manufacturing of faith-based products, paraphernalia, and other religious lifestyle products such as hats a T-shirts with slogans such as "Jesus Freak" (Leland, 2004). A third design consideration is to create faith-based products that require significant technical engineering. For instance, Azan digital clocks have alarms set for the times of prayers according to the Muslim call to prayer, or the 'kosher phones' that comply to ultra-Orthodox standards (Jeffay, 2013). Fourth, the advent of new technologies can help facilitate religious practices in new ways. While Orthodox Jews observe the practice of Sabbath by not operating technology, the appliance manufacture, Whirlpool, partnered with Star-K, a kosher certification organization, to enable 'Sabbath mode' for their electronic appliances. This setting entails disabling of electronic displays, lights when opening appliance doors, and user controlled delayed functionalities until after Sabbath (Gorman, 2009, pp. 16-17). The final design consideration is religiously neutral technologies that are customizable by religious users. With the advent of smart phones and the functional personalization with apps, a whole industry was created to allow users to personally customize their own religious and spiritual experiences using faith-based software.

Wong (2013) identifies the challenge of using technology beyond the intended scope of

the design. He builds on Walzer's (1994) notion of *thick morality* and *social criticism* as a way forward for design ethics using the following criteria:

> (i) *Hermeneutical*. It is about (re-)interpretation of the existing morality. It is, thus, essentially hermeneutical. It starts with the assumption that the existing views of the good life have some validity.
>
> (ii) *A Form of Immanent Critique*. It begins from within not from without, that is—it argues from the existing views of the good life, but not from some universal or objective theories. Its critical force, therefore, does not come externally.
>
> (iii) *Participatory*. It requires the researchers to engage with the public. It involves participation and engagement in the current debate by paying real attention to it and responding seriously.
>
> (iv) *Empirical*. It is built on the existing views of the good life. Hence, it is, in an important sense, empirical. It is not abstract theorizing, but to examine actual behaviours, social practices and/or public discourses in the society.
>
> (v) *Pluralistic*. It recognizes the fact that societies and cultures can be different. It is this recognition that drives the approach to start from actual behaviours, social practices or public discourses in the society in order to avoid imposing a false sense of universality or objectivity. As such, it starts with the assumption of a plurality of the views of the good life. (Wong, 2013, p. 38)

For Wong, these criteria, which he labels the "Walzerian approach," allow the discussion of ethics and values as a starting point; however, this is followed by further discussion, critical discourse, and potentiality of reinterpretations within one's culture. In this way, normative

judgments regarding disparate values can be addressed via public discourse. Additionally, this manner of design ethics justifies the inclusion of an ethical specialist who can facilitate discourse about ethical and moral deviations from the designer's intentions. Design, then, is a living process that is laden with uncertainty, ambiguity, yet also with promise. Design science, or more broadly a philosophy of design, can be understood to be theoretically justified as it works itself out methodologically.

2.12 Summary

In this chapter, I provided a literature review of critical elements forming my conceptual framework. Research on maker culture and education was reviewed to give a sense of the focus and setting for the research. Research in ANT was reviewed as it facilitates analysis of non-human actors in the technotheological networks. VSD accounts for human and technological values in designing technotheologies. The literature review also involved the investigation of religion and theology, spirituality, ethics, technology, and design. I explored some basic questions that help focus the conceptual framework: How and where does design and faith intersect? How do makers and hackers define and establish the good life (Borgmann, 2003; Higgs, Light, & Strong, 2000)? In this way, the literature clarifies the conceptual framework and technotheological response to the participants and data in the study. The next chapter addresses the methodologies used for my research. ANT and VSD has been used conceptually and methodologically. Chapter 3 describes the case study methods and other research instruments for researching technotheologies.

Chapter 3: Methodology

Chapter 2 elaborated on the conceptual framework, including ANT and VSD. Both ANT and VSD, historically, have been employed conceptually and methodologically. In this chapter, I present case study, ANT, and VSD methodologies, including video ethnographic techniques (Figure 4). Case studies facilitated in-depth examination of makers and hackers as the main actors of our inquiry. The use of video in dialogue with ethnographic inquiry allowed for nuance, discerning complexities, and giving form to expression in designing technotheologies (Derry et al., 2010; Fetterman, 1998; Goldman-Segall, 1995; Goldman-Segall & Maxwell, 2002; McCurdy, Spradley & Shandy, 2004; Schnettler & Raab, 2009; Voithofer, 2005; Zahn, Pea, Hesse, & Rosen, 2010).

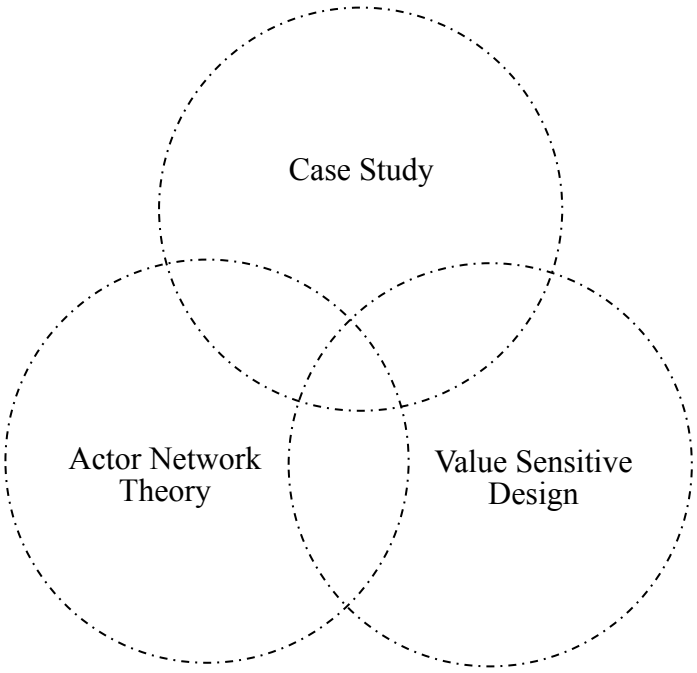

Figure 4. Conceptual and methodological framework: Case Study, Actor Network Theory, and Value Sensitive Design.

3.1 Case Study

Ragin and Becker (1992) asked "what is a case?" They answered by creating a conceptual map of four typical ways to understanding cases. Cases can be understood as empirically real and bounded in either specific or general forms, or understood as theoretical constructs in specific or general forms. In this way, cases are either found, interpreted as objects, are made, or are conventions (Ragin & Becker, 1992, p. 9). While there is potential for confusion about such conceptualizations of case studies, Flyvbjerg (2006) addresses five common misunderstandings about case study research and in particular, concerns over its methodological validity and reliability. The five misunderstandings about case studies as merely theoretical, generalizability, possibilities for theory testing and building, possible bias toward verification, and difficulties to summarize case studies, are misconstrued and point to a robustness in case studies research.

The case study methodologies that I used can be described as intrinsic (Stake, 1995), explanatory (Yin, 2014) and theory-testing (Bassey, 1999), to "reveal the unique complexity" (Stake, 1995, p. 63). I wanted to discern the meanings of the makers and hackers' everyday life experience within a conceptual framework of ANT and VSD. These makers and hackers are a rich source of information in which there is no prior "in-depth perspective on this 'case'" (Creswell, 1998, p. 95). Within this bounded system of the individual participants identified as a maker or hacker (Merriam, 1998), grounded theory was used to facilitate analysis (Corbin & Strauss, 2015; Glaser, 1992; Charmaz, 2006). Each maker and hacker constituted a case for analysis, in order to find commonalities and differences (Yin, 2003, 2014). A family of four also constituted one case in the study. Using ANT language, these cases are both actors and networks,

since the cases are actor-networks. At the center of these case studies, I aimed to describe how these makers and hackers design technologies and develop values within the system of persons-in-interaction-with-technology (Petrina, Feng, & Kim, 2008). The case studies, then, involve investigation of this bounded system of makers and hackers to discern emergent patterns. More simply, I asked how and why (Merriam, 1998; Yin, 2003, 2014) these makers and hackers are designing technotheologies? My research subjects, then, are particular case studies that do not necessarily generalize beyond their particularities. Stake (1988) describes the importance of case studies in the following way:

> What is being studied is the case. The case is something deemed worthy of close watch. It has character, it has a totality, and it has boundaries. It is not something we want to represent by a score. It is not something we want to represent only by an array of scores. It is a complex, dynamic system. We want to understand its complexity. Lou Smith [1974] used a fancy name, bounded system, to indicate that we are going to try to figure out what complex things go on within that system. The case study tells a story about a bounded system. (p. 256)

This research required significant fieldwork framed by the synthesized methodologies. For my fieldwork, I followed Stake's (1988) guidelines for doing a field-observation case study: 1) Anticipation; 2) First visit; 3) Further preparation for observation; 4) Further development of conceptualization; 5) Gather data, validate data; 6) Analysis of data; 7) Providing audience opportunity for understanding.

First, I anticipated key problems, persons, and events, and defined the boundaries of my cases (makers and hackers at the Vancouver Mini Maker Faire and Seattle Code for the Kingdom). I then communicated preliminary access with potential research subjects to arrange a

first visit. Before the visit, I was able to work out the ethical and technical details in preparation for the observation. This included the gathering and curating of research tools, particularly in the use of video and audio recording. At the same time, I prepared for further conceptual development by researching the theoretical, social-cultural, and theological contexts of my research subjects. When I began the process of gathering data, I used my audio and video devices to make observations and interview my research subjects. This generated qualitative data based on regular interaction with the participants. The methods focus on "direct and sustained contact with human agents, within the context of their daily lives (and cultures), watching what happens, listening to what is said, and asking questions" (O'Reilly, 2009, p. 3). I then proceeded to review the raw data, searching for patterns and linkages, and making tentative conclusions. The result is "richly written accounts that respect the irreducibility of human experience, acknowledges the role of theory, as well as the researcher's own role, and views humans as part object/part subject" (O'Reilly, 2009, p. 3).

In order to generate rich, thick descriptions (Geertz, 1973), I observed the physical context, participant characteristics, and the design process. Of particular importance were the conversations, symbolic and connotative meanings of words and interactions (Merriam, 1998, pp. 97-98). I recognize that "every informant's personal reality is not equally important, either epistemologically or socially" (Stake, 1995, p. 102). Thus, I have strategized and selected specific designers-in-interaction-with-technologies (ANT) who can articulate and interpret their ethics and values (VSD) more meaningfully than others (see Chapter 4). I utilized multiple evidence sources (observation, e-mail, Skype, in-person interviews) in the case studies of makers and hackers to ensure triangulation (Mathison, 1988) among my research subjects for better accuracy (Patton, 1990).

3.1.1 Case studies in ANT and VSD

Case studies form a central methodological framework for both ANT and VSD. The early days of STS, employed case studies "to assist the reader in recapturing the experience of those who once participated in exciting events in scientific history" (Conant, 1948/1957, p. ix). Conant (1948/1957) produced a set of case studies for a course at Harvard to help students develop a working knowledge of scientific research and understanding. Kuhn, in turn, was hired by Conant as an instructor for the course and wrote a case study on the Copernican revolution (Kuhn, 2000, pp. 275-276). This developed into Kuhn's (1962) *Structure of Scientific Revolutions*. More recently in ANT, case studies such as Callon's (1986a) research on scallops at St. Brieuc Bay, Latour's (1987) study into science in action, and Law's (1988) examination of the TSR 2 aircraft demonstrate the primacy of case study methodology.

VSD as a distinct methodology within HCI also adopts its focus and implementation of case study methods. For instance, in the annual Computer Human Interaction conference, authors and presenters can choose to showcase their work in case study format. For the conference, "case studies are compelling stories about HCI practice based on real-world experiences" (CHI 2017, n.d.). Case studies have been used to highlight the role of user-centered design (UCD) (Corry, Frick, & Hansen, 1997). More specifically, case studies have been coupled with the teaching of UCD to help students focus on design scenarios to discern how users interact with a technological interface (Carroll, 2000; Rosson, Carroll, & Rodi, 2004).

3.2 Actor-Network Theory

My purpose for using ANT is to discern how technotheological networks are mobilized and stabilized within maker and hacker culture. A first step is to consider all the components or actors in the network. They collaborate, cooperate, or compete with one another and undergo the process of translation to stabilize the network. My aim, then, was to unpack these two different networks, to better understand maker and hacker culture (Figure 5).

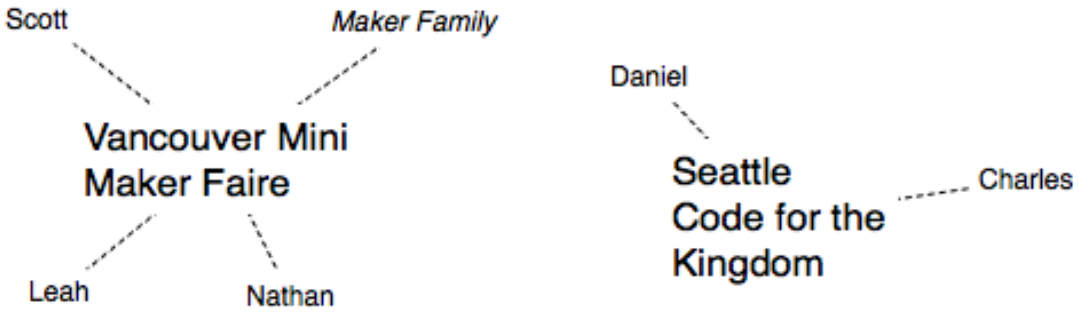

Figure 5. Preliminary assemblage of maker and hacker technotheological networks.

As ANT necessitates "attention to the number of heterogeneous realities entering into the fabrication of some state of affairs" (Latour, 2005b, p. 92), the tracing of associations and articulation of infrastructures are also required. In my case, this is accomplished with attention to key actors in the networks, use of ethnographic methods, and participant observation. The heterogeneity of the networks also prioritizes "generalized symmetry" (Latour, 1993, p. 94) such that the tracing of networks includes humans and nonhumans, subjects and objects. As Latour (2005b), remarked, "objects too have agency" (p. 63), such that all actors, human and nonhuman, have agency to stabilize or disrupt their particular networks. By following the actors, beginning

with either human or nonhuman, I was able to consider translations through motivations, interests, and conflicts.

For Callon (1986), translation is composed of four different moments. First, problematization presents the relevant actors that make themselves necessary for defining the problem. Second, interessement finds the primary actors recruiting other actors to assemble roles in the network. Third, enrollment happens when actors formally accept and define their roles. Fourth, mobilization refers to how the primary actors becomes representative of other actors, and assemble them by their aligned interests and mobilize them to action. In this way, ANT's generalized symmetry is particularly well suited as a methodological partner with VSD.

3.3 Value Sensitive Design

As mentioned in Chapter 2, VSD integrates conceptual, empirical, and technical investigations. The investigative sequence takes place within an iterative cycle so the order may vary depending on how we approach a particular research project. However, the first methodological step (Friedman & Kahn, 2003) typically involves conceptual analysis of significant values given particular design context and processes (Manders-Huits, 2010). These values are central to VSD, which become the focus of the investigation within technological developments or designing technologies. In my case, these values, often, become the key actors (ANT). The empirical investigation includes qualitative research techniques such as interviews, video research, and participant observation. This step captures the words, images, and videos necessary to provide the data for the research. The technical investigation focuses on how the values identified in the specific technologies relate to the values identified conceptually. Thus, human values and nonhuman values may stabilize a technotheological network, or can lead to

disrupt the networks, resulting in new conceptual and empirical phases whereupon values are proactively incorporated into a new iteration of design and technology.

3.4 Research Timeline

Table 1. Research timeline from recruiting research subjects to concluding interviews

Date	**Description**
June 2015	First visit to the Vancouver Mini Maker Faire.
July 2015	Recruited Nathan and Leah.
October 2015	First visit to Code for the Kingdom Seattle hackathon. Recruited Daniel.
September 2015	Began online correspondence with Nathan and Daniel.
November-December 2015	Attended various Lego clubs led by Leah.
February-June 2016	Visited Nathan's office to observe his iterative design process of an education toy.
June 2016	Attended my second Vancouver Mini Maker Faire.
July 2016	Recruited Scott and the Maker family.
August-September 2016	Visited Scott's home.
October 2016	Attended my second Code for the Kingdom Seattle hackathon. Recruited Charles.
October-November 2016	Visited Maker family home and workshop to see how they learn, play, and make.
October-December 2016	Concluding interviews with all participants

3.5 Research Setting: Maker Culture and Hacker Spaces

Maker spaces include FabLabs (Gershenfeld, 2005) and Computer Clubhouses (Kafai, Peppler, & Chapman, 2009), which are extensions of schools such as the ones at Stanford and MIT. Altman, a hacker and inventor, derides 'institutionalized curriculum' while championing the personalized flexible learning experiences of direct interactions with technology (Baichtal, 2011). Within the hacker and maker community, there is a constant tension between the

institutional labs and informal learning spaces (Kolb & Kolb, 2005). There are varied sites of maker and hacker spaces (Peppler, Halverson, & Kafai, 2016b; 2016c), however, I have chosen to investigate the Vancouver Maker Faire and the Code for the Kingdom Hackathon in Seattle. These two sites offered unproblematic access and provided a diversity of makers and hackers that served as research participants.

3.5.1 Vancouver Maker Faire

The Vancouver Mini Maker Faire is an independently operated branch of the Maker Faire productions. "Maker Faire" is part of Maker Media, a company created by Dale Dougherty, the person who coined the term "web 2.0" and the co-founder of O'Reilly Media. Maker Media produces the Maker Faires, publishes *Make* magazine, and is involved with the Maker Education initiative in the United States. *Make* magazine launched in January 2005 focusing on do-it-yourself (DIY) and do-it-with-others (DIWO) projects involving electronics, woodworking, metalworking, robotics, and computers. The following year, the first Maker Faire was organized and held on April 22-23, 2006 in the Bay Area. The Maker Faire is:

> Part science fair, part county fair, and part something entirely new, Maker Faire is an all-ages gathering of tech enthusiasts, crafters, educators, tinkerers, hobbyists, engineers, science clubs, authors, artists, students, and commercial exhibitors. All of these "makers" come to Maker Faire to show what they have made and to share what they have learned. (Maker Faire, n.d.)

Since the original Maker Faire in 2006, other independently produced Maker Faires have been held around the world. The Vancouver Mini Maker Faire began in 2010 and by 2016 hosted

more than 125 makers who showcased their expertise in robotics, crafting, Lego, art, music, education, and designing technologies.

3.5.2 Code for the kingdom

Code for the Kingdom is a ministry initiative launched by Leadership Network in 2013, a Christian non-profit organization who's self described role "is to foster innovation movements that activate the church to greater impact for the glory of God's name" (Leadership Network, ca. 2014). Code for the Kingdom, then, "is a weekend hackathon and ongoing ecosystem where global issues are tackled from a Christian perspective" (Code for the Kingdom, ca. 2014). The "hackathon" moniker describes a collaborative computer programming event and demonstration of computational participation (Kafai & Burke, 2014), in which a multitude of designers, programmers, and technologists gather for a defined period of time, for the purpose of designing and completing a prototype of a technological project (e.g., an app). Hackathons have often taken on purposes of technological innovation such as the TechCrunch Disrupt Hackathon where developers and engineers create new products that can win a variety of prizes and potentially get funded to create their technologies. As hackathons have diversified in content and organization beyond technology companies, several organizations use the hackathon system to hack for altruistic purposes. For instance, HackerNest is a Canadian non-profit organization that helps build local technology communities around the world "so they can afford to live healthier and happier" (HackerNest, n.d.). Code for the Kingdom specifically adopts the hackathon system for a 48-hour period with the aim of designing and creating apps and websites to help solve societal problems. Since Code for the Kingdom is a Christian hackathon, this entails the creation of new technologies that have an explicit religious ethic. It is adapting Christian theological processes to

"the framework of a religious sensibility determined by technology" (Vahanian, 1977, p. xvi). Attendees are not necessarily Christian or religious *per se*, however there is an understanding that Code for the Kingdom has an underlying spirituality which values the historical concerns of Christianity and its message of peace, hope, and love. It is performing a new kind of liturgy in which the "Kingdom changes its site," whereupon "secular tasks are as fascinating as the call of the sacred once was" (Vahanian, 1977, p. 151).

Code for the Kingdom has hosted a number of independently operated hackathons around the world, including two faith-inspired global hackathon weekends in 2015 and 2016. The global hackathons were coordinated events in which different cities around the world hosted Code for the Kingdom hackathons simultaneously. The format of the hackathon begins with attendees pitching different ideas for a new technology. The focus tends to address issues of social justice, developing Christian ministries, or impact personal spiritual formation. Once the pitches end, all attendees can join a team to tackle one of the technology proposals. The attendees, now in groups dedicated to designing and creating their particular technology, begin working around the clock until hackathon ends after 48 hours. This process begins by articulating the core purpose, values, and design of the product. The group members then proceed to design, prototype, code, compile, and debug their app or website. The all-day and all-night sessions, fueled by coffee and snacks, continue in an iterative process of conversation, review, coding, and prayer. Additionally, mentors with engineering, design, and entrepreneurial expertise are available for consultation to help with the development of projects. At the end of the hackathon, the different groups present their projects that were created, progressed, or attempted during the hackathon. A panel of Christian judges with technical expertise allocate the winning groups awards based on categories such as "best new code," "best existing code," "people's choice," "best social justice," and "best

spiritual formation." Resulting projects include apps and websites designed for peer-to-peer refugee housing, fighting sex trafficking, 3D bible game, and networked prayer app.

3.6 Research Participants

I met my maker research participants at the 2015 and 2016 Vancouver Mini Maker Faire. They attended the Vancouver Mini Maker Faire as either a maker tending a booth to showcase their work, or they were just an active participant enjoying the festivities. As I began to interact with these makers, we had extended conversations about their projects and their aims and goals as makers. From my perspective, they serve as noteworthy research subjects as they have differing perspectives and interactions with their technologies or technical media. Additionally, they possessed a range of spirituality or religiosity, which brings a level of nuance and complexity to my study. I attended the 2015 and 2016 Seattle hackathons hoping to meet hackers who could articulate their theological and technological processes. Since the hackathons were intensive designing events that took place over 48 hours, I chose to spend most of my time speaking to multiple groups while being mindful of their project deadlines. At times, this meant conversing late at night, silently observing a team meeting, or inquiring about technical specifications as the hackers were coding their respective programs. In the end, I met two particularly thoughtful hackers who demonstrated computational literacy (diSessa, 2001) and who were excited about sharing their projects. Our conversations began at the hackathon where they were working on two different apps. I continued corresponding with them via e-mail, Skype, and face-to-face meetings to clarify and expound on their theological and technological ethics and rationale. In the following sections, I offer a snapshot of these seven makers and two hackers and their respective roles within the maker and hacker communities.

