A. Foundations

The first chapter of this thesis is subdivided into three distinct sections. In the first section (A.I), the motivation for investigating the emerging phenomenon of digital transformation of business is introduced and the general outline of this thesis is presented. The second section (A.II) illustrates the context in which this thesis is set, i.e., in the automotive industry with a particular focus on incumbent automotive organizations, also providing the relevant theoretical foundations for understanding the phenomenon of digital transformation of business. The third section (A.III) introduces the configurational perspective used for addressing the research problem as well as the research questions of this cumulative thesis.

I. Introduction

This first section introduces in its motivation the relevance of the examined research topic, followed by the presentation and description of its research questions including an outlined structure of this cumulative thesis. Afterwards, the chosen research design is explained, including the positioning of this thesis within the philosophy of science. Lastly, this section is concluded with an illustration of the anticipated contributions of this cumulative thesis for research and practice.

I.1 Motivation

In his visionary article twenty-five years ago, Weiser (1991) initiated a discussion about a phenomenon that has become increasingly prevalent in today's society, stating, "The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it" (p. 78). The phenomenon of digital transformation is broadly understood as the significant changes digital technology has engendered throughout human life, slowly blending reality with technology (Stolterman and Fors, 2014). Digital technologies have become immersed in people's routines through everyday artifacts, changing the way people communicate, work, and engage in their daily activities (Aral et al., 2013; McDonald and Rusell-Jones, 2012). They enable people to access, store, and mobilize a variety of information that was previously not readily available, paving the way for a vast new array of opportunities (Tilson et al., 2010; Yoo, 2010).

In a digitally intensive world, firms are taking advantage of the decreasing costs of computing and global connectivity to fundamentally transform or adapt their businesses to the new digital era (Bharadwaj et al., 2013). Notable examples include Apple's iPod causing a radical reshuffle in the music recording industry and Amazon's Kindle redefining the book-selling ecosystem (Westerman et al., 2014; Yoo, 2010; Yoo et al., 2010). In this context, digital technologies enable a more rapid pace of innovation, shorter product lifecycles, and cross-industry disruptions that result in a major shift in established business structures and competitive landscapes (Setia et al., 2013; Yoo et al., 2012).

Thus far, research on the impact of digital technologies in businesses has primarily focused either on industries whose core products could be fully digitized (such as the printing, entertainment, and photography industries) (e.g., Barret et al., 2012; Huang, 2005; Jiang and Katsamakas, 2010; Lucas and Goh, 2009; Utesheva et al., 2012) or on managerial issues, such as the elaboration of new strategic views for creating differential business value in the digital landscape, without a specific industry focus (e.g., Granados and Gupta, 2013; Lucas et al., 2013; Mithas et al., 2013; Setial et al., 2013). However, the transformative impact of digital technologies on industrial-age manufacturing industries, whose core product cannot be fully digitized, has remained under researched (Yoo et al., 2010).

The automotive industry is such an industrial-age manufacturing industry that is clearly undergoing a digital transformation (Hildebrandt et al., 2015). Digital technology

advancements, such as interactive safety systems, vehicle connectivity, and ultimately, self-driving vehicles, have been transforming the physical, core product of this industry into a smart device, which has been newly referred to by many industry specialists as a “smartphone on wheels” (Gao et al., 2014; Henfridsson and Lindgren, 2005; Yoo, 2010). As a result, incumbent automotive manufacturing organizations have been challenged to compete in a digital world, demanding new expertise and organizational capabilities to keep pace with a different kind of competitor from outside their industry (e.g., Google, Apple) – one that is attracted to and already involved in the new technological possibilities emerging in this market (Gao et al., 2014). The tensions that arise are mainly related to the ability of an incumbent automotive manufacturing organization to achieve “a fine balance between its traditional product- and technology-driven past and its potentially ubiquitously connected consumer lifecycle-centric and service-driven future” (KPMG, 2015, p. 2).

Prior information systems (IS) and organization science research has already begun to shed light on the foundations necessary for automotive manufacturing organizations to embark on a digital transformation. For example, previous work has extended the body of knowledge on digital innovation in this industry context (e.g., Andreasson et al., 2010; Henfridsson et al., 2009; Hildebrandt et al., 2015; Hylving and Schultze, 2013; Hylving and Selander, 2012; Svahn et al., 2009) and on new practices of product development (Henfridsson et al., 2014; Hylving and Selander, 2012), including institutional entrepreneurship (Henfridsson and Yoo, 2014). These studies attest to the occurrence of a digital transformation of business in automotive manufacturing organizations, affecting their business core while requiring rapid organizational responses to survive unprecedented threats and embrace new business opportunities (Kane et al., 2015). However, we still lack a holistic and deep understanding of how the phenomenon of digital transformation of business manifests itself in automotive manufacturing organizations as well as which organizational capabilities are necessary for such organizations to survive and thrive when facing such a transformation (Hildebrandt et al., 2015a).

To address these research gaps, this cumulative thesis explores the phenomenon of digital transformation of business, focusing on three