3.6.1 Nathan the engineer and entrepreneur

Nathan is a software developer with a degree in electric engineering. He was raised in a household where his father, an engineer, encouraged him and his brother to play with Lego, motors, batteries, and electronics. Instead of purchasing the newest things, Nathan's family built and fixed things, including fixing their family cars. This ethos of making and fixing propelled Nathan to pursue engineering in university and to continue designing, building, and prototyping technologies as a hobby. The hobby soon turned into a possible business venture for Nathan. He and his business partner Frank (a friend from university), decided to begin creating different technologies for their nascent start-up company. While they both work at their respective companies, their spare time was filled with drafting business plans, brainstorming marketing outlines, and prototyping a product that could be used as an educational toy. The Maker Faire offered Nathan and Frank an opportunity to present their product and solicit feedback. One of the first iterations of an educational toy was a set of interactive blocks that could be used to construct shapes and have outputs with different sounds (beeps, squeaks, and ticks), visuals (light up buttons and screens), and connectors between blocks. The toy prototype would take on different design iterations and would later on be reconfigured as a musical toy.

3.6.2 Leah the Lego educator

A common tool at the Vancouver Mini Maker Faire was Lego, the popular plastic construction toys that consist of an array of interlocking plastic bricks, gears, and other pieces that can be assembled and connected in a variety of ways. Within the Greater Vancouver Area, there are numerous Lego clubs, school programs, and even conventions dedicated to Lego enthusiasts. At the Maker Faire, numerous makers utilized Lego as part of their technological

artifacts. Lego was used as toy vehicles for racing. The popular robotic kit, Lego Mindstorms, was used by several makers to showcase school programs involving robotics and coding. The Vancouver Lego Club, a group of adult hobbyists, had a large display of self-designed Lego creations such as cityscapes, Star Wars vehicles, and a "Great Ball Factory" which is a kind of Rube Goldberg machine that propels small plastic balls around its machinations.

Among the many Lego enthusiasts, I met Leah, a Lego educator who's a director of a Lego based children's camp. Leah grew up as a consummate geek, teaching herself to code in Java and attending after school camps that involved playing with Lego. For Leah, Lego imprinted ideals of creativity, hands-on learning, and a thirst for learning. She easily praises Godtfred Kirk Christiansen, the creator of Lego, who offered ten criteria for the ideal toy system: 1) Unlimited play potential; 2) For girls and for boys; 3) Fun for every age; 4) Year-round play; 5) Healthy, quiet play; 6) Long hours of play; 7) Development, imagination, creativity; 8) The more Lego, the greater the value; 9) Extra sets available; 10) Quality in every detail (as cited in Konzack, 2014, p. 9). Leah has a background as a former grade school teacher and her self-declared "passion for young children" compelled her to begin these camps as a way for children to participate in serious play (Kurkovsky, 2015; Rieber & Matzko, 2001), in creative ways using technology. The camps use Lego as a medium to teach kids about STEM. Through hands-on teaching, the camps involve aspects of coding, robotics, and making Lego creations in its curriculum. The campers are aged 5-12, and there are approximately 8-10 camps in the Greater Vancouver Area at the writing of this dissertation.

3.6.3 Scott the maker priest

Scott is a Lutheran priest who loves tinkering with arduino and raspberry pi to create

different gadgets and programs. His passion for making and designing stems from his upbringing in Taiwan where his father and uncle opened a radio factory in the 1960s. His parents sold electronics such as transistors and other original equipment manufacturer (OEM) parts and subsystems to be used by technology companies around the world. Scott grew up playing in the factory and his dad taught him how to connect different components to create functioning motors, circuit boards, or VCRs. Scott's burgeoning passion for electronics continued into his teenage years when he attended a college in United States for electrical and computer engineering. The program afforded him the opportunity to study software and hardware development where he refined his design skills and developed his technical knowledge. Upon graduation, Scott worked as a software engineer for a Research and Development company that focused on speech recognition. He was part of a research team working with the software team, doing scientific experiments to improve the speech recognition capabilities of the software. While at his company, he felt increasingly dissatisfied with his work. Given time, through thoughtful reflection, Scott felt "called into ministry" and decided to pursue a vocation in Christian ministry. He is now a self-described "geeky priest." Most of Scott's day-to-day responsibilities consist of his priestly duties with his parish: preaching on Sundays, ministering to his congregants, serving the outsiders and the poor in his local community. In spite of his priestly duties, Scott still finds time to tinker with his electronics.

3.6.4 Maker family

As I walked through the aisles of artists, makers, and vendors at the 2016 Maker Faire, the booth that stood out for me consisted of two boys demonstrating their inventions to the attendees. While some maker booths catered towards children, all makers at the Maker Faire

were adults. This was the only booth featuring two kids. The boys had created a slingshot kit and a spud gun using PVC piping that they were selling. They had a display of Nerf guns that they modified to shoot foam darts at a faster speed and further distance. Various cartoon figurines, created using a 3D printer, littered their display table. A custom made video game costume hung in the background. Seeing two boys exude so much passion for their design and inventions piqued my interest and I soon met their family to listen to their story.

The boys are Tim, aged 13, and Luke who's 11. Their mom, Allison, is a school teacher, and their dad, Jeremy, is a former IT professional. Jeremy grew up in a small community of farmers where you could buy repair parts for farming machinery. As a child, Jeremy remembers that his local community would repair their machines and he was encouraged to explore making and repairing things at an early age. This ethos of making continued into his marriage where Allison, his wife, also enjoys making pottery, glasswork, and art. As they became parents, they wanted to instill the same making and creating values into their kids, however, they admit that it is a complicated yet fulfilling process.

3.6.5 Daniel the vision app developer

Daniel attended Code for the Kingdom because he's a software programmer and he wanted to use his skills in a way to serve others due to his religious beliefs as a Christian. He came into the hackathon with a specific idea that he wanted to pitch. However, unlike other more ambitious proposals for app and web designs, Daniel wanted to create a smartphone app that was a database of donated glasses. Initially, this simple idea seemed mundane, not particularly spiritual, and does not fit the ethos of the hackathon. Yet ultimately, Daniel won one of the prizes offered at the end of the hackathon, in part, because his app was well designed with effective

code, and also his purpose was actually very practical and served a community in need.

3.6.6 Charles the prayer app developer

Charles, a former software developer, was another hacker that I met at Code for the Kingdom. He envisioned an app that technologized prayer. At the hackathon, Charles pitched the idea for the prayer app and had a number of volunteers join his team. The final result was an app named *intercession*. The aim of the app is to enable everyone to pray. Through the act of prayer, users have a "taste of the kingdom of God." Charles explains that his design philosophy was UCD. Whereas designers use UCD for their clients, Charles envisioned a God-centered design where God is the ultimate user. As a Christian, Charles' rationale stems from the biblical passage, 1 Timothy 2:1, which states "First of all, then, I urge that supplications, prayers, intercessions, and thanksgivings be made for everyone." Charles reasons that if God desires and commands us to pray for one another, then his team can design an app to enable Christians to pray for others. While there are already many websites and apps that focus on prayer, Charles is quick to note that many are often inward oriented, and potentially self-centered. Instead, *intercession* is designed with an outward orientation, encouraging its users to pray for others. In this way, the design of other-centerness through prayer results in design decisions to create an app that embodies the values within its technological design.

3.7 Ethical Considerations

In accordance with the UBC Behavioural Ethics Review (BREB), I adhered to the appropriate ethical guidelines for research. All research participants were given a letter of consent (see Appendix A) explaining the research purpose and the provisions for participating in

the research study. As this research involved several children, they gave their assent to participate, their parents were debriefed and authorized the involvement of their children (see Appendix B). Additionally, to maintain privacy and confidentiality, pseudonyms were used for all research participants.

3.8 Data Collection, Coding, and Analysis

After initial contact with potential research participants, I began an online correspondence with them, outlining my research intent sending out letters of consent. These conversations began with their self-narration and explication about why and how they chose to attend and be a part of the Vancouver Mini Maker Faire or Code for the Kingdom Seattle. Throughout the next few months, I was invited to observe how they ideated, designed, constructed, or utilized their various technological artifacts. To gain more in-depth understanding of my research subjects, I conducted semi-structured interviews (45 minutes to 1 hour) with all makers and hackers. The interviews were recorded, transcribed, and the interview questions are included in Appendix C. Due to the semi-structured nature of the interviews, the conversations, at times, diverged from the initial questions, which led to constructive detours in framing the technotheological networks.

Along with the regular implementation of participatory observation, interviews, and simple survey instruments, I monitored the design process using video artifacts that the makers and hackers created themselves, as well as those that I recorded for my research. Using video as design artifacts "involves the systematic design, production, testing and study of videos as catalysts for learning and teaching" (Petrina, Feng & Wang, in press, p. 10). Like video ethnography, my use of video applications and technologies allow for greater nuance and

discerning complexities in design processes, data analysis, and presentation of results (Derry et al., 2010; Goldman-Segall, 1995; Schnettler & Raab, 2009; Voithofer, 2005; Zahn, Pea, Hesse, & Rosen, 2010). Goldman-Segall and Maxwell (2002, pp. 421-422) recommend the design of "perspectivity technologies" concerned with creating multiple viewpoints and perspectives. This use of video, then, would have a different viewpoint of audio or writing tool, creating a particular filter or layer to enact a particular story. We can then observe multiple layers of different perspectives, stacked upon one another, to share and shape the research we find ourselves in. Video "constructs the visual as a type of knowledge" (Voithofer, 2005, p. 7), allowing the design of new media research and materiality of data.

The cameras were used in three primary ways: at the corner of the room in order to record a broad overview of designer interactions, handheld recording to follow intricate design processes, and documenting interview footage (Appendix D has a full list of the equipment used). Derry et al. (2010) set out four challenges for the implementation of video design research: selection, analysis, technology, and ethics. The question of selection entails conceptualizing any video clips or segments, and how to select multiple videos at different stages of inquiry (pp. 7-8). While selecting video clips is a subjective process, the goal is to discern patterns across evolving narratives of the videos (p. 15). The next step, analysis, is an iterative process involving selection, interpretation, evaluating, and representation (p. 15). The challenge of technologies for video research is the continual iterative process of updating technical knowledge for video research workflow (Figure 6). The contention in this step, according to Pea and Hay (2003), is that there are at least ten different video operations that require different technologies. These operations include: video acquisition, chunking, transcription, way finding, organization and asset management, commentary, coding and annotation, reflection, sharing, and

presentation (Pea & Hay, 2003, pp. 11-12). The video research workflow process also constitutes an iterative process, however, the quick upgrade in technologies demand multiple technological substitutions through the life cycle of the research. The video data generated by the fieldwork and videos were compiled and coded for meaning using grounded theory and qualitative data analysis (QDA) software.

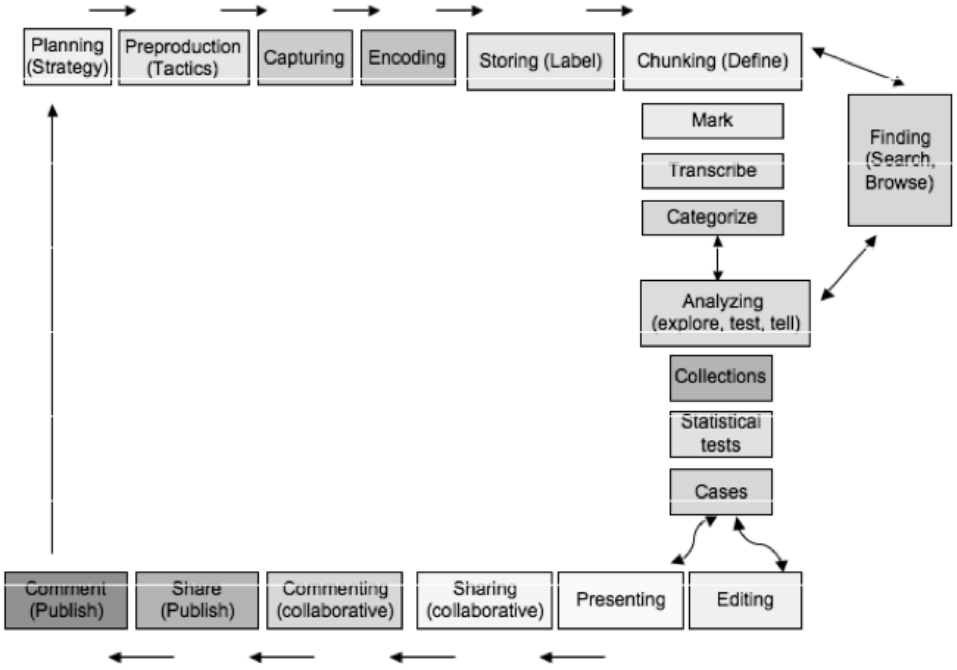

Figure 6. Diagram of video research workflow processes (as cited in Derry et al, 2010, p. 26).

The data collected from each designer was cross-checked against one another for discovering themes, commonalities, translations, distinctions, and conflicts. In addition, I triangulated the multiple data sources as well as member checked when possible to ensure that the interpretation of the design process, and specifically, the values and ethics, were understood accurately by the participating designers (Mathison, 1988; Yin, 2014, p. 119). This research was committed to prolonged engagement and persistent observation, and I attended meetings and

faires. In this way, any observational bias due to particular processes of each design phase was minimized as major themes emerged.

The video recorded for the research proved indispensible for data collection. For analysis, I rewatched the video recordings, paying particular attention to makers and hackers, their words, and their technological artifacts. The transcribed audio recordings and images extracted from the recorded videos were primary representations of data for the written report of this dissertation. Hence, the video was indispensible for contextualizing and grounding the participants, artifacts, and networks, for qualitative data analysis (QDA) I primarily utilized audio transcriptions and still images. Once a decision was made to represent the makers and hackers as unique cases and networks, QDA focused on the extensive interview transcripts and still images extracted from the video. The video also served to triangulate findings with the audio transcriptions and images. Coding was focused through the conceptual framework, using ANT and VSD concepts (e.g., nonhuman actor, spiritual value). The conceptual codes helped organize the research data and initial tracing of networks, which in turn allowed for further questioning of the makers and hackers in subsequent visits or analysis. The resulting codebooks for makers (Table 2) and hackers (Table 3) served as guides to help analyze the interview data and were derived through an iterative process throughout the phase of analysis (DeCuir-Gunby, Marshall, & McCulloch, 2011, pp. 138-139).

Table 2. Makers codebook

Analytical Codes	Informant Codes	Analytical Codes	Informant Codes	Categories/Themes
Human Non-human	**Actor-**	**Network**		
H	1. Nathan	Nathan-designer-toy-music-meditation-journal-art	Design functionality Joy, happiness Meditation, art	Artistic contemplation Meditation Joy, happiness, play
NH	2. toy blocks	Blocks-joy-kids-journal	Joy, happiness Journal Maker faire	
NH	3. journal	Journal-music-meditation-art-toy	Design, art, music	
NH	4. music tiles	Tiles-joy-play-kids-music-journal-art	Art, music Joy, happiness journal Maker faire	
H	5. Leah	Leah-Lego-coding-slowness	Morning reflection Slowness Impactful coding	Meditative practice Creativity and modularity Coding and blocks
NH	6. Lego	Lego-games-curriculum-camps-coding-slowness	Convivial tools Lego camps, coding Maker faire	
H	7. Scott	Scott-theology-God-technology-daughters	Fleshy/techy spirituality Online learning Priest Technical design Maker faire	Curiosity and wonder Technology and theology Co-designers of spiritual and material connections Theology incarnated into code and circuit
H	8. Scott's daughters	Scott's daughters-school trip-frogs-raspberry pi	School learning Field trip Curiosity and wonder	
NH	9. Arduino blinds	Arduino blinds-smart phone-online learning-fleshy/techy spirituality	Technical design Online learning Problem solving Fleshy/techy spirituality	
NH	10. Raspberry pi echo	Raspberry pi echo-technical design-fleshy/techy spirituality-daughters	Voice enabled device Amazon AI	
H	11. Maker family	Allison-Jeremy-Tim-Luke-making	Family values Community Teaching/learning Making	Joyful frustration Maker family pedagogy Contemplative making Do-it-Together Do-it-with-Others

Table 3. Hackers codebook

Analytical Codes	Informant Codes	Analytical Codes	Informant Codes	Categories/Themes
Human Non-human	**Actor-**	**Network**		
H	1. Daniel	Daniel-vision app-theology-optometrists-Cambodians	Medical mission support staff hackathon	App design Biblical theology Joy of service Sacred time
NH	2. Vision app	Vision app-phone database-glasses-optometrists-Cambodians	Glasses database Vision specs Retrieve glasses Cambodians	
NH	3. Biblical theology	Biblical theology-joy-service-children-design rationale	Designing Sense of responsibility Parenting values	
H	4. Charles	Charles-theology-God centered design-prayer app	theology prayer for everyone user centered design	God centered design Kingdom of God Coding as theological act Prayer as care and service teleos
NH	5. God	God-Charles-scripture-theology-God centered design-beautiful code-prayer app	God as user Co-designer Jesus Purposeful design	
NH	6. Prayer app	Prayer app-theology-Jesus as co-designer-God centered design-beautiful code	Care Service eschatology	

3.9 Synthesizing ANT, VSD, and Case Studies

The conceptual framework previously explicated in Chapter 2 and the methodologies form a cogent "mixed methods" approach. I am interested in all aspects of media and technology as related to systems of learning, connections of emotions and spirituality, and operationalized through design processes. Broadly speaking, the methodological process involved using video to document case studies of maker and hacker networks (ANT) and their design of technotheologies (VSD). At the center of this research design, I aimed to discern how these participants discover meaning, construct knowledge, develop values, and design their technologies in conjunction with theological trajectories. Similarly, my intention was to discover

how the non-humans in these systems have agency and enact transformations within their complex networks. This framework and methodology, therefore, provided a creative approach in situating the analysis within the complexities of persons-in-interaction-with-technology. This complex system emphasized the inseparability of humans and non-humans. The research, therefore, followed the actants and actors in technotheological networks, and traces the contours of what they do in relation to each other. Determining the connections between any given human participant to a particular technology, idea, emotion, theology, or practice, enabled this research to generate rich data.

3.10 Summary

In this chapter, I presented the methodologies used, including case study, ANT, and VSD to study the maker and hacker actor-networks and design of technotheologies. My use of observation, interviews, and video to capture the unique designing processes was described. The research participants constituted multiple case studies. The next chapter presents the research participants in more detail and features the findings and focus on their various technotheological networks.

Chapter 4: Findings

In this research, I entered into hacker and maker spaces to observe how 2 hackers and 7 makers assemble their world into technotheological networks through designing technical systems and artifacts, and employing values, ethics, and devices. From ANT, we understand that in each case, human and non-human actors structure, maintain, and reconstruct the technotheological networks. The actors are linked to the influence and scope of the networks they mobilize. In my research, the significant actors are the human research participants, the makers and hackers. Their views and articulations about designing technotheologies mobilize their own unique ways of being a maker or hacker. Thus, I view these actors as technotheological networks in of themselves. While they are complex entities, these complexities have been simplified and mobilized as black boxes. My aim, then, in this chapter, is to open the black boxes of these makers and hackers identify other actors that help assemble each technotheological network. In particular, my role as technotheologian prioritizes the articulation of values and ethics that are uniquely enrolled in each network.

Since the key actors are the makers and hackers, I have primarily drawn my understanding of their individual networks from my observations and conversations with them. This included hours of conversations with the research participants through e-mail, over phone and Skype calls, and in-person correspondence. As we talked, I focused my inquiry on their understanding of design, technologies, values, ethics, rituals, religion, and spirituality. I accepted people's statements as valid expressions of their states of mind. Whenever possible, I asked them to reframe their positions or consider how values, ethics, and in particular, theologies are considered in their designs. In so doing, my positionality as technotheologian oriented the participants toward common ground. I studied in detail their answers to my questions, their

process of designing, and in particular how they articulate their reasons, beliefs, and values that define themselves as makers and hackers. By following these actors, I began to trace out how the non-human actants are active and influential within maker and hacker spaces. Technological tools and devices such as a coding language, Lego, or 3D printers shape the way the human actors design and create. The values, ethics, and theologies stabilize into various forms of maker and hacker networks for designing technotheologies.

While this chapter articulates a technotheological way in which hacker and maker spaces are assembled, there are other ways in which such spaces might be described. For instance, the maker movement views making primarily as a curricular and pedagogical innovation (Peppler & Bender, 2013; Peppler, Halverson, & Kafai, 2016a). Hacking, at times, has been framed as deviant behaviour (Halbert, 1997) or anonymous hacktivism (Goode, 2015). My application of ANT acknowledges there is ontological variability and no singular view of hacker and maker spaces (Law, 2008). Instead, designing technotheologies dissolves the divide, or rather, finds a new space that bridges *techno* and *theo*. In this way, it opposes the ontological separation between meaning and materiality, between the thing and the sign. In the following sections, I begin by tracing the practices of the makers and hackers as they design their technologies. Like Latour, I ask how they pack their world into words (Latour, 1999, p. 24). Second, I investigate the emergence of their technological practices and devices. I describe in case study form each of the participants or family of participants and a variety of their practices in making and hacking.

4.1 Makers

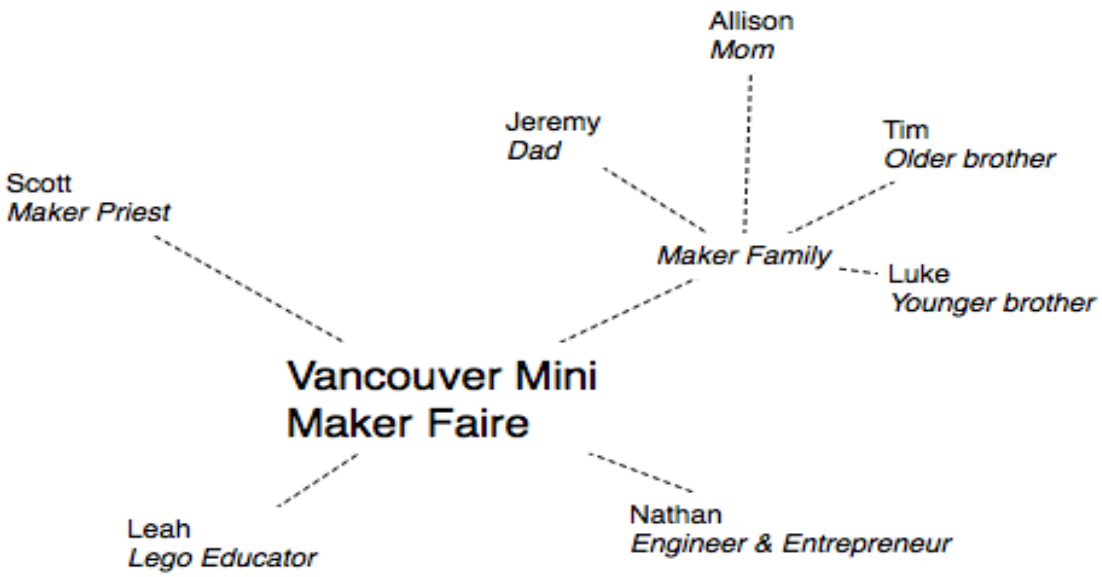

Figure 7. The network of Maker research subjects.

4.2 Nathan the Engineer and Entrepreneur

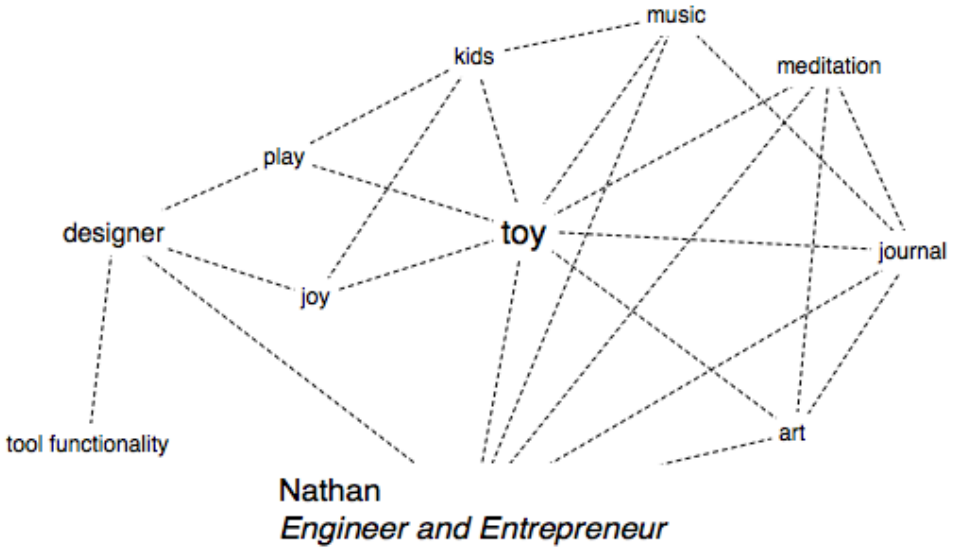

Figure 8. Nathan the engineer and entrepreneur.

Among the makers I interviewed, Nathan offers a fitting introduction into the classic designer. Raised in a home that valued making and tinkering, and trained as an electrical engineer, Nathan has all the hallmarks of the vocation of a designer. Yet as I opened up the black box of Nathan's designing processes, I found his previous 'designer' moniker to be rather a simplified network. Following the example of Callon (1987), I question the durability of this technotheological network.

When I first met Nathan at the 2015 Vancouver Mini Maker Faire, Nathan had a booth where he and his business partner, Frank, showcased a design and prototype for their educational toy. They created a set of interactive blocks that could be used to construct shapes and have outputs with different sounds (beeps, squeaks, and ticks), visuals (light up buttons and screens), and connectors between blocks. The toy prototype was made out of cardboard and wood. Much like traditional block toys for children, their idea was to build a new version of the block toys which valued "something you put together, that you build something." Nathan explained the reasoning behind their design process.

> Nathan: I think about the big picture of what's going on in either the industry or the people that I intend to build that for. For example I still have to build an internal tool for my company. Instead of building a web application, I look at what's going on there, who's involved, what the main problems are, what do they really need, because the obvious things might not actually work for them. I really think about it from a really high level, to the point where it's actually not related. For example, for the toy, I thought what do children need? What does the younger generation use? What are the problems involving the younger generation? What are the problems the parents have with the children? And these can be very unrelated things, not even related to toys. Then, for

example, the toy, the main reason why I wanted to build it is to take kids away from screens. Because I think screens and social media and all the other games they play on the iPads is actually detrimental to them. Because it takes them away from what they should be doing and that's building things, playing with things, playing outside, those sort of things that I used to do as a kid and I loved it. I can't imagine growing up with my face in a phone all the time, right? And that's not even related to toys, that's just a grand problem that I see. I did some research on that and thought a bit more about what needs to be done. What should be built to solve this problem. The solution might not be anything technical, might not be a toy at all, but what I arrived at was a toy. If I build something more fun then a screen, I can bring them away from that. It seems crazy to do that, but it's the guiding principle of what I built now.

Nathan demonstrates the traditional UCD processes, in which he as the designer gives consideration to the end users at all stages of his design. Initially, he identified what he perceived to be the problem among the younger generation. In particular, he felt that his identification of the major problem, screens and social media, was detrimental for the full experience of being a child at play. Nathan enrolled toys to play a significant role, which compress time back to his childhood to counter obsessions with screens and social media. Building blocks, then, served as a key actor that stabilized his technotheological network.

4.2.1 Designer actor-network and the technotheology counter-network

I began to probe into Nathan's framing of the problem, that he as a designer would seek to address the issues of play as mediated through screens and social media. In so doing, I began to problematize his design purposes and procedures. From a VSD perspective, I was

investigating values that formed his network. To begin, I questioned what he valued and found meaningful in his design process.

> Nathan: So just to let you know it's not like when you build things everything is so meaningful. But then, I'm finding that these days it's actually become more meaningful because I'm trying to know more of what I find will meaningful. There's a couple of things that I find meaningful. The ones that I did for work, the internal tools I developed for them, plus the other job I have a contract with, the work I did with them I find really meaningful, and that's mostly because its being used. I don't really find much meaning in building something just for myself. It's fun, sure, but then I use it or don't and then it's kind of pointless. Whereas if I see others using it and its helping them or its making the company more efficient or in anyway useful for another person, that's what I find meaningful. And so mostly the tools that I developed for my company, and the toy that I presented at the Maker Faire, I found that pretty meaningful too because I saw kids actually playing with it and enjoying it and had to be dragged away by their parents. They just wanted to play with it more. And pretty much all of my art has been very meaningful. When you build the toy, then seeing kids happy to use it, the joy they find in playing with it, that's what I find meaningful.

In our conversation, Nathan reveals two main values that he considers significant in his designing: first, he finds meaning in the tools that he develops for his company. He values functionality so that users of his designed technologies benefit from his expertise. His technological tools help users or clients in efficiency or usefulness and this is valuable for Nathan as he takes pride in creating technologies that work for these purposes. A second valuation is not tied to his designing for function, but rather in the sheer enjoyment of the

children who play with his toy. This valuation of joy, happiness, and play, hints at Nathan's technotheological network. Designing for children's joy, happiness, and an ethic of play is part and parcel of his design process. These values are the starting point of translating his problem of screens and social media. We can see that Nathan is keen on these values as he continues his design process, thinking through how he enrolls other actors, technological or otherwise, into the design of his toys.

> Nathan: From a high level idea-wise, I start to break down what could I do to accomplish those. That's when I start doing research about what's out there right now, what exists, and I ask questions to myself: Why are they doing this? Why do parents love this particular toy? Why do children hate this toy? I think about those questions and I write them all down. One big problem I came across was that quality toys are really expensive. That's a question I came across and I thought about that a lot – why are toys expensive, how do I make a toy not expensive, do parents want a toy that's not expensive. I'm sure they do but do they really care. I think about questions like that. Instead of looking at competitors' toys that already exist and what they do specifically, I read between the lines and look at ideas they're trying to put across and what are they trying to accomplish and compare to my notes. This process is not quick at all. If I wanted to release something next month I can't do this. This is something that takes a lot of time. I'm slowly finding that the time is worth it because I come up with something that is really meaningful to me that I like, that they will like, and that's actually unique too. So that's phase one.

Nathan's technotheological network has previously been stable due to the blackboxing of design elements that often do not need further justification. While he tries to follow protocols of

UCD, many of his design elements or, at least, his points of questioning are derived from his valuation of play, happiness, and the children's enjoyment. In this way he meets with some curious actors that are mobilized towards his technotheological network. Nathan begins his design of the educational toy from a position of inquiry. When he speaks about the "big picture," his questions are framed around the needs and problems involving children. His first hand experience about the proliferation of devices and having children being tethered to screens (Turkle, 2012) seemed at odds with his delight in experiencing the world through acts of play, making, and building. The result of his investigation became the idea for his educational toy, a series of interactive building blocks. When settled on creating a toy for the purpose of directing children's interest towards acts of play and making, Nathan identifies his specific design process which consists of iterative phases from high level investigations, or "phase one," and moving towards specific tasks, such as sourcing out materials in building parts for his toy.

> Nathan: Phase two is when I start to go from high-mid level to the ground level. That's when I think about what does the physical toy incorporate. I take the research from my mid-level analysis and I start to buy some parts, buy some materials, get the electronic components, put it together, and try it out. Then usually I come up with the first prototype at that phase. That's when I present it to someone, whether it be a parent or child. That's when I do a lot of building and iterating when it's a continuous process, the prototyping phase which is the phase where any engineer or product and designer would do, just the building and iterating phase. Throughout the process I review my notes. The notes that I took in the high level and mid level thought process, I review them all the time. I never want to waver from those conclusions. Once you start building stuff you eventually move away from it and find that you completely do something different. Which is good if you

need to do that but you should always have a core, why you're doing this so you still look at that. I always look at whenever you build something there's two main parts to it: the internal part and the external part. Internally, behind the scenes what needs to happen, what is the idea behind this. Externally, what do they see, what do they interpret, what do they perceive of this thing that I'm building. There's almost two ways and the membrane between them is actually what I build. It's also a concept I'm still working on myself. Internal is usually something that comes inside me, something I thought of. External is what they will think of when they see this.

Nathan now shares his process of designing as it progresses from ideation to the creating of the technological artifact. His language is that of a designer: moving from building to prototype phases, using a process of iteration. One part of the conversation in which I directed my attention was his emphasis on reviewing his notes. Throughout his designing, Nathan took copious notes. He apparently reviewed them all the time. These notes, then, were another key actor in his technotheological network. How then do the notes manifest themselves in his designing and how to they recruit and enroll other actors, particularly to manifest in Nathan's technotheological network?

4.2.2 Translating the technotheological network: Processes of creativity in meditation, journaling, and art

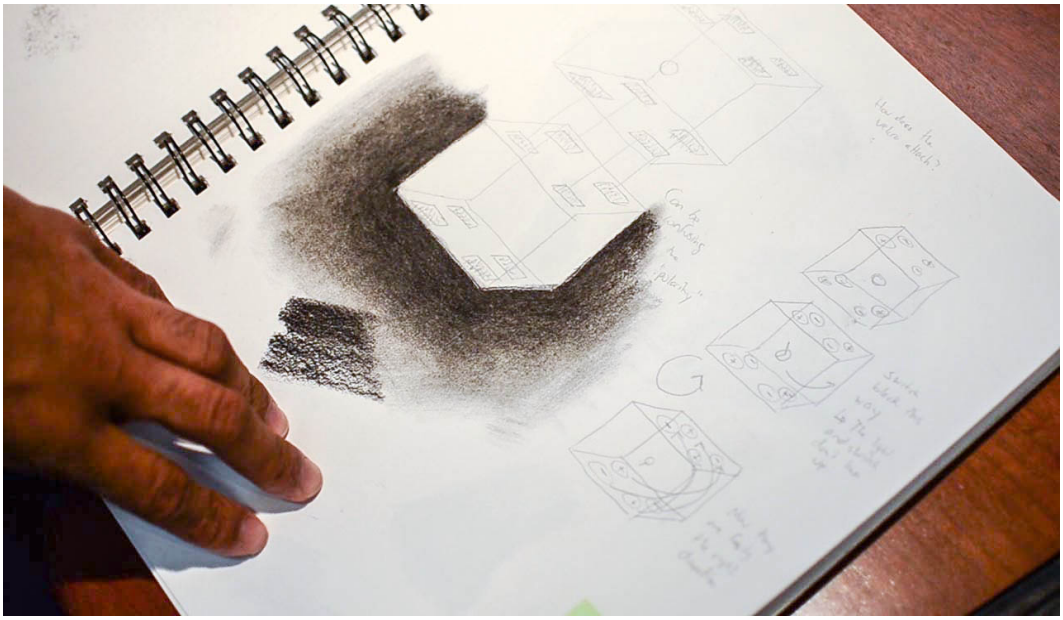

Figure 9. Nathan's sketches in his journal depicting ideas for his education toy.

The design process that Nathan described to me is a result of his time spent meditating and journaling. These are two daily rituals he finds necessary for his peace of mind as well as his creative work. His aim for meditation is to close his eyes, maintain a meditative state, and foster a state of mindfulness with a focus on his breathing.

> Nathan: I do meditate. When you look at what meditation is, it's just focusing. The normal breathing meditation that we all think of is just you focusing on your breath. But you can apply that focus on anything. So just as I focus on an art piece, it's exactly as meditation except it's on art except for breathing. And so everyday I would do some sort of art and I would do meditation in the evening, twenty minutes or something.

From his time in meditation, Nathan cultivates this capacity for focus, which is revealed in his journals. He has four different journals that are categorized differently and used for different purposes. His main notebook is carried around with him all the time. This is for writing out his ideas, drawing sketches, or anything that is related to his work. A second notebook is reserved for his personal thoughts, a kind of diary. The remaining notebooks are just other means to reflect on his ideas and compare them to each other. It is these journals and notebooks that become the primary actors for mediating action in the technotheological network. Nathan's notes are materialized in these notebooks, which negotiate and establish definitions and meaning to understand his values, which align the interests of the other actors to form the contours of the technotheological network.

> Nathan: If I come across something that's unrelated, it actually might give me inspiration so I'll need to write it down. I'll go home and look at my other notebooks that's related and compare the ideas and think about it. By doing so, I feel that it's bringing out what's inside me which contributes to the inward part of the design. I don't feel or think there's a way to do that if you don't look deep inside you and constantly look because you can't just think about it and let it come out, it comes out when you least expect it.

For Nathan, the journals activate his self-reflection process. As he sketches out ideas, drawings, interspersed with his personal musings, something emerges and synthesizes into the educational toy. His main journal becomes filled with notes related to the toy. Yet his alternative journal became an art book where he began drawing block designs as prototypes for the toy. He drew inspiration from a variety of places, including cell biology, noting that cells interacted and connected in a way that he found inspirational. By drawing out these cells, Nathan named this design process as "artistic contemplation," which for him, was his primary form of meditation.

The actors of joy and happiness are materialized in the journal, and align the convergence of other material and non-material actors to begin designing a new toy that more closely aligned with this technotheological network.

4.2.3 From toy blocks to music tiles

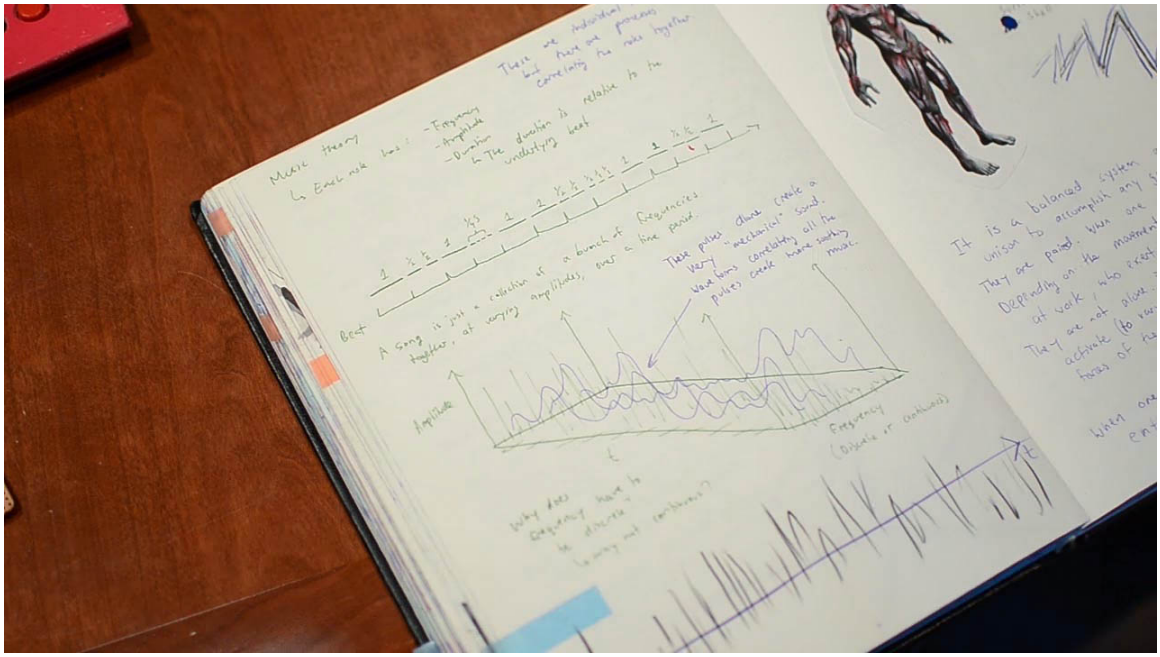

Figure 10. A significant entry in Nathan's journal about music theory in the form of waves.

From the 2015 Vancouver Mini Maker Faire, I continued to periodically speak to Nathan online as well as in person. Nathan continued to iterate new features and designs for his toy blocks, yet some time in early 2016, he eventually pivoted towards a new idea for his toy. At the 2016 Vancouver Mini Maker Faire, Nathan and Frank presented a new toy, music tiles, that can be arranged in different formations and create unique tones and patterns of lights. This was done, in part, because Nathan continued to press into his focus on artistic contemplation. Our previous

conversations helped him understand and articulate that art was a valued and crucial part of his designing. His notebooks were the necessary actors to open up the black boxes of his design. As he spent more time in meditation and reflecting on his notes, he found that his values of art and music were necessary elements in his desire to convey joy, happiness, and play in his toy.

> Nathan: I actually didn't grow up an artist at all. I couldn't even draw. It came to a point where I realized I was missing a whole side of creating without art. In engineering, you really look at things from a logical utilitarian standpoint. You look at what's needed, you build it and they can use it. But art is about impacting them emotionally which engineering doesn't do on its own. I've built a lot of things for a lot of people but they didn't like it. Then I realize that I need this emotional component for them to actually like it. Now that I start doing that, it took me on a road that I didn't even expect. I started to learn how to draw in order to learn how to draw the toys better and then learn that side of things a bit. But I started to become what I would call an artist and it changed my life completely.

This newfound balance with art compelled Nathan to experiment with music, wherein he had no prior formal experience. Applications such as *GarageBand*, rolled out in 2004, opened the blackboxes of songwriting and music production and gave novices like Nathan an opportunity to make music rather than merely download and consume. He began learning piano and started auditing a course at the local university about music theory. He listened to a variety of music and taught himself to read sheet music. His training as an engineer enabled him to analyze music as different types of frequencies, which he jotted down in his notebooks.

> Nathan: I started to get ideas on when waves interact, interesting things happen. They either combine or they negate each other, the interaction of waves are interesting. I

started to think about the creativity angle as really important. I thought if I could make a toy more of an art form it could be interesting. If we look at the block toy I had previously [designed], it's not really an art form. If I could, I always try to find the balance between art and engineering. I'm starting to get it back now. What I originally planned was to make an art show, to put these little blocks together all oscillating at different frequency and you get an art piece. That's an interesting idea and I started developing the blocks. What I have here is each block, each block has a wave in it, a frequency and when you put them together, interesting things happen. That is forming a very simple art piece.

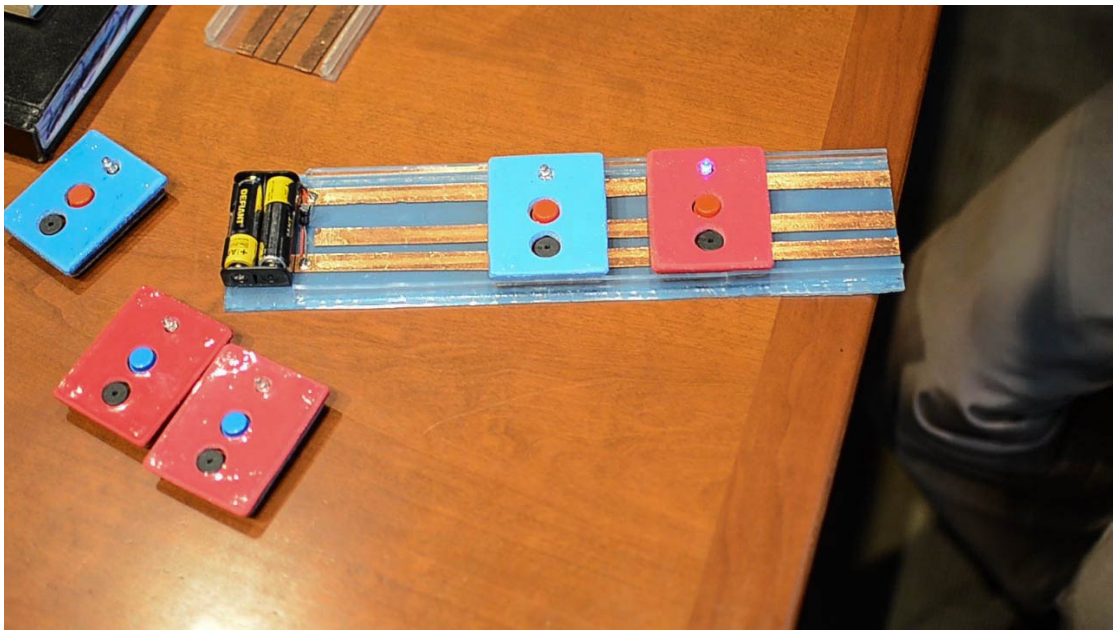

Figure 11. Prototype for music tiles.

Nathan's notebooks enrolled specific manifestations of art and music, and materialized them into sketches, doodles, and notes. These notes, in turn, became the basis for Nathan's new design for his music tiles. Each tile has a specific frequency, the red tile has a fast frequency and

the blue has a slow frequency. Nathan wanted children to have an opportunity to modify and manipulate the waves so he attached buttons that manipulated the frequencies, making them pulse faster or slower. The tiles are moulded plastic set into a circuit board with different components that produce lights and beeps. Building on his idea of music tiles as art form, Nathan initially presented his music tiles as an art display at the Maker Faire.

> Nathan: The first day it was just horrible. I didn't know what to call my art light show thing. The buzzers were annoying them out. It did not go too well. It was really good because in the end I started to think, there's a music angle to this. Because when you think these are beats and you put them together it creates simple rhythms. I told my partner, Frank, we'll push the music angle and see how it goes. [We] got a speaker and played a hip hop instrumental beat in the background. Told them it was a musical instrument. Made the buzzer a little louder, made the lights a little brighter to make it more visual. As soon as I did that, they loved it. Exactly the same product presented in a different way. The kids, they listened to the beat in the background playing along with it and trying to synchronize it, trying to figure out a new way of using it. They were playing a lot with it and experimenting which is exactly what I wanted. So after that day, I decided I can actually really push this on the musical instrument angle.

Nathan's technotheological network demonstrates the challenging, iterative process of designing technotheologies as a maker. This is a general pedagogical approach of making, sometimes described as "tinkering" (Resnick & Rosembaum, 2013), which entails an iterative way of investigating a design, technique, or material. From his first design of block toys as outlined in his notebooks, multiple drafts were ideated and conceptualized in note form. Journaling, meditation, and brainstorming on paper and design software are interwined. Prototyping and

fabricating with plastics, electronics materialized the original block toy. Yet as I continued to meet with him to speak about his role as a maker and helping him articulate his values, his reflection on his journals revealed a new network, which ultimately led towards the design of music tiles as a major actor in Nathan's technotheological network. The music tiles can be traced back to Nathan's journals, which conveyed his values and desire to integrate art and engineering, and to create a technological artifact that reflected his burgeoning love of music. The notebooks, then, became the crucial non-human actor that brought about the possibilities of self-reflection and transformation that were inherent in his technological and spiritual engagement (Turkle, 1996, p. 192). This translation of art and music into his technotheological network expresses a process of designing through the valuation of joy and happiness.

At this juncture, Nathan is neither engineer nor entrepreneur without the cooperation of his toys. Helping Nathan become more social, the toys translate the interests of children and parents he talks with and meets at the maker faires into testers within the technotheological network. The blocks interested and enrolled a volume of new actors and the music tiles another. Nathan explains how, at the maker faires, he and his co-designer, Frank, sit back and let the toys do the work. At one of the faires, the music tiles changed their name to "musical instrument," got street smart with hip hop, and managed to translate kids into experimenters within the technotheological network.

4.3 Leah the Lego Educator

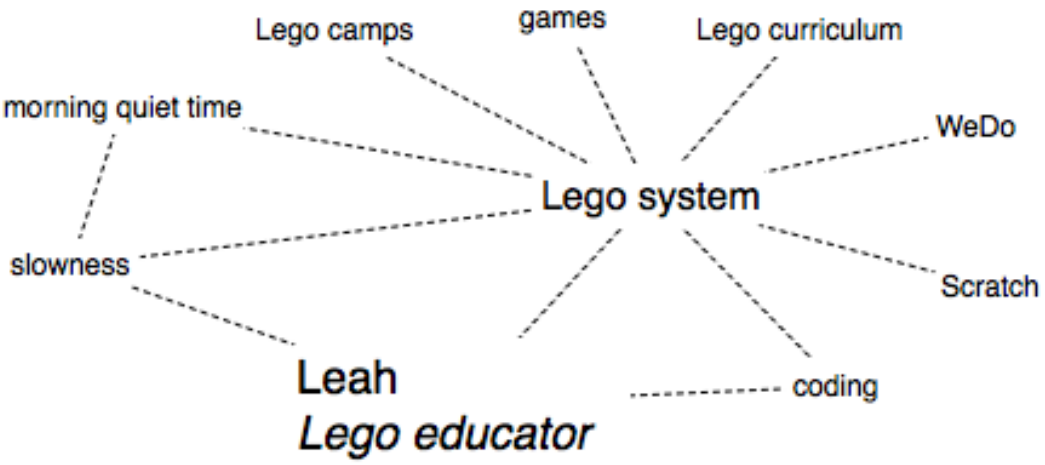

Figure 12. Leah the Lego educator.

Another participant recruited at the 2015 Vancouver Maker Mini Faire is Leah. Leah's experience as the director for a children's Lego camp intrigued me as she was attempting to use, remix, and repurpose Lego for her own designerly ways. On explaining reasons for creating her Lego camp, she gave an example of one of her first classes.

Figure 13. The Lego WeDO education core set.

Leah: When we started the program we had the intro to junior robotics that introduced students to coding and it was an icon based program. As that program was going on throughout the year, that's when a lot of talk happened between parents because school curriculum about coding and computer programming was really beginning to pick up quite a bit. We were excited about that and we started thinking how can we can enhance this and extend it so we added MIT media lab scratch program. We wanted to implement compound learning and we took kids from icon based program to text, and then closer to actual coding process where you are typing out words in a coding sequence. That was very rewarding especially teaching kids to code at such a young age and it wasn't in the curriculum yet. Kids are not exposed to that at such a young age. I remember when I was at a young age, I was in grade 6, and I taught myself Java code. I didn't know what it was, I thought it would be cool to make my own website and I found out that's how you could

> go about doing it and no one showed me. I remember feeling a big sense of accomplishment and [wondered] what if kids were able to be exposed to that. If you look at the people that shaped the technological landscape and the future, Steve Jobs, Bill Gates, Elon Musk, and Mark Zuckerberg, all learned coding at a young age. [Coding] really teaches you how to think in a certain way to impact the world. That's what's meaningful to myself and my team.

Leah articulates an altruistic vision of a technological education system, and a world where technology, and in particular, coding, enables children to "impact the world." This was another simplified network that needed to be opened. To accomplish this, I visited multiple Lego camps to observe first hand how the children are taught a "Lego curriculum."

The Lego camps and curriculum are centered around the Lego Education WeDo construction sets (software kits similar to scratch), the children are given game scenarios at the beginning of their camp in order to create their own game. By week 6 or 7, the campers are able to program their own game using a combination of Lego, WeDo, and scratch. Probing deeper, I asked Leah about the particular construction of her camps and the curriculum therein. The emphasis on coding in combination with making and creating with Lego stems from Leah's personal belief that every child is capable to confidently create and personalize their own Lego creation. Her language in the use of Lego toys symbolize specific representation of children's imaginative potential as forms of life in education. Adopting this constructionist perspective, Leah has created camps that prioritize the materiality and construction of artifacts as play in learning and knowledge development (Ito, 2009, pp. 153-154).

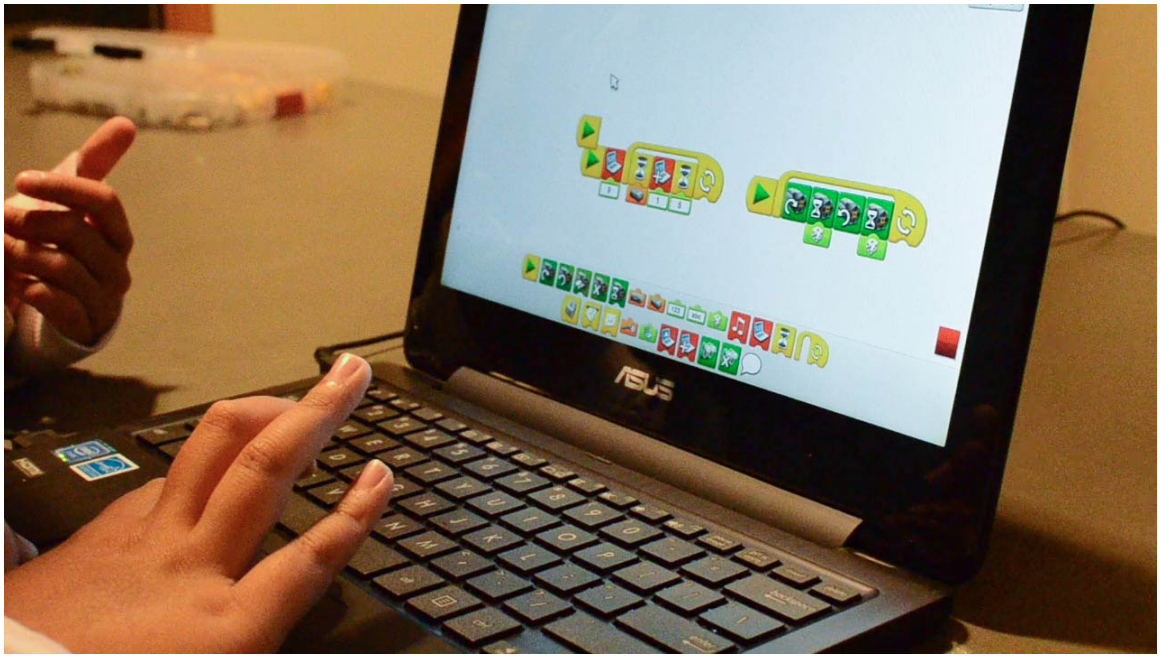

Figure 14. The WeDo 2.0 software, a visual programming language.

4.3.1 Lego as convivial tools

Following Illich (1973), Leah sees Lego as "convivial" tools that are modular and adaptable to serve different people's needs, empowering self-expression, and encouraging conversation. Lego components, then, are the primary actors for Leah's technotheological network. Unlike the previous case with Nathan, Leah does not design or create the Lego, per se, but rather uses it in a variety of ways for her camps. Lego's unique construction as an adaptable technology enrolled Leah into its processes of creating, designing, and building. From an early age, Lego was a tool or technology that Leah worked with. In effect, it afforded her a high degree of independent efficiency, enabling her to thrive creatively as a person-in-interaction-with-Lego.

While there are designated Lego curricula, Leah and her team choose to customize their

own curriculum depending on the numbers, age, and interests of the campers. This designing and re-designing is an iterative process that changes for each campsite with their own unique makeup of kids. The actual beginning of designing an interactive Lego camp begins with Leah every day during what she calls her "morning ritual of quiet time." Every morning, she begins in thoughtful reflection, silently thinking about the camps and the possibilities associated therein. For Leah, silence perfectly suits her process of writing out ideas, sketching out drawings on a tablet, or looking online for new ideas. Within this silence, she can clearly articulate the many connections that she finds among her thoughts, online ideas, and her reflection on the various camps. This routine becomes ritualized, in that the value of this morning quiet time becomes a sacred time that serves her well being.

> Leah: When things are more peaceful, when I'm inspired, the stillness, being happy, and being at peace begets inspiration. At times, if I'm emotionally sad or drained the focus is to get myself back to a level of [being] functional. I find the product of my design is produced with a happy heart when the focus is not on myself. I remember what I'm doing, I want to create a meaningful environment that impacts kids in turn impacts the future. It's easier to focus on that when I'm well and happy.

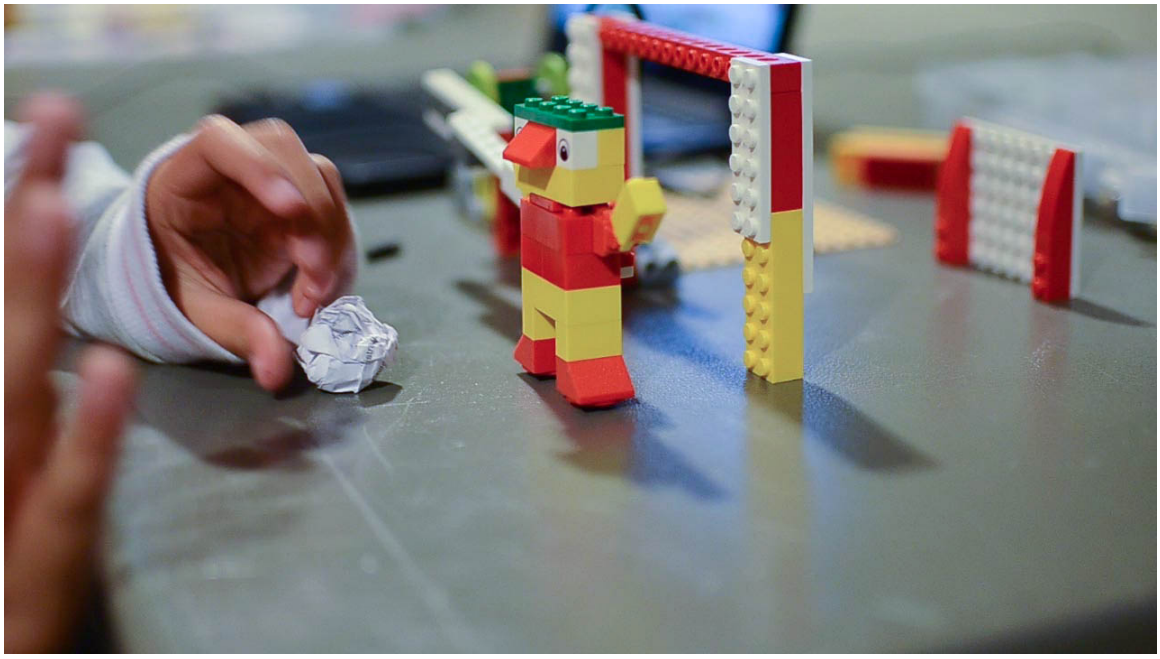

Figure 15. A motorized goalie as part of a programmed soccer game.

The Lego has mobilized Leah's quiet time ritual as a way for her curriculum to be manifested in unique ways. Her calm mornings focus her passion and foster a sense of gratitude that she finds meaningful. Her valuing of intentional calmness and quietness, in turn, becomes implemented into the Lego curriculum through a time of slowness and reflection. For Leah, children are inundated with a fast paced lifestyle. They are shuttled to school, herded from class to class, and then quickly shuttled again to various after-school programs. Her plan is to have purposeful pauses in the curriculum where the campers can "slow down and personalize what they find meaningful." During these reflective moments, the children are afforded time to act, create, think, or not do any of the above. They are given a block of time after guided lessons to do as they please. Sometimes this becomes a time for modification and customization of their Lego projects. Other times, this intentional slowness results in boisterous children acting out.

Nonetheless, the emphasis is to enable the campers to think anew by slowly asking questions, creating a process of inquiry into the challenges of the world. Lego and Leah enroll children within a technological network that allows them to design and create. Leah finds reward in morning rituals, translating plans for Lego maker camps into these rituals. Plans for slowness cannot so readily be connected to the Lego blocks and controllers in this network. Enrolling spiritual or theological practices is not so easily done and the children's interests readily break or undermine links within this tenuous technotheological network. Hence, it's much more technological than theological.

While Lego has translated Leah's educational interests and meditative practices into camps, the Lego blocks have not readily translated theological values and processes of inquiry into the curricular praxis of the campers. The Lego blocks continue to offer interesting creative technological possibilities and enroll new actors such as Boost Lego, a robotics and programming-oriented educational kit. The Lego blocks can now talk, move, play music, and assemble themselves. It remains to be seen how these plastic toy blocks can translate the campers into thoughtful and reflective actors within the technotheological network.

4.4 Scott the Maker Priest

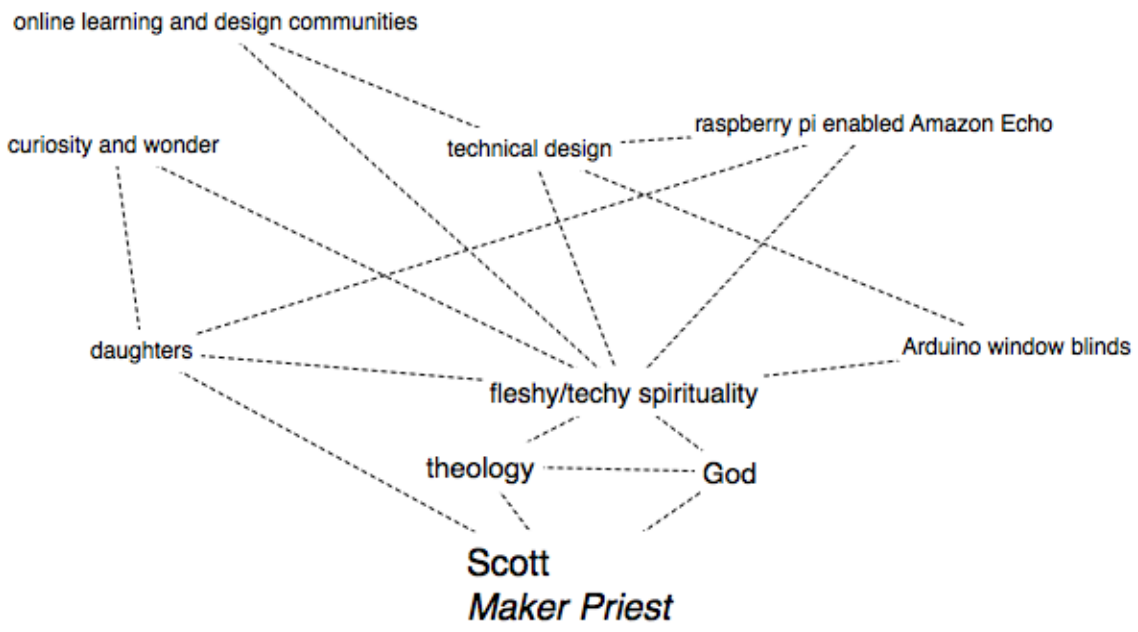

Figure 16. Scott the maker priest.

At the 2016 Vancouver Mini Maker Faire, I met Scott, a Lutheran priest. He was an attendee particularly interested in the electronics display. He scoured all the booths that had various arduino or raspberry pi projects. Scott was accompanied by his two daughters and was looking for specific projects that can involve his daughters in the process of making and tinkering. As I learned that he was a priest, our mutual interest in theology led to many discussions online and in person over coffee. Soon, Scott invited me over to his house to show me the various projects that he was tinkering with for personal enjoyment. Among the many makers, Scott is explicitly religious and naturally begins all conversations from a place of theology based on his belief and obedience to God. In this way, theology is the key actor for Scott, which seems to mediate a majority of actions within this technotheological network.

> Scott: Tech is still a big part of me. I don't see it as useless or anything like that. I enjoy this conversation, this interaction. It makes me think we are human beings made in God's image with creativity, with wisdom, with know-how. We can make stuff. I don't see this as technology as something separate from the spiritual or other ways we live in this world. So I think it is very connected.

Scott hints at the typical dualism found in religious rhetoric that often separates religious or spiritual things from material things. Instead, Scott has a connected view of the world in which spirituality, theology, and creativity, are all tied up together with the making and design of technologies. As Scott articulates, this perspective is thoroughly theological, which serves as the basis for his rationale. In fact, his role as spiritual leader in his church is often conflated with his technical expertise. At times, he has to operate the sound mixer during Sunday service. Additionally he has to fix issues with the wireless network, update printer drivers, and parishioners would often bring their computers to the church for him to fix. "IT guy, tech support, that's what I am," says Scott with a smile. His humble self-description as an IT guy actually hints at theological importance. Scott does not separate technology from the spiritual, and so doing these mundane tasks of fixing devices is an important spiritual act. Scott's theology mobilizes his technical expertise, negotiating definitions of what he calls creatively rewarding, and spiritual fulfillment. One project that he shares with me that demonstrates these actors in his technotheological network was the creation of an arduino controlled blind device for his home.

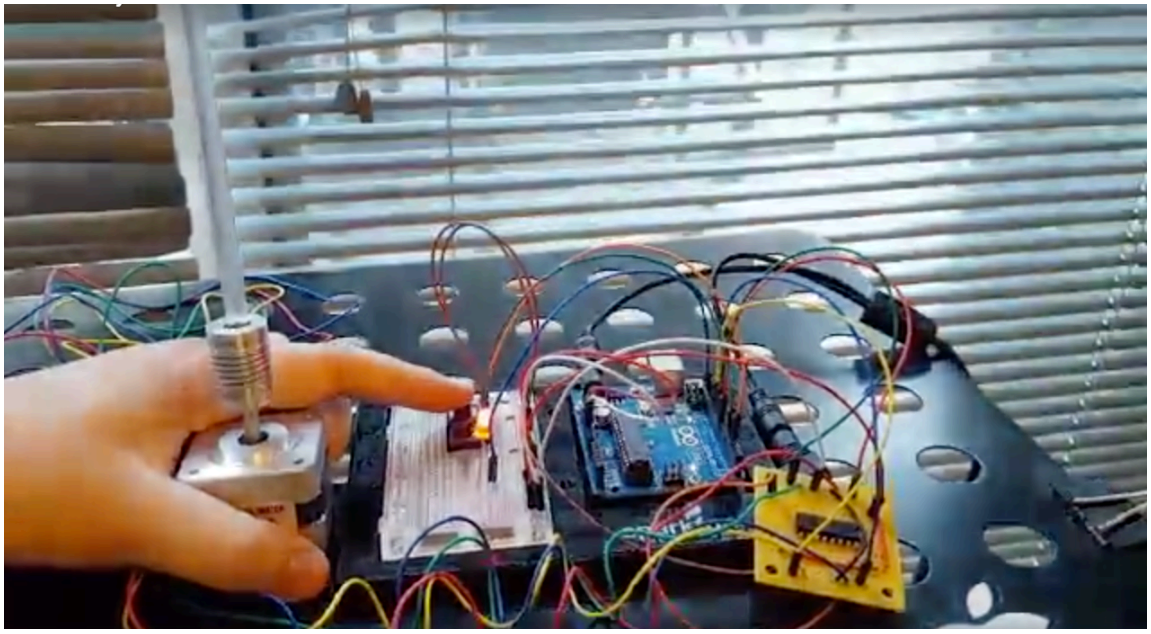

Figure 17. Arduino controlled blinds.

Scott: One of the most satisfying [experiences] is using smart phone to control my window blinds. At the beginning I knew nothing at all. I just didn't know what can be done but I heard a lot about arduino people talking about it. I know a lot of arts people use it to drive lights and doing these simple motion stuff and I bought an arduino board just to play with it. I did a few exercises, and found that there are input and output pins and I can control a lot more gadgets doing that. And I asked, what if I can control my blinds? I went to an electronics store and bought a motor and said how do I use this? This is what you need and they brought me a tiny chip. I'm very intimidated. They gave me a chip with 16 pins and the guy basically said look up the spec online and you'll figure it out. I just didn't want to be seen as really clueless and I said ok. The arduino community has this library and it’s so easy [to use]. I started connecting the buttons to turn [the motor] left and right. But then I didn't want to stop at that because I wanted to explore

> further how I could operate the blinds using Wi-Fi. I downloaded the spec sheet, studied it a bit, looked up some tutorials, and voila, I assembled the system and it was just very satisfying to be able to use smart phone and have these virtual buttons to control the blinds. I think the whole thing isn't about getting the end product, but it's about not willing to be intimidated by things I do not know and step by step figure out what the problem is. What changed in me is that there's always a way to work around things. I mean I could have easily given up at the beginning, thinking, this is too complicated for me, I don't want to do this or I could just buy something already made which I did find. There are companies that make these so called kits for a window blind controller. They are very well made but it would be a different story if I bought one of those and didn't go through the process because what I gained I think I retained and could be used in other parts of my life. When I found a complicated thing, I feel really stupid I don't understand it at all. If I'm willing to persevere and keep working at it, nothing is really impossible.

Scott takes advantage of the openly networked design for making and sharing, as demonstrated by the arduino community and the greater maker community. He connects his technology projects to a broad ecology of connected learning (Ito et al., 2013). Online communities and digital forums have opened new opportunities that intersect with makerspaces. The mechanical production of Scott's arduino controlled blinds is intrinsically connected to online media productions such as tutorial videos, shared computer code, and technical commentary on blogs and websites. From a VSD perspective, Scott values the problem solving and perseverance necessary in his arduino blinds project. He was new to the technical specificities required of arduino and, at times, felt foolish or intimidated with tackling such a project. However, Scott's blinds enroll arduino and motors, etc. as other actors connected within a technotheological

network in which all things are interconnected: heaven, humans, the world, online communities, and tiny technologies.

4.4.1 A fleshy (and techy) spirituality

Figure 18. On the bookshelf: Bible concordance and circuit, technology and theology.

Since Scott is a priest, I was curious how he would articulate his understanding and practice of technology in relation to his spirituality. As Scott mentioned above, the perceived dualism between technology and his religion, or more generally, with materiality and spirituality does not reflect his theological beliefs. Instead, he has an integrated theological perspective that forms the basis for his praxis as a priest and as a technologist, or as a technotheologian. Using

ANT, the actor "theology" is the key actor to set about the process of translation, the process of forming and stabilizing Scott's network.

> Scott: I am very influenced by [biblical scholar] Rikk Watts. His understanding of the world and God and everything is very fleshy. I mean he really doesn't like this dualistic way of thinking, there's spiritual things and there's earthly things. The whole incarnation is God becoming flesh and there is something there! So I really don't think spirituality is just about being quiet, being mindful in this meditative state. Being spiritual is to be in this world and be fully human. I think the intention of God's creation is that human beings are given the breath of life from the spirit to have the physical body but empowered by the spirit within us. It's both together and that is what the human being is meant to be.

Scott's Christian theology serves as rationale for his worldview. He frames the theological notion of the incarnation, where God becomes flesh in the form of Jesus, as his *raison d'être*. In that way, spirituality is an active engagement with all things in the world whether they be spiritual or material. He further elaborates.

> Scott: In the scriptures, a lot of spiritual moments are very physical too. Like Jacob wrestling with God, it's a very physical and very spiritual moment in his life and I don't think we should dichotomize the spiritual and the physical. I find just playing with electronics sometimes I [may] cut my hand. I try to get these really tiny components when I solder and it demands a lot of concentration and patience since I don't want to connect it wrong and burn my circuit. There's a lot of risk taking there. I know this is what I'm doing and I have to trust that it will work and I turn the power on [hoping] that it works. I think there is a lot of faith in that too because you cannot see it. It's not a

> physical system and you have to trust that this is how it is designed and you turn the power on and electrons flow in the system and it works. I think there is a lot to explore in that I can see there's a lot of spiritual things going on that parallels what we are trying to learn as persons of faith. It's about realizing the potential or materializing an idea. I think that [design] process is a very theological thing because God is also a God that creates something out of nothing and if you look at the whole biblical story, we started with a garden and then with the city. God expects us to be technological beings, there will be progress, and he wants us to draw out this creativity throughout the history of mankind.

From theology, Scott's technotheological network also involves his personal design processes through realizing potentiality or materializing ideas. These technological acts are thoroughly theological. The technological actors express "interessement," whereupon Scott and theology, through God, enroll these actors to play prominent roles to help mobilize and stabilize the technotheological network. This important relationship, between technology and theology, also readily extends Scott's technotheological network to variant actors of design, creativity, and spirituality. He articulates a biblical theological network in which God created humanity to be technological beings, tend gardens, invent tools, and build the infrastructure and the technologies to create this Holy City. Ultimately for Scott, design, technology, and creativity can readily be traced back to the key actor, God, and theology. The possibility, then, is framing Scott's technotheological network as a response to the necessarily creative and technological role in which he finds himself more generally, as a servant of God.

4.4.2 Empowering daughters through a design of curiosity

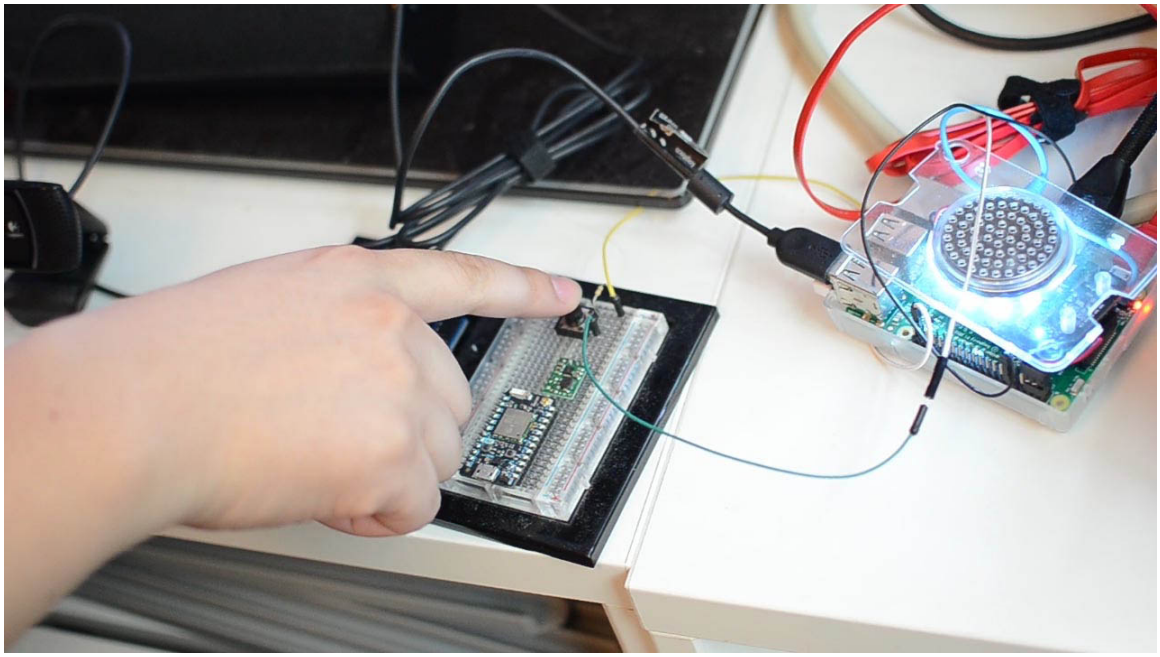

Figure 19. Raspberry Pi project: Scott presses the button to activate the Amazon AI, Alexa, to ask it a question.

Along with his arduino projects, Scott uses raspberry pi, a small card size single board computer, for other technology projects. One project was to use a raspberry pi to mimic an Amazon Echo, a voice enabled device that interacts with the users. He first became interested in this project out of a posture of curiosity and wonder. The raspberry pi connects to Amazon's developer cloud service so that you can use Amazon's AI, named Alexa, to interact with users. The raspberry pi connects to a microphone and webcam, and is activated by the push of a button. The gadget captures your voice and your questions get transmitted to Amazon's cloud service. Alexa then vocalizes an answer in response to your question. This is similar to Apple's Siri or Google Now, both digital assistants that are used on their respective smartphones. The Amazon

Echo, however, is beginning to tap into the Internet of Things, offering future possibilities of controlling smart devices and thus becoming a hub for home automation. While these voice enabled devices are still in nascent stages of development, Scott wanted to create his raspberry pi gadget, in part, to "draw out the curiosity of [his] daughters."

Having two daughters, Scott is particularly interested in how they learn. He notes that the youth, particularly his daughters, are at an age where they are actively exploring, creating, and producing things and are not satisfied with just buying and consuming. As an actor, the raspberry pi is enrolled alongside Scott's ethos of producing and co-creating. Scott gives an example of how his daughters would attend a school field trip where they crossed a river. The class noticed frogs beside the river and the teacher altered the lesson plan to prioritize their inquiry into frogs. When Scott's daughters came home, they asked the raspberry pi many different questions about frogs. Scott later took his daughters to the riverside and asked his daughters about the frogs, and they excitedly shared all that they had learned at school and through his gadget. Scott's daughters have a sense of curiosity and wonder about the world that they encounter on a daily basis. These actors of curiosity and wonder of his daughters alter links within Scott's technotheological network. This technotheological network becomes more stabilized as his daily interactions with his daughters become more mediated through the raspberry pi.

Scott is a Maker priest shaped by his relationship to God and theology. The rich, theological tradition enrolls materiality, in particular, technology, to form a unique technotheology network. Theology mobilizes Scott's technical expertise and negotiates definitions of creativity and spiritual fulfillment. The arduino and raspberry pi AI device, translate Scott's theological interests into blinds and controls of light and darkness. These devices, then, become co-designers of spiritual and material connections in a technotheological

network. Theology becomes incarnated into code and circuit, device, and AI. These are the stuff of the sacred.

4.5 Maker Family

Figure 20. The maker family.

The Maker family is a moniker I gave the family of Allison, Jeremy, Tim, and Luke. Their collective familial involvement in the maker faire were particularly curious to me as I was interested in how the values of making, tinkering, and creating was so prominent in the two boys, Tim and Luke. After speaking to the parents, Allison and Jeremy, I was able to get consent to visit their home and workshop which served as their personal makerspace. My conversation began with Jeremy over coffee, asking him what does he value personally, and what do they value collectively as a family. Additionally, I wondered out loud how these values were passed along within their family network and materialized at the maker faire. I then was able to visit

their home to speak to the rest of the family and observe their design and making processes.

> Jeremy: My boys like being involved in making things, and part of that was born out of frustration and desperation as a parent when my boys got to the point where they would come home and they would watch YouTube all day, they would play games, they were getting into an age where they were getting dragged into all the electronic entertainment. Seeing my kids being unhappy at school, seeing them consuming all this information, I could see that they had a need and a desire that wasn't being filled. So we started to try and get them to do things hands-on, and we noticed when they started doing things, they were less frustrated in other areas. My two boys, they probably told you of their plans of how they are going to start businesses and how they are going to do this and how they are going to do that. That's all being born from starting off with a pair of scissors and some papers and folding cubes from Minecraft and building the skills and the resilience and getting to the point where they feel they have agency and they can create the things they want to create. Making. Get your kids doing it, get yourself doing it.

Jeremy describes how his sons, Tim and Luke, express themselves through the making of their own technologies rather than simply purchasing readymade alternatives. Like most boys, they valued playing, consuming information, and electronic entertainment at home and at school. Yet, as Jeremy points out, there was "a need and a desire that wasn't being filled" in the lives of his children. What was missing, he contends, was the act and value of making. Making, then, is the key actor upon which we begin the process of problematization, defining what Jeremy identified as a problem of unfulfillment, and set about recruiting other actors to form a technotheological network to address the problem. As the father, Jeremy felt a responsibility to direct his sons towards making things. He began with simple projects based on their hobbies, such as making

paper cubes in the form of the Minecraft game. Making was a value and practice in which Jeremy wanted his sons to have agency and discover their own projects to create. In effect, making is the primary actor that influences their entire family.

Figure 21. Maker family slogan and mascot.

The two boys, both attribute their reasons for creating, making, and designing things to their parents. Luke, the younger brother, said matter-of-factly, that he "makes stuff because my dad likes to make stuff and I follow in their path." Making, as the primary actor, readily mobilizes the family members to support one another in the facilitating of its making objectives. For instance, Tim recalls that "the first thing that got to spark doing was when my dad brought us to the first Mini Maker Faire in 2010." Specifically, Tim remembers an eight legged walking

spider robot that people were riding called *the mono spider*. Another highlight was the Vancouver Fan Fest booth, which consisted of self-designed Halloween costumes and props. Both Tim and Luke were amazed and the Maker Faire served as a catalyst for them in creating their own designs, tools, and technologies. Their family soon prioritized being involved with the Maker Faire, and every year, from 2011 to the present, they set up a booth of their own as the Maker family.

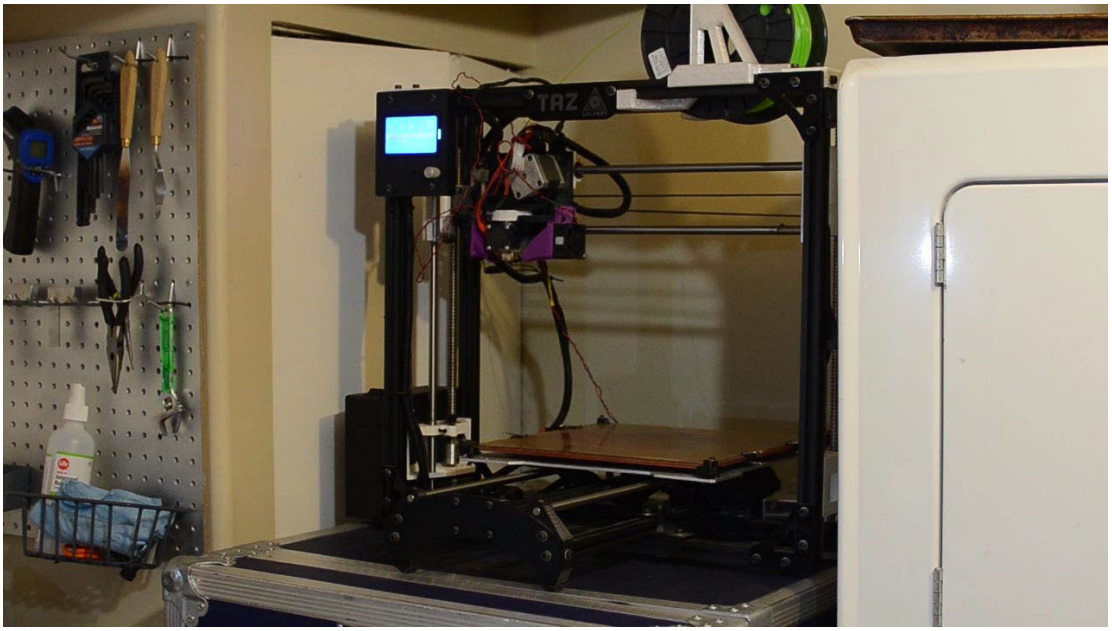

Figure 22. Jeremy's 3D printer used to make props for the boys' costume.

4.5.1 The joy and frustration of making

Making serves as the primary value, and the main actor, that enrolls all other actors into the network. A natural extension of making, then, is to recruit technological artifacts as actors to facilitate various forms of making. When I visited the maker family's workshop, their space was

bulging with various tools, devices, and technologies. Two tables held multiple cutting mats with scissors, glue, and X-Acto knives with paper and foam projects in various phases of design. I found a Computer Numeric Control (CNC) machine close to the entrance, offering precise programmed commands to shape and cut wood. A wall had an art display of random circuit boards, including video gaming systems that showcased the boys' ability to deconstruct their electronic devices. Three 3D printer machines laid side-by-side in the corner of the room, simultaneously printing different plastic components for the different projects.

Tim and Luke, in particular, juggle multiple making projects at the same time. They have many similar interests and projects, and they also have their own individual focuses and passions. Making, for Luke, primarily involves woodworking while Tim mainly associates making with designing props and costumes using 3D printing and laser printing. Luke learns to make projects out of wood by watching YouTube videos by King of Random and Jimmy Diresta, two makers who post tutorial videos online. Luke encouraged his dad to purchase the CNC machine for precise cutting of wood pieces. He was then able to design, laser cut, sand, and construct customized slingshots that he then proceeded to sell at the Maker Faire. Other projects that he worked on included a Nerf dart blowpipe, and an air cannon pipe. Tim, on the other hand, particularly enjoys designing costumes. He also learned by watching YouTube videos, specifically by Evil Ted, a professional movie prop and costume designer, and Punished Props, a husband and wife team who make props and costumes based on video games.

Figure 23. Tim's costume helmet prototype.

At one point, Tim suggested that he and his brother would both design the same Halloween costume, a replica of the Halo video game master chief. Both brothers enjoy hanging out, messing around, and geeking out in these DIY online worlds (Ito et al., 2009) where YouTube serves as the catalyst for their collaborative explorations of costume design and construction. The costume consists of body armour made out of foam. Tim spearheaded the Halo costume project, and began with the prototype of the helmet using paper. The process was labour intensive involving sketching from multiple templates, using math to discern dimensions, and personalizing the size of the helmets to fit the heads of both brothers. From this initial prototyping, Tim and Luke cut out foam mats and created the next step in their costume design. Using glue and heat treatment, they bent and shaped the foam pieces to construct a respectable looking version of a battle armour helmet. As they showed me the YouTube video tutorial they were trying to emulate, they acknowledged that, at times, their attempt at costume designing was

nowhere near the level that they desire to achieve. This frustration seems to be an inherent part of the iterative process of making. Additionally, their processes of visioning, creating, and designing the parts for their battle armour costume are also intrinsically linked to this making ethos. They grapple with the challenge and frustration of building on the designs that they see on YouTube, yet their rapid prototyping and iterative design process can lead to moments of empowerment. Their mom, Allison, acknowledges this common challenge in creating and designing.

> Allison: At home we've had a lot of tears and frustration with the boys wanting to make something and it's going to look this perfect way like in the video game. And then, there are tears because it doesn't look like that or it doesn't work. We've had to do a lot of talking around this as just your first attempt, this is just one iteration, and you have to let go of that perfection and be comfortable with making your thing.

Allison describes this valuing of working through multiple attempts at designing costumes as a fixed mindset versus the growth mindset (Dweck, 2006). She wants her sons to understand that there is a pure joy and a deep value in embracing the entire creative process, including the mistakes. She wants her kids to be "producers rather than just consumers," not wanting them to be passively led by some other source of creativity, particularly established technological products such as video games. When I asked Allison to reflect on her desire to instill values of producing versus consuming, she describes this value as joy of creating stemming from within ourselves. For her, making and creating is a "recharging feeling," an "energizing process" which connects to something inside that needs to be expressed to the world. This metaphoric fountain of creativity begins within, generating streams of life as it comes out "that is deeply human,

renewing, feels so good, and it gives you the twinkle in the eye we want to see in people." Another image of making and creating that Allison recalls is based on her role as a mother.

> Allison: There's few things that have led [me] to a sense of pride. I look at my boys and I think, I made that! Cause giving birth is very much a peak life experience. But making stuff is a smaller version of that, you are birthing an object, you're taking an idea and making it manifest.

Allison's technotheological network deeply connects her understanding of making and creating to her experience of motherhood. For her, there is great joy in the moment of childbirth, and yet at the same time, there is a lot of frustration, pain, and suffering. Her point is that the birthing of an object, a technology, or anything that comes from a place of design and creativity necessitates the joys and struggles through the act of creating. Her children, Tim and Luke, are experiencing firsthand the manifestation of their own creations. Through every iteration of a designed costume, or crafted artifact, they are learning painstakingly the joyful frustration of the design process. Allison tries to mobilize the actor of "joyful frustration" into the technotheological networks of her sons, Tim and Luke. We see here how this particular actor intermingles in all technotheological networks in the maker family, manifested in different technology projects. The iterative design processes of making, then, is aligned by this actor and value of joyful frustration, demonstrating an important step in stabilizing the technotheological networks of the maker family.

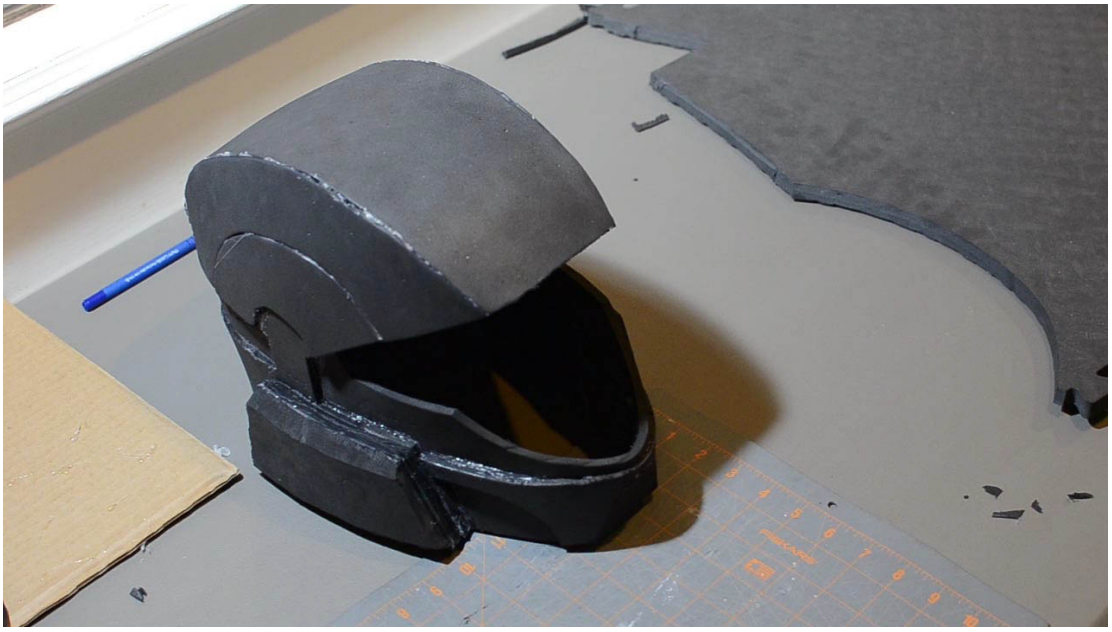

Figure 24. First iteration of helmet made with foam.

4.5.2 Designing contemplation time for the germination of creativity

As I inquired more deeply about the ways and values of the maker family, they began to identify an important area of their praxis that is not often readily associated with making. Both parents, Allison and Jeremy, soon acknowledge that contemplation is a necessary practice for fostering creativity. Allison traces this practice back to her childhood where she remembers the long days of summer filled with unstructured time. She would lie on the lawn with her friends watching clouds float by, a seemingly boring time that happens every day. Yet these moments of boredom, the pauses in life, allowed her mind to be filled with many ideas for creating things. These are times "Where you are not trying anything. It's a kind of germination time." Much like a seed that grows to be a tall oak tree, it needs time to sit still in the dirt, be left alone in order to grow. From these so-called boring moments, Allison and her friends envisioned making puppets

out of paper towel tubes and using chicken wire and paper maché to create a horse costume. For Allison, the link between making and contemplation is a primary relationship that is functionally indispensible to their technotheological network. Similarly, Jeremy points to the same making-contemplation such that all actors converge within the realm of making and contemplating, mediating all interactions between actors within their technotheological network.

> Jeremy: My family life is very busy with kids, I think it's a case of its the only time I can get by myself in the quiet to really think out a problem. If I could create a perfect working space it would be a quiet room for peace and contemplative, meditation around the problem. That's something I would like to build into the design process. Because I think there's so many things that can happen when you can calm your mind, visualize the problem, and try and take it in the entirety. I think the human imagination is just an incredibly powerful thing, we don't give it the space to exist the way we used to.

As Jeremy considers the historical practice of contemplation, he notes that for his family, it's a personal and necessary way of living in which making, creating, and designing emerges out of the banality of peace, contemplation, and meditation. In fact, for Jeremy's technotheological network, making is also a meditative act.

> Jeremy: [Designing] problems end up being a lot of meditative thinking about the puzzle of how different parts fit together and mentally adjusting myself or physically going to look at it from a different perspective… I found it a very meditative process of just looking at the problem, working it out in my head, closing my eyes, imagining it all, then comparing that to the reality. Where possible, I make mock things out of cardboard or wood or easy to use materials that are cheap or inexpensive and then you template it out and double check that it all works.

Jeremy's design process, in particular, reinforces the point that to template is to contemplate; his practice of meditation is intertwined with technological experimentation. For him, these are natural extensions of one another, a symbolic and synergistic relationship that results in design ethic that prioritizes the intrinsic pleasure of creating and making within their technotheological network.

4.5.3 Towards a community of makers

While this maker family articulates a vision of making and designing that stems from a place within themselves, or from contemplation, they juxtapose their subjectivity by being in relationship with one another, and to the wider maker community. In fact, the Do-It-With-Others (DIWO) ideal is a dominant value within the praxis of makers. Allison describes her DIWO connection to other makers as "face factor." She has shirts made by a local mom who does silk screenings and makes winsome designs for children's clothes. Every time she pulls the shirt over her children's faces, she is reminded about this mom. She so greatly enjoys her pottery dishes that were made locally, that she chose to meet the potters and thank them. When she buys meat, she goes to the local butcher and they have an extended conversation about the delicacies of the various cuts of beef. These are conversations and connections that maker her feel apart of a greater world when her family creates. Black boxes of food, tableware, and textile production are opened within this technotheological network. Her prioritization of a DIWO culture is demonstrated by her motherly instinct to instill DIY and DIWO ideals into her children. Her and her husband, Jeremy, want their boys to be co-producers within this web of connections, discerning a sustainable praxis in which everyone can actively participate. This family naturally

reuses spare parts, modifies old ones to be customized for new purposes, and actively makes and creates rather than just consumes latest technologies.

Jeremy agrees that making through collaboration is one of the most meaningful things for him. He found that collaborative projects with others, or in service of others were personally meaningful. When he worked as an IT professional, his group organized events such as altruistic hackathon, cleaning up the local community, or doing workshops to repair electronics and bicycles. The moments of partnership and communal service for one another capture his ideal of what making should produce intrinsically within our wider society. He takes Bowers' (1988) call serious in that a secular scientific or technological mindset can potentially reduce reality and "denigrates the forms of spiritual discipline necessary for living harmoniously with other forms of life that make up the Gaia of planet earth" (p. 9). These values ultimately led him to move away from his IT job and work towards a vision of making that serves the community.

> Jeremy: One of the reasons why I left my original profession after 15 years working in the IT field [was because] I couldn't live up to the morals that I believed in on how things should be designed, why they should be designed, what impact they should have, and how people should be expected to implement and correct them. I left that to create a company to actually help people to find the time and the space to be creative. My goal is to give people access to [maker] equipment but really I think the key is to give them access to a space where they have permission to go slow and to try multiple ways where its ok to take longer or slower and to come up with something completely different than what they thought they would start with. I think that's probably how I will be successful in this business idea, the long term, people will think this is actually a community, this is

> actually an environment, this is a place I can be at peace with wondering about things and wondering how things go together.

At the writing of this dissertation, Jeremy had quit his IT job and began the process of creating a commercial makerspace where his family's values of community, contemplation, and joyful frustration can be established in a physical space. The makerspace has yet to be found, yet the family is full of anticipation and all family members readily agree that it's an exciting venture in which they will all actively serve as co-makers of their family's grand maker project. This family exhibits all the hallmarks of a "maker family," where the value of making has created, constructed, and customized their family technotheological networks. Making has enrolled technological tools, familial traditions and values, to enact complex interdependent networks to reinforce their maker praxis.

For this family, making is the value and practice that links them all together. Making translates the joy and challenges of everyday family life. From parent to child, 3D printer to YouTube, making intimately enrolls all actors into this unique connections between the family's technotheology networks. Making has enrolled contemplative ideals in the parents, who desire to have mindful practices instilled into their sons, who in turn make things, albeit with a mindfulness that only kids can explain. At the same time, making taps Tim and Luke into online communities of creativity and design practices. Making has instilled a joyful frustration, perhaps, an iterative design process aligned to moments of contemplation and frustration, translating this family into a maker-family.

4.6 Hackers

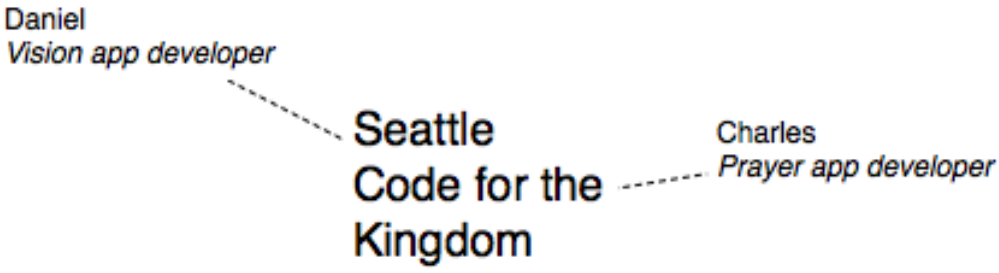

Figure 25. The network of hackers at Seattle's Code for the Kingdom.

The hackers, as my research subjects, served a comparative function in case study analysis. First, the two hackers, Daniel and Charles, were technologists who primarily designed technologies using a digital medium. Second, they are Christian. As such, their technological aims were explicitly religious, whether by form or function. In this way, their technotheological networks tend to form around key actors: religion, theology, and technology. Their processes of translation thus enable us to discern their distinctive network characteristics compared to the makers previously mentioned.

4.7 Daniel the Vision App Developer

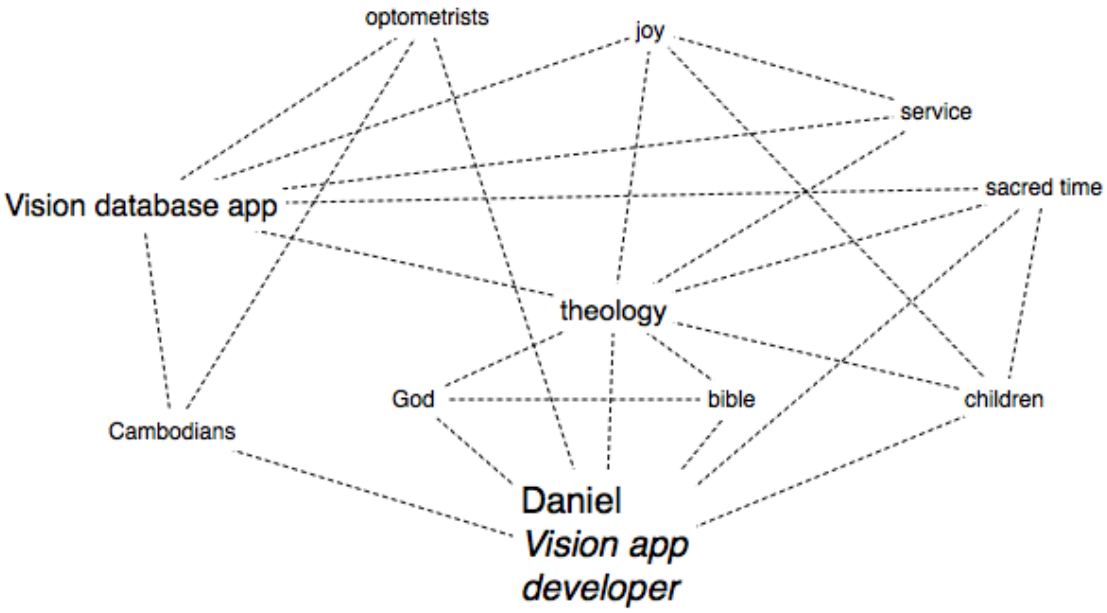

Figure 26. Daniel the *Vision database* app developer.

The app that Daniel designed was simply called *Vision database*. He developed the idea for this app because he was part of a team of doctors, dentists, and optometrists from his church who provided free medical, dental, and optical assistance to rural communities in Cambodia. Since the creation of the app at the Code for the Kingdom hackathon, it has been made available to download on Google Play. Daniel is not a medical professional, so his role was to act as support staff to the doctors. As this team began planning for their medical mission trip to Cambodia, Daniel noted that they used a bizarre system to categorize, sort, and retrieve the medicine, glasses, and dental tools. In particular, the number of glasses that needed sorting (several thousand donated glasses) proved challenging and needed a database to function well so that the optometrist can efficiently retrieve the appropriate glasses for their Cambodian clients.

The old system used dated database software on a laptop that was confusing to use for the optometrists. Additionally, laptops proved problematic because several villages did not have power. The back up plan was to print out 50 pages that held an account of all the different lenses with the variety of prescriptions for both eyes. An optometrist looking for two lenses to match the prescription of a client would need to crawl through these pages, which would take at least several minutes. This proved to be too long as there were often over one hundred clients per day who wanted new lenses for the two weeks they were in Cambodia.

Figure 27. On site in Cambodia with all the glasses.

Given this particular problem of time and efficiency, Daniel wanted to create an app for the smartphone, allowing multiple devices to search through their glasses database instantaneously. Daniel described the general design challenge for his app:

> Daniel: The last time you looked at your glasses prescription there is usually six or eight different numbers – four for your right and four for your left eye – and we rarely have an

exact fit but there is often a close enough fit. So first of all, [the design problem] is to catalogue everything. Once you catalogue everything, you have a good sense of what you have and what you don't have. And when you're in the field, you need to be able to search and find that one quickly. Often we actually grab a couple of glasses and we have them try it on to see, because some of these folks have never worn glasses. Giving them glasses for the first time, fixing their vision all the way to 20-20 is too drastic for them. Oftentimes we just give them something in the middle and that will correct their vision better because it doesn't give them headaches in that case.

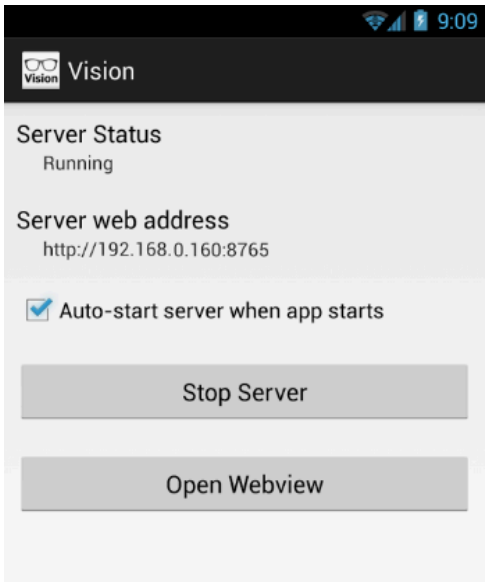

Figure 28. Running the *Vision* app program by connecting to server.

Daniel: I had to work with the optometrists to give me some idea of the rules. Because it's not like for every number if it's within ten percent is fine. Basically there is one number that is the strength, and one number that is for astigmatism, there is one number

> for the shape of your eye, so astigmatism is in the eye and how much of it, and then at what angle. When those are high there is a much lower tolerance for a number that doesn't fit versus if you have a little astigmatism then it doesn't matter if its this degree or that degree. So a lot of those rules, I had to go back and forth a lot with the optometrist because I didn't understand how that stuff worked.

For Daniel, his design challenge was to create a better process of searching through lenses given the huge catalogue of donated glasses and the specific rules of optometry. He wanted to optimize the search and retrieval of lenses so that his team could serve more people. His technotheological network sought to translate this problem through the recruitment of the vision app. This app, in turn, was connected to his theology and valuing of service. Daniel's particular network showcases how it addresses specific issues of technological design in relation to his theological values. For instance, in Cambodia, testing a person's vision took a significant amount of time, yet it was often rewarding as the team built some cherished relationships with the Cambodians. Part of Daniel's goal was to minimize the search and retrieval process since it was "non-relationship building" due to prior frustrating process of searching on the computer or pieces of paper. Due to the possibility of no power, Daniel created his smartphone app since the phone battery could last throughout a whole day on a single charge with limited use. Multiple users are able to access the app at the same time, search through the database, and retrieve the glasses more quickly and easily. Additionally, the database could be updated at the same time by multiple users. For instance, if two optometrists were searching on the app for similar prescriptions, the first optometrist may mark out ten glasses to try and fit onto a single client. Since they are not looking for exact prescriptions, the optometrists have to find the best combination of prescriptions that felt most comfortable for the clients. The database would

indicate that the ten glasses were taken out and the second optometrist would have to find other prescriptions to serve the clients. This simple app proved tremendously helpful for the team and saved a few hours worth of unnecessary time spent on administration and processing.

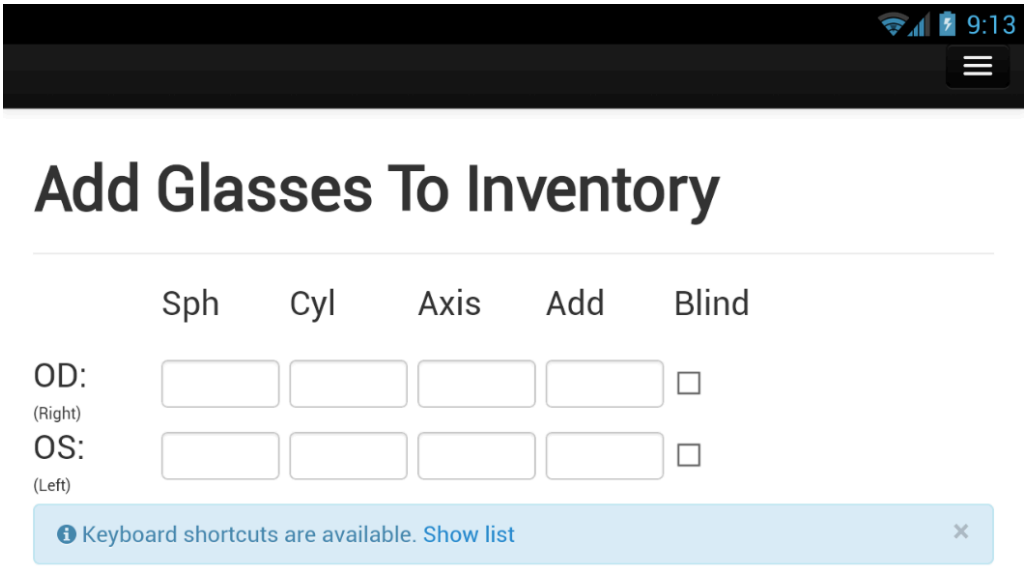

Figure 29. Screenshot of *Vision database* app.

4.7.1 The joy of service

The vision app served a specific function to help his team serve the people in Cambodia. Yet it demonstrates how different values and theological intentions were imbued in its design and use. For instance, when I asked Daniel about his rationale for creating the app, he shared the following:

> Daniel: I would say to do it as a service would probably be my primary motivation. But one thing I've actually noticed in the last couple of years is that there is a certain joy I get in building. I get a lot of joy in the process of creating, which is like building. I used to get in trouble with my wife because I would come home from work and she would say

> what did you today? And I would say "nothing" and after a while she got mad at me because when I said "nothing" she thought I was dodging the question. And I'd say, "I do nothing. I go to meetings. I write some docs. Then I go back to meetings. And then I go back home. I do nothing." And then in that moment, part of me realized that it's not "nothing" but it's just the way I value that work versus the work of building. So there was a lot of joy in building and problem solving. I guess some of it feels like subduing. You know how they talk about redeeming the fall and part of it is we as people will subdue things and be the master of it. I feel part of that in a small way, that there's chaos and I could bring order by reducing the chaos and bring some order to it.

Daniel is connecting his subjective experience of joy to acts of building and problem solving. In turn, he links these acts to the biblical narrative arc of the fall of humanity due to sin, and a process of redemption through God. A part of scripture in this biblical narrative is found at the beginning, in Genesis 1:28 where God promised Adam and Eve to "be fruitful and multiply, and fill the earth and subdue it; and have dominion over the fish of the sea and over the birds of the air and over every living thing that moves upon the earth" (NRSV). At times, this verse has been used as theological rationale for pillaging the resources of the earth no matter the cost. However, another bible translation, the Message (MSG) translation, renders the passage as "Prosper! Reproduce! Fill Earth! Take charge! Be responsible… for every living thing that moves on the face of Earth." Within this interpretation, Daniel articulates what he is feeling. "Some of it is joy. Some of it feels like responsibility to provide what is best. Because if I'm doing this service for people and then ultimately to God, then I don't want to do something just good enough." The vision app enrolls Daniel's sense of responsibility and conviction of service into its design goals. In particular, the app brings a particular value of joy to Daniel in the process of making, creating,

and letting the optometrists use it in service of others.

4.7.2 The sacred time of designing

As Daniel recalls his design process, he constantly used the words of building and problem solving. He connects these design processes to his theological understanding of joy, particularly since the app actively addresses a problem or need and is intended to serve others. When I asked about his particular habits of designing, he surprisingly answered by way of story.

> Daniel: I would say there's something very specific about my stage of life that allows me to do a lot of this. A lot of the problems I end up solving happens late at night when I'm holding some kid, one of my kids that are freaking out, because in those cases I'm typically standing because they don't calm down if I sit. It's dark because they don't calm down when it's bright. So I'm basically standing in the dark. The specific thing about that is that there's no distractions around so it allows me to focus in a way unlike when a Facebook message comes up and I decide to answer it and 30 minutes later I'm somewhere else. So I do find a lot of the brainstorming aspect done… in fact there are certain times I put my kid down faster so I can go down and write it down before I forget. But this distraction-free time is when I get the most building done.

As a parent with young kids, Daniel spends countless nights having to rock his kids to sleep. This is a long and arduous process that leaves many parents fatigued. Yet for Daniel this time is valued. While he is comforting his child, his mind finds focus in this nightly ritual. This time is precious time with his kids, and also his optimal time for brainstorming, building, problem solving, and ideating. The time with his kids and the time spent designing, coalesce into a sacred ritual where both family life and designing technologies meaningfully inform one another in the

same space and time.

The vision app stabilizes joy and service in this network. These actors are valued theologically and emerge particularly in Daniel's unique sacred time of designing. The vision app, then, enrolls Daniel's theological convictions, his role as a father, and his technical expertise all the way trough the digital realm to the Cambodian glasses, prescriptions, and clients. Helping the optometrists resolve the challenges of space and time, the app translates the interests of the Cambodians into active participants within the technotheological network. It participates in the redemptive arc and eschatological vision of Christian theology, moving from the Garden in Genesis to the New City in Revelation. Daniel's technotheological network showcases this little app, its material expressions of theology, and its reassembling of joy, service, and sacrality.

4.8 Charles the Prayer App Developer

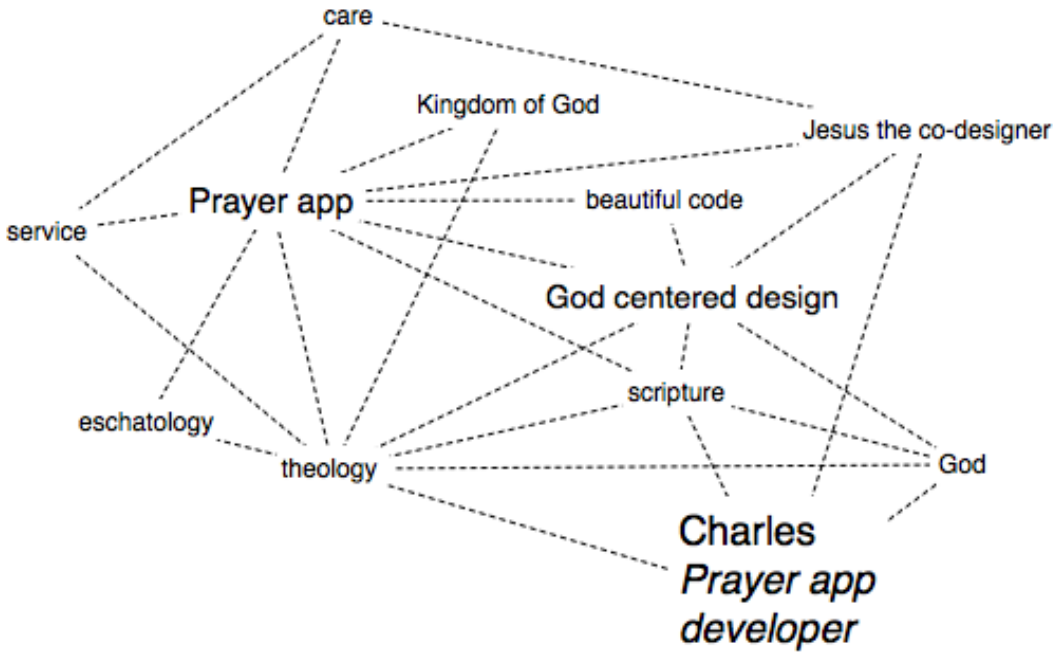

Figure 30. Charles the prayer app developer.

Charles is a former software developer, but due to his enjoyable experience at the hackathon, he has chosen to leave his full time job to refine the design of his app. It has since been made available on iTunes and Google Play. At the writing of this dissertation, his app, *Intercession,* had approximately 2000 weekly active users who open the app once a week to pray for others. Charles believes this is proof of concept, in that his team designed the app to make God their main customer, and yet this design decision has resulted in people actively praying for others. The app has a simple interface. When you download it to your smartphone, it crawls through your contacts and adds them to its system. You can then choose to pray for a designated number of people everyday when an alarm prompts you to pray at a given time. Afterwards, the

app shows the picture or names of three random contacts and you have the opportunity to pray for them. This simple design aesthetic, combined with the habitual prompts of alarms and reminders has helped many users (re)discover the practice of prayer. *Intercession* articulates a grander vision for prayer in its design and use. Charles explains:

> Charles: Our vision, the big number, is personal prayer for everyone on earth. I know 3 months ago [our users] were praying for more than 400 thousand people. We want that number to reach 7 billion people that are being prayed for. You only need 1% of the world which would be 70 million Christians to pray everyday and personally pray for everyone on earth. That's the big dream. We reach that number because if God gives us 1% we can do something unprecedented, we fulfilled 1 Timothy 2 to actually pray for all people. And the scale is there… last time I shared, it was about 34 countries and recently Intercession reached all 50 states in America before the 2016 election. It's a very beautiful thing to see the map light up and also can show you the areas of no Gospel witness, Christian presence. You can see those frontiers and it gives us some focus about what do we need to do to activate prayer at those boundaries, at the boarders, at those neighbours of those people, praying for their neighbours.

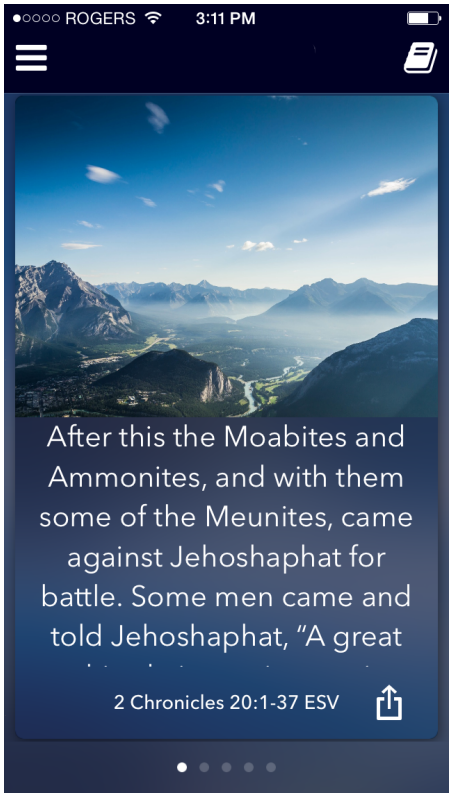

Figure 31. *Intercession* prayer app with bible verses for reflection.

Intercession seems to be the key actor in Charles' technotheological network which has enrolled multiple actors for its purposes. First, it naturally enrolls Charles' theological perspective, in particular, his biblical foundation and relationship with God. Charles had written a philosophy of design, consisting of five tenets (see Appendix E). Tenet 1 states the following:

> *God is the ultimate customer.* We want to help people do God's will, enjoy his presence and pray as he would have them pray. Our user experiences prioritize his desires and values above all else. When users prefer things that may not help them do more of what God values, we bias towards furthering God's ends over user preference.

The app, then, directly enrolls God as another key actor, through a God-centered design. In Charles' technotheological network, this actor relationship necessitates the enrollment of another

key actor, the bible. More specifically, Charles cites a particular biblical passage, 1 Timothy 2:1, which speaks about the value of praying for others, as the theological rationale for the app. We see, then, that Charles' network is founded on multiple non-human actors: the prayer app, God, scriptural text, and theology. These actors assemble and recruit others to form Charles' unique technotheological network, in particular how the app manifests its connection to the technical specificities of designing technologies.

Figure 32. *Intercession* app prompting a prayer for 'dad.'

4.8.1 Jesus as co-designer

Charles described a God-centered design that form the basis for his design philosophy. God as customer, sets up specific design requirements for his app, as mediated by design specificities that Charles interprets from the Bible. For Charles this is a "deep theology of technology to understand the scriptures, to understand what God wants. And what He deeply desires and how He wants it and what he values and what He identifies with." Through a user-centered design process, you begin to know your customer much better. Similarly, the app

enabled Charles to draw closer to God because "that's what design is, customer empathy, you start to empathize with God more deeply than ever because you're trying to design something that He wants." As a Christian, Charles believes God is also incarnated in the form of Jesus. Jesus had clear priorities in the Bible to help the poor, oppressed, the widow, and the outsider. So another perspective that Charles adopted was to ask "what if Jesus was a designer? What if he was on our team? What kind of experience would he want to give?" These questions add new layers of complexity to the design of the app. Now how does one begin to design a prayer app that demonstrates the passions, prioritizations, and the very heart of Jesus? Certainly this would entail modes of care for others. Perhaps an active form of intercessory prayer that takes the form of service, especially for those who are in need of prayer due to a physical, mental, or spiritual pain. In the end, this question has not been fully addressed but is finding its way into the next iteration of the app. With regards to Jesus as a co-designer of his app, Charles recalls how this relates to his personal motivation as a designer and technologist.

> Charles: As a child I liked making things. One of the deepest joys was seeing an idea coming alive. It gave me immense satisfaction. Personally I'm motivated by that, on a broader level when you ask why I create, there's a *teleos*, there's a purpose, there's an end to it. And I know theologically I can say, we create because we were all made in God's image as the creator so we all flourish... I think the *teleos* of human beings is more specific. I want to see the kingdom of God to come, I want to see Jesus Christ return. I want to see the things I create be aligned with that outcome. And if people experience it and they enjoy it, what you really love about that is the taste of the kingdom of God is where Jesus is in charge and his creativity is on full display. And his love is being experienced throughout all who hear.

Charles links his depiction of Jesus as co-designer to the classic Christian doctrine of the Kingdom of God. This Kingdom characterizes the intimate relationship between God and humanity in which Jesus is represented as the ruler of this kingdom. The kingdom is both "here and not yet" in that it is a present reality that will be fully realized in the future. This *teleos* that Charles speaks of, is eschatological, filled with hope for a future in which humanity and God are destined in eternal relationship together. Charles' technotheological network, then, stabilizes around the cluster of non-human actors that articulates a design philosophy based on the relationship among God, the bible, theology, and biblical ethics. Charles specifically recalls Jesus as a co-designer, whereupon the complex theologies of the incarnation, kingship, and eschatology are fully integrated with a valuation of creativity and love.

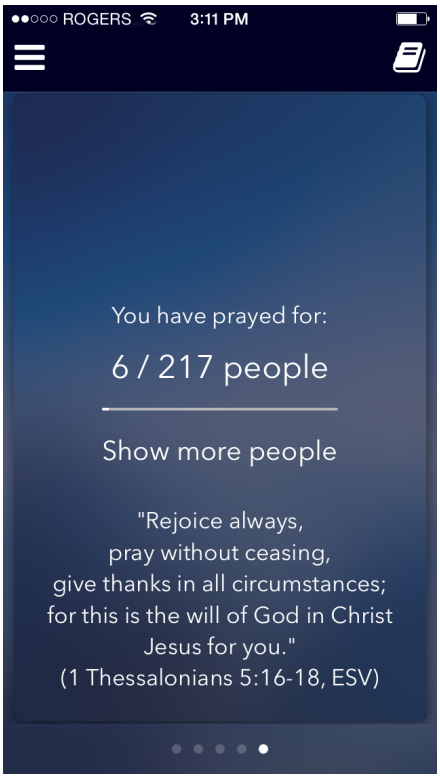

Figure 33. *Intercession* keeping track of people you have prayed for.

Intercession as a prayer app was organized around the infrastructure of a specific coding language and its internal rationality. In this case, it was using the language Objective-C to create a version of the app for Apple products such as iPhones and iPads. This design for computer programming transforms Charles' technotheological artifact into abstract lines of interrelated bits of logic. He acknowledges that at times, the coding process is itself a tedious endeavour, having to write, compile, and debug the same words (i.e., float, double, length) or decision making functions (i.e., if, then, else) for countless permutations. Yet, in spite of the monotony of this arduous process, Charles came across a line of code he described as beautiful.

```
// in case you didn't notice, the following line is beautiful.
NSSortDescriptor *prayerRecordCountDescriptor = [NSSortDescriptor
    sortDescriptorWithKey:@"prayerRecords.@max.createDate" ascending:YES];
```

Figure 34. Elegant code that is deemed beautiful.

For Charles, this "line is beautiful" because he was able to design a complex function using a single line of code. He shares that not only is it aesthetically pleasing and technically satisfying to create this line of code, but the elegant process itself seemed miraculous, finally being written in the late hours of the night with little sleep and a hazy mindset. The technical design of computer programming, at least for Charles, can be a religious experience. Charles' experience is part of the complexity of design. Charles' technotheological network specifically articulates his distinct enrollment of technological and theological actors, which find stabilization around the *intercession* app.

Charles now mainly provides support for *intercession*, which continues to enroll and

mobilize more and more users around the world to pray for others. The app actively serves and cares for others through its digital interface, beautiful code, and theological values. It mediates each link in a chain of prayer to person to prayer and so on. *Intercession* plays a priestly role, mediating the relationships between heaven and earth, God and humankind. In this way, *intercession* follows the biblical instructions on prayer in 1 Timothy 2, "that supplications, prayers, intercessions, and thanksgivings be made for everyone." *Intercession* helps us pray, teaches us to pray, prays for others, and prays on our behalf. Charles and *Intercession* are mobilizing a prayerful technotheological network.

4.9 Summary

We can see that among our makers and hackers, technotheological networks articulate specific values alongside technological creations, practices, and personal ways of being. The makers and hackers serve as empirical case studies at the crossing of design, technology, and theology, allowing us to open up black boxes and trace through their technotheological networks. Beginning with the key actors, the makers and hackers, we can see how assembling a technotheological network contributes to ethical know-how in the design, engineering, and use of media and technology. Questions about whether theology processes matter in design (Wyche, Aoki, & Grinter, 2008) only serve as changes to our network, or perhaps, the recruitment of actors to competing counter-networks. Regardless, my research into makers and hackers demonstrates how they design technotheologies with considerations for ethics, pedagogies, and spiritualities. I have demonstrated that within their diverse design processes, their spiritual and theological processes have different preoccupations, subjectivities, and intentionalities. In their own unique ways, these makers and hackers inquire into the materialized morality and design

phases of ethically responsible decision making processes. This is a *thick morality* whereupon moral theologies enact design processes using critical, empirical, hermeneutic, participatory, and pluralistic criteria for ethical design. Conversely, the non-human actors express their own values within technotheological networks. I explored these values, as technotheologian, through a framework of ANT and VSD and through case study methods. This research involved conceptual, empirical, and technical investigations, in order for actants, human and non-human, to deliberate shared values for designing, engineering, and using technologies. At times, I became an active co-designer, helping the makers and hackers with value discovery and translation into design requirements. My role as a technotheologian helped facilitate competing value claims by positing a normative focus and by temporarily opening black boxes, following the actors, and tracing or testing links through their technotheological networks.

In the final chapter, I connect the makers and hackers, and their technotheological networks to a common actor: education. In so doing, the assembling of technotheological networks offers a unique account of curriculum and pedagogy.

Chapter 5: Conclusion

In Chapter 4, I analyzed case studies of the makers and hackers, tracing their unique technotheological networks. I opened up black boxes with these individuals and found that each maker and hacker was an assembling of various actants, human and non-human, extending from theological to technological, and from ethical to designed. The primary research questions were: 1) What role do ethics and values perform in maker and hacker networks? 2) How are ethics and values integrated and manifested throughout the design process in maker or hacker networks? 3) What are the routines, rituals, and subjective well-being of participants in the maker or hacker design process? Chapter 4 presented the findings, emphasizing the diverse roles that ethics and values play in the cases and the roles the actors play in rituals and routines.

In this chapter, I begin by discerning an obligatory passage point (OPP) common to these cases (Callon, 1986a, p. 26). The OPP is a crucial connection tying the technotheological networks to education, an ever present yet under-appreciated actor. In this way, education is a primary actor that connects the maker and hacker actors. Next, I summarize my research, particularly as these technotheological networks relate to curriculum and pedagogy (Figure 35). As a primary goal was to discern values in these networks, I analyze how we care for these technotheological networks. Finally, I offer suggestions for further research.

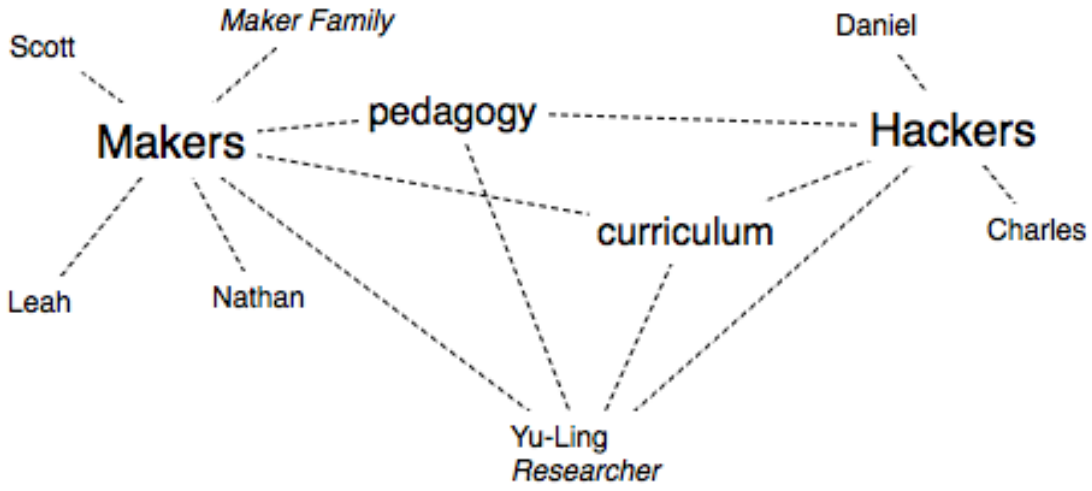

Figure 35. Technotheological networks enrolling pedagogy and curriculum.

5.1 Assembling Technotheologies as Critical Education and Critical Making

A common perspective regarding education among the research participants is a critique of education or schooling. For instance, Nathan remarks that our "educational system looks at [students] as if they're all the same, as if they all learn exactly the same, they all should be proficient in exactly the same things." Daniel dismisses his academic learning from a reputable technological school, and says that the most helpful thing that he learned in university was to leave his assignments to the last day and devise a plan to recruit help from fellow students. Charles notes that in academic settings, too often people do not sense a purpose in learning and are only persuaded by extrinsic motivations such as grades. Allison uses the language of "fixed mindset" when describing teachers who follow prescribed learning outcomes with a rigid spirit. Leah found the designed Lego WeDo curriculum to be missing specific engineering elements so her and her team went through a process of iterating a new curriculum that linked "computer

coding process to models that were related to solutions that engineers used in real life to solve engineering programs." All these observations speak to a common criticism of education held by the participants. Following Ross (2008, 2015, 2016a, 2016b), critical education and critiques of schooling extend from small actions to figure out how education works to tinkering with the system to full protest and revolution. The participants in this study offered a range of insights into pedagogical renovation and actualized novel means of learning by fashioning their own DIY curriculum.

A second dominant theme is the emphasis on critical making (Ratto, 2011a, 2011b, 2012; Ratto, Wylie, & Jalbert, 2014). As Nathan was critically reflecting on his music tiles, and particularly the educative values associated with his design, he envisaged a particular design of curriculum. His criticism is that education tends to remove the sense of curiosity and wonder among students. Huebner (1959/2008) observes that wonder is the "participating with the time and being of the other" and that "we are free only to the extent that we maintain and develop our capacity for wonder" (pp. 6-7). Nathan, through a process of critical making, hopes that students can have a daily experience in exploring, questioning, and wondering. Bersanelli and Gargantini (2009) argue that in "the heart of all great scientists there is something that, as in a child, keeps their eyes wide open… this wonder at existence is the condition for an authentic encounter with things and opens up the possibility of knowledge" (p. 4). In the end, curiosity and wonder are ultimate values for many makers and hackers.

Daniel, the vision app developer, entered a process of participatory design with his team of optometrists, believing that his app would constitute a better technology than their current one. This belief stemmed from his theological understanding of joy and Christian commitment to service. His sense of responsibility for designing well and not "just good enough" serves as a

form of critical making, arguing for a specific view of good design which necessitates a change in vision technology. Daniel's design process illustrates critical making, and the negotiation with his team demonstrates a plurality of views for the good life. While they all have similar religious dispositions and theologies, their dispute over the use of technology led to the transformation, translation, and distortion of their technotheological networks. In this case, a plurality of views on different ethics led to different technological artifacts. Collectively, our participant makers and hackers mediate the network alongside the non-human actants through design processes. Designing technotheologies is an ethical process in which all actants, human and non-human, try to stabilize their network.

5.2 Making, Designing, and Valuing Creativity in Curriculum and Pedagogy

A purpose of my research was to discern how makers and hackers actualize their making and design processes. Scott, the Maker Priest, exemplifies ethically responsible decision making processes in his design and use of his raspberry pi project. His formulated problem was to use the raspberry pi to create an amateur version of the Amazon Echo using affordable parts. The project was to satiate his personal sense of curiosity and wonder that was evident in his daughters. These values trumped the other design decisions so he prioritized the construction of an object that championed the interaction between himself, his daughters, and the Alexa AI. He justifies not having the need to create or design a fancy casing to house his project because the priority is the dialogue between human and non-human actants. This solution ultimately led to a straightforward assemblage of components such as the raspberry pi, connected with a microphone, webcam, and button to the Amazon cloud. Wonder and curiosity served as basis for this project, and continues to be evident in the learning of Scott's daughters.

When our discussion veered towards education, Scott had similar criticisms as other participants of the education system. He admits that he does not remember much about his time at college, and that is why he wishes for a "different way of learning – learning hands on, not by not 'knowing,' not by telling you what steps you should take, or hear a bunch of stuff and go with it." Scott explained his rationale by way of a memorable course he attended at Carnegie Melon during his last year of college, which was part of the first batch of students in an experimental, interdisciplinary course about virtual reality with the famed Randy Pausch. Pausch used unconventional pedagogical and curricular methods, however, he prioritized imagination and creative failure that leads to an iterative design process. These values seemed to be at the heart of Scott's technotheological network and desire for a maker kind of education.

5.3 Enrolling Technotheology Values alongside Pedagogy and Curriculum

Another unique enrollment of curriculum and pedagogy can be seen in Charles' technotheological network. Charles adopted UCD for a God-centered design, ensuring the ethics and values of all stakeholders, most importantly, God's ethics and values, form an important part of design. From his specific religious worldview and God-centered design, he wonders how a curriculum can become oriented towards a similar religious design ethic. He asks, "how can I craft a curriculum or an education that will help [others] embody that one principle [of God-centered design]" in designing technotheologies. In his rumination we can see Charles unknowingly drawing on a tradition of understanding curriculum as technotheological text. Whitehead famously said that the very essence of education is "to be religious" (Whitehead, 1927, p. 23). Phenix claims that such education with concerns for ultimate meanings of life is religious education (Phenix, 1966, p. 26). Charles mobilized religious rituals, small business

sensibilities, and technological practices. Achterhuis, adopting Latour's analysis of technologies as bearers of morality, proposed a "moralization of technology" (Verbeek, 2006b, p. 124). This notion of the morality of technology allows Charles and other makers and hackers to explicitly embed spiritual value systems within the process of designing. The bible as a technotheological artifact has a value system that was impressed upon Charles through his God-centered design. Additionally, Acterhuis suggests that moralizing technologies would continue a process of reflection as designers discern the values and ethics they build or omit into the technology they are designing. As an app developer, Charles is keen to suggest that budding designers and technologists should "produce something and take it to market." For Charles, producing something and getting it to market form and train designers "beyond education and beyond [the] academic" to "apply it to any sphere of life."

Related to Charles' technotheological network is Scott's explication of spirituality as it relates to technology and curriculum. He values education, and clearly affords spirituality and religion a primary role in his life. Yet, he believes that spirituality should have a wider conceptualization in order to be valued within educational discourse. "I can't recall in my 22 years of being educated," Scott says,

> what kind of teacher would explicitly talk about these [spiritual] virtues or values in learning. It's mostly just the textbooks you have to read and take these exams and do these projects and I'll give you a grade. Education isn't about forming you as a person, life long virtues you can keep and keep learning. I think that is how technology, education and so-called spirituality can all tie together in these unseen things.

These unseen things that Scott speaks of, are the values and virtues mobilized in his technotheological network, which he wishes would be enrolled alongside curriculum and

pedagogy. Scott is explicitly using a VSD analysis of education, particularly espousing values that he believes are inherently spiritual or 'unseen.' In this way, all of the participants' technotheological networks offer case studies of how to negotiate values within education.

5.4 Designing Technotheology Curricular Practices

As a teacher, Allison is particularly critical of allocating every single minute to some kind of planned activity. Additionally, she notes that this need to fill up our time is constantly reinforced by our digital technologies such as the constant desire to check our smartphones looking at email, messages, Facebook updates, snapchats, and tweets. Allison "would love to see spaces set up in schools where kids have the sort of freedom that I was lucky enough to have as a child. Where you have uninterrupted larger chunks of time, not just 20 minutes or 40 minutes, but you have a whole afternoon. Its something more fluid and you have a bit more time to develop." Jeremy is also critical about the lack of contemplation time or what he calls "daydreaming" in how children are educated and raised. He observes that digital technologies have led to information overload, even in the school systems. "I've been working with kids, using Lego and things," Jeremy reflects," and "they rush to gather information, and then they start to make a plan. The plan doesn't work and then the eyes go vacant, the computer is processing, and the brain is off in its own world. Because this happens, the school [says] stop daydreaming, but really I think daydreaming is a critical part of solving a problem."

As maker parents, both Allison and Jeremy believe that maker education frees up time for contemplation, daydreaming, or just getting frustrated and being able to work through it. Together as a maker family, they wanted to "learn together — as designers and inventors — through the use of computational tools" (Roque, 2016, p. 48). The parents are learning partners

in the development of technological skills (Barron, Martin, Takeuchi, & Fithian, 2009), and designing their makerspace becomes a goal for family learning (Brahms & Werner, 2013). Making, at least for Allison and Jeremy, entails an educative element that necessitates designing curriculum in ways that encourage a prioritization of thoughtful understanding of temporality (Lee, 2016). "I think there are opportunities for kids to be given big chunks of time to generate something," Allison asserts. "It has to be something indigenous and authentic because being told what to generate is never as satisfying as when it's self generated." Allison points to the inherent messiness that is necessary for a maker kind of education. Interestingly, Allison sees a way forward, particularly mobilizing technology in a direction to help the students encounter their subjective wellbeing. Allison acknowledges: "It's not an easy task, I like the fact there is a making and creative design in the new curriculum in BC. I like the fact that some teachers are doing things like genius hour where it's totally kid directed and I think we need more of that." She continues,

> I also do like that reporting has less letter grades because that helps people keep their fears at bay and so I think it's a nice counter to all the technology and flood of information of people's ideas. The maker movement, and the 3D printing and fabrication… I don't want to get rid of the technology. I think it's fabulous to have instant access and the various tools, but we have to have a counter way because if you get have all this information coming from the outside, it could drown you. You won't have a sense of yourself and you would be missing all the chances to rejuvenate and get excited about life again.

Allison believes maker ideals and tools help re-discover unique modes of renewal, rejuvenation, and excitement through making and creating things. Her family's technotheological network,

then, demonstrates care and concern for contemplative and creative values.

5.5 Summary of the Research

This study of makers and hackers and their technotheological networks, is a study of DIY learning, plugged-in pedagogy, and hybridity of humans, technologies, and theologies (Williamson, 2013, p. 110). For instance, Tim and Luke, the boys in the maker family, joyfully extol the virtues of learning through YouTube and other online channels. They ostensibly can customize their own learning to suit their skill development and creativity. Tim specifically wants to see costume clubs in schools. For him, he easily ties in designing costume props with his 3D printer to the necessity in learning math. Luke, more generally, desires a hands-on type of curriculum whereupon "you are learning how to use skills and also you are learning how to work with the materials, and if you are in a group you are learning how to work with other people to build stuff." Daniel, the vision app developer does not dismiss "formal learning," but believes that "education can leverage technology [because] it's just very inefficient." He offers a solution that he's heard among other software developers, using intelligent software to create an algorithm to rank people. The ranking would then result in a range of challenging questions in a curriculum tailor made for the individual. These examples demonstrate that technology is, at times, treated as the "killer app" for education: By discovering the right tools, or creating the appropriate personalized learning software, education can be redeemed from its current predicament. There may be a renewal of convivial tools that lead to unpredictable, creative, and lively possibilities in designing technologies (Illich, 1973, p. 75). In Petrina's (2002, 2004) case studies, these senses of the 'education of tomorrow' and 'individualization' are part and parcel of the history of education.

Maker and hacker can be considered the newest iteration of the optimism. The prioritization of creating and making emphasized by President Obama's Nation of Makers initiative, launched in June 2014, resulted in the White House hosting a Maker Faire, and the declaration of June 17-23, 2016 as *The National Week of Making*. Maker Education emphasizes a multidisciplinary model and is often associated with STEM or STEAM. Additionally, the rhetoric and reasoning for such an emphasis on maker or hacker education is often pragmatic, emphasizing it as the gateway to new economies filled with new jobs (Anderson, 2012). Yet, there is some disparity in framing education under the making or hacking moniker. For instance Blikstein (2013) investigates one case of making in schools and found children are reduced to just manufacturers of keychains. In another case, students are unable to "hack" their individualized learning projects (Blikstein & Worsley, 2016, p. 71).

In Nathan's case, there is also a priority of resourcing one's curriculum. Nathan explains that "when it comes to thinking about where you should look to learn about what to create and make things, I can give a whole list like Google, Khan academy, Wikipedia… I think the most important thing is to look inside yourself." "Once you have Google and yourself," says Nathan, "almost everything is possible, right? His educational ideals centre on curiosity, an inward exploration. Many Christian retreat centers offer opportunities for such exploration and a spiritual director or guide is provided to help the individual during this time of solitude. A genuine community, having communion with one another, necessitates moments of solitude. In that respect, a theological practice deriving from spiritual exercises seems very similar to the technological processes of many makers and hackers. They retreat to their basements, workshops, and computers to enter a sacred time of designing technologies. This is not a retreat from the world, but an engagement with themselves in the capacity for creativity and possibility.

Much like the time spent in solitude at spiritual retreat centers, these sacred times of designing serve as a pause in life. These times are filled with the ordinary routines of writing code, soldering metal wires, and assembling Lego. Yet we observe that these technological acts can be spiritual or theological acts, which in turn are curricular. Here, as Crawford (2006/2009) points out, maker or hacker craft is soulcraft.

Among our participant makers and hackers, prayer, contemplation, and meditative practices were the most common rituals. Leah has a morning ritual of quiet time, spending time reflecting in silence. This is a peaceful time that is productive that she tries to design the curriculum of her Lego camps. Nathan spends his nights in a meditative state, cultivating the capacity to focus through journaling. Both Jeremy and Allison identity contemplation as a crucial pedagogical practice necessary for fostering creativity in their whole family. Their design practices emerge out of their contemplation, resulting in a different design ethic that leads to the joy of creativity. For Charles, his work on *Intercession* includes a whole design philosophy based on his understanding of prayer. He wrote a white paper, titled 'tl;dr' to outline the design philosophy of his prayer app. Typically, 'tl;dr' is a shorthand notation, literally "too long; didn't read." This has since been used as internet slang to suggest the text being used is too long to warrant the time needed to read or as signifier for an edited summarized version. In the case of Charles, he cheekily used this moniker to write out a philosophy of design consisting of five tenets: God is the ultimate customer, intimate friendship with God and others, convenience in praying, people-orientedness in prayer, and God as source of the user's delight (Appendix E).

5.6 Conclusions: Technotheologies as Matters of Care and Concern

Borgmann (1984, 2002, 2003) suggests that a focal concern for things and practices can

be part of the good life. Focal practices and concerns "gather our world and radiate significance in ways that contrast with the diversion and distraction afforded by commodities" (p. 22). They help us uphold the promise of enacting the good life (Borgmann, 2011, p. 16). Latour calls us to move from matters of fact toward matters of concern (Latour, 2004; 2008). For Latour, the enlightenment was centered around matters of fact, which excelled at debunking various myths, beliefs, and powers. Yet this development, brought to its logical conclusion, resulted in matters of fact being critiqued by its own critical methods. Latour asks whether we can now move towards matters of concern. Matters of concern serve as a better descriptive tool "whose import then will no longer be to debunk but to protect and to care." In part, this is because concerns "transform the critical urge in the ethos of someone who adds reality to matters of fact and not subtract reality" (Latour, 2004, p. 232).

Technotheological networks demonstrate that technological *things* are matters of concern. For the politics of things, a *dingpolitik*, there are politics concerning ways of knowing and representing things that have disclosive and world-making effects (Latour, 2005a). For instance, technological objects are compared to Heidegger's jug, a celebrated thing (Heidegger, 1971/2001). Compared to the jug, other containers, say pop cans, are portrayed as objects designed as meaningless parts of the machinery of commodified and consumer society. Heidegger's jug, then, is often celebrated as a thing of art and craft, and filled with rich connections. Yet, Latour questions the mistreatment of objects as he asks: "What would happen, I wonder, if we tried to talk about the object of science and technology, the Gegenstand, as if it had the rich and complicated qualities of the celebrated Thing" (Latour, 2004, p. 233)? Latour believes the dichotomy between complex objects and simple things is a result of the bifurcation of nature, which he drew from Whitehead (Latour, 2008; Whitehead, 1920). The result has been

the perpetuation of critical discourse with nary an agreement on issues ranging from science and concerns to a common world. This form of critique bends and twists our matters of fact, and construe them into disbelief, for instance, in global warming (Latour, 2004). Thus, Latour calls for a move towards matters of concern, which is "what happens to a matter of fact when you add to it its whole scenography" (Latour, 2008, p. 39). Matters of concern command respect for one another and our respective issues.

Bellacasa (2011) draws on feminist knowledge politics to propose "matters of care" to go alongside Latour's matters of concern. For Bellacasa, we care for our things and technologies "as an everyday labour of maintenance that is also an ethical obligation: we must take care of things in order to remain responsible for their becomings" (p. 90). Care is related to concerns, but "with stronger affective and ethical connotations" (p. 89). For example, to say 'I am concerned,' may bring about a kind of thoughtfulness or worry about a particular issue. However, to say 'I care,' is to denote a sense of strong affection and commitment. Suchman (2007) locates issues of care and concern within the technological world of software algorithms and wireless devices. In her study of software agents and "smart" devices, she depicts a type of interface design in which these technologies are domesticated, becoming a kind of service economy. In this way, Suchman is interested in how these human-machine associations train the users to dismiss issues of care. The challenge of these human-machine relationships is that it represents technological information in a way that creates a glamorous fog of representing reality (Borgmann, 2013, p. 18). This fogginess is the lure of commodification in which our makers and hackers can easily just go about designing technologies and become disengaged as a way of life (Borgmann, 2011; 2013). An example of care as materialized morality in my research is the case of Leah and the Lego camps. The Lego bricks were designed around the notion that everything connects to

everything else. What begins as a design for a plastic brick with studs and tubes can extend to an entire Lego system, an ethic of all things fitting together through an embodied way of serious play. Lego has a devout following whereupon its users associate "an ethic of thoughtfulness, caring, and playing together" (Gauntlett, 2014, p. 191; c.f. Baichtal & Meno, 2011).

The tracing of technotheological networks responds to a world exemplified by makers and hackers who demonstrate virtuous design sensibilities that appropriate technologies in service of focal concern and care. It is their practices of engagement with their values and the good life that ultimately leads to how they innovate. The good life, set within a way of sacred design gives care for matters of concern. In this sanctified space, these makers and hackers innovate new forms of engagement through focal things and practices in the lived reality of their spirituality. They are technotheological designers who demonstrate care and concern for their spiritual, material, and relational being in the world. Caring, then, seems to be a designerly way of living the good life.

To finalize the tracing of technotheological networks, let us follow Aoki (1987/2005; cf. Lee, 2017), who recalls that one of his doctoral students, Carol, was in the hospital receiving care via regular dialysis treatment using hemodialysis technology. Aoki describes Carol as a child of technology, "the first to see beyond technology for they know technology with their lifeblood" (p. 157). In the case of Carol, we understand this metaphorically and literally as she is authentically able to say "we acknowledge our indebtness to technology; we refuse to be enslaved by technology" (Aoki, 1987/2005, p. 157). As Carol experiences the technological life-saving treatments at the hospital, she reflects on the hemodialysis system on which she has become dependent and indebted. Even as she is being given life by technology, she realizes this is a way of blocking out "spiritual pain." In this way, Carol teaches us "the significance of that

which is beyond the technological in the technological" (Aoki, 1987/2005, pp. 157-158).

5.7 Recommendations for Further Research: Technotheological Networks

My dissertation has laid out an agenda to investigate, articulate, and conceptualize how makers and hackers assemble into technotheological networks. In so doing, I traced the contours of technotheological networks through ANT, VSD, and case study, progressing through technology, values, ethics, design, and education. My role was in relation with the makers, hackers, and other non-human actants that imprint values and meanings. Due to the particularity of my dissertation, further investigations are warranted.

First, more research into maker and hacker education is necessary. Current research can be classified into three categories: understanding creating and making as designed learning activities, studying hackerspaces and makerspaces as communities of practice, and exploring maker identities (Halverson & Sheridan, 2014; Peppler & Bender, 2013). My use of ANT and VSD suggests that other empirical research is necessary for a more comprehensive understanding of how hackers and makers translate matters of fact into matters of concern and care.

Second, Caputo (2001) believes that our innovative technologies have opened space for "a new religious imagination… [in which] the secular world became post-secular" (p. 78). This religious imagination does not denote a "return of religion," or at least as traditional religion as found in religious institutions. Rather, it is a religious transcendence that evolved to other forms that "reproduce the structure of religion outside the traditional faiths and outside the classic oppositions of religion and science, body and soul, this world and the next" (Caputo, 2001, p. 89). His observation, in many ways, describes technotheological networks, an "amazing symbiosis of religion and technoscience in the post-secular world" (Caputo, 2001, p. 71).

Are technological artifacts in the classroom "objects to think with" (Papert, 1980) and to be encountered as objects with agency, or perhaps, as subjects within an I-Thou dialogical encounter (Buber, 2004)? Studying curriculum as technotheology, in this way, might help us reconsider our relationship to what we consider ultimate, good, or godly.

My dissertation was, in part, a test of various ideas and materialities of technotheology. My use of ANT, then, identified human and non-human actors in order "to intervene and experiment rather than to abstract and present" (Fenwick & Edwards, 2012, p. xviii). Similarly, VSD facilitates analysis for discerning beliefs and values. In these cases, the technotheological networks prioritize ethics, values, theologies, and technologies in interaction. Additionally, these technotheological networks help us reconsider how curriculum history has been presented, *re*-presented, and mis-represented (Lee & Petrina, in press; Petrina, Lee, & Feng, 2016). A recommendation for historical research includes disrupting common historical conceptualizations and representations of curriculum as technological *versus* theological text (Eisner & Vallance, 1974, pp. 7-9). Hence, further historical research, attuned to old and new conceptions of education, technology, and theology is needed.

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Appendix A: Visual analysis consent form

THE UNIVERSITY OF BRITISH COLUMBIA | VANCOUVER

Department of Curriculum and Pedagogy

Visual Analysis Consent Form
How We Learn (Media & Technology Across the Lifespan)

Investigators
The principal investigators for this study are Drs. Stephen Petrina and Franc Feng, members of the Faculty of Education and who may be reached at (604) 822-5325. This research will be used for the PhD dissertation of Yu-Ling Lee, a graduate student in the Faculty of Education, who may be reached at UBC (604) 822-5477.

Study Purpose and Procedures
Building on research literature of exploring maker and hacking communities for technotheo education, the researcher draws upon video design based research (VDBR) to explore how religion or spirituality matter in the consumer use, design and engineering of media and technology. In particularly, VDBR is used to discern values and ethics throughout the design process. This study is therefore situated in maker and hacker designs for pedagogical and curricular purposes and consists of several video interviews with the possibility of follow-up interviews.

Confidentiality
Your identity will be kept strictly confidential. All documents will be identified only by code. Physical hard copies will be kept in a locked filing cabinet. Electronic copies will be encrypted and protected by password. This data will be kept in the research office in the Neville-Scarfe building on the UBC campus and will be accessed only by research team members.

Contact Information
If you have any questions or desire further information with respect to this study, you may contact Dr. Stephen Petrina at (604) 822-5325 or Yu-Ling Lee at (604) 368-8079. If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the UBC Office of Research Ethics at 604-822-8598 or if long distance e-mail RSIL@ors.ubc.ca or call toll free 1-877-822-8598.

Consent
Your participation in this study is entirely voluntary and you may refuse to participate or withdraw from the study at any time. Visual data analysis will be conducted only with your assent or consent of the use of photos and video clips. Please use the attached form for providing assent or consent for the use of images or visual data.

_____ _____
Participant Signature Date

_____
Printed Name of the Participant

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Visual Analysis Consent Form
How We Learn (Media & Technology Across the Lifespan)

Please check the box indicating your decision

I have reviewed the photographs or videotape segments that are being used in the research report and communications about this project and

☐ I CONSENT to the use of these photographs or videotape segments in this way.

☐ I DO NOT CONSENT to the use of these photographs or videotape segments in this way.

Participant's Name (please print)_____

_____ _____

Signature Date

Appendix B: Parent/Guardian release form

THE UNIVERSITY OF BRITISH COLUMBIA | VANCOUVER

Department of Curriculum and Pedagogy

Parent/Guardian Release Form
How We Learn (Media & Technology Across the Lifespan)

Parent/Guardian Release
I hereby authorize my child's participation in this UBC technotheology research study. I know of no physical or mental problems that may affect my child's ability to safely participate in this research study. By signing this document, it is my intention to exempt and relieve UBC, its instructors and employees, agents and servants from any and all liability of personal injury. I am aware that UBC does not provide medical/accident insurance for the enrolled participant and I understand that the responsibility to arrange such insurance, or to otherwise cover any medical costs, is mine.

I hereby authorize the staff of the UBC technotheology research study to act on my behalf in the case of illness or injury involving my child. I agree that UBC and/or its instructor(s), agents, employees, servants or any of them, shall not be held liable for any injuries or damages which may rise out of the research study's activities, regardless of cause, unless such injuries or damages result expressly from the sole negligence of UBC and/or its instructor(s), agents, employees and servants while acting within the scope of their duties.

Student's Name (please print) _____

Age _____

Parent or Guardian's Name (please print) _____

Phone Number _____ Email Address_____

Emergency Contact _____

_____ _____
Parent/Guardian Signature Date

Appendix C: Interview questions

THE UNIVERSITY OF BRITISH COLUMBIA | VANCOUVER

Department of Curriculum and Pedagogy

Interview Questions
How We Learn (Media & Technology Across the Lifespan)

1. Why do you create, make, or design?
2. What projects have you created or designed that you found meaningful? Why?
3. How would you describe your design process?
4. What are the daily routines (dreaming, meditation, journaling, sketching, etc.) in your design process?
5. How does your subjective well-being (physical, emotional, spiritual, relational, etc.) impact your design process?
6. What do you find meaningful in the design process? What values do you prioritize in the design process and with the ultimate outcome?
7. How do you integrate your values, ethics, or what you find meaningful throughout the design process?
8. Who or what have influenced your design decisions and processes?
9. What resources or people would you recommend to others who wish to create, make, or design?
10. How do you think designing should relate to education?

Appendix D: Video and audio equipment used for data collection

Equipment listed from top left:

Nikon D7000 camera with 50mm 1.8 lens, 18-105mm lens, Sennheiser G3 wireless microphone, Zoom H4N recorder, Rode Videomic pro, Audio Technica lav microphones, GoPro hero 3+ black, Xiaomi Yi action camera, selfie stick, Kamerar Viewfinder QV-1, TASCAM headphones, Sescom DSLR splitter cable, various camera mounts, MacBook pro, external hard drive, various GoPro accessories, light reflector, tripod, various tapes, power cable/bar, lighting kit, batteries, memory cards.

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Appendix E: Charles' philosophy of design

Tenet 1: God is the ultimate customer. We want to help people do God's will, enjoy his presence and pray as he would have them pray. Our user experiences prioritize his desires and values above all else. When users prefer things that may not help them do more of what God values, we bias towards furthering God's ends over user preference.

Tenet 2: Intimacy. Prayer shouldn't feel like a To Do list. We are always inviting people into deeper intimacy with God and others by designing experiences that slow them down and help them experience prayer deeply. Opening Ceaseless should feel partly like opening a good book, settling down and anticipating joyful surprises, insight and intimate friendship with God.

Tenet 3: Convenience. We want to make it convenient for people to know who to pray for and invite people in their daily lives to pray for others. We do this by integrating with the things they are already doing and making it easy to know who to pray for.

Tenet 4: People--oriented. We want to encourage people to pray for others, connect with others, reach out to and serve others. Our designs help people not so much by solving their "prayer problems", but by empowering and encouraging them to empathize with and pray for the needs of others. We prioritize people over projects, requests and institutions. When we show institutions/projects/causes we always try to include faces, names and stories to uphold the people-orientedness of prayer. Prayer requests are transient, but people are forever, therefore we emphasize the personal side of the prayer experience.

Tenet 5: God is the source of delight. The aha moment must come from him and the pleasure of using the app comes from the serendipity of who the Spirit chooses to show, the answers to prayer God is giving and the joy of obeying, remembering, thanking and praising Him. We believe God really hears prayer and responds according to His will and that the true joy of prayer comes not from merely knowing someone prayed for you, but that God answered. The app's mechanisms make space for God to be the source of user delight rather than relying merely on human means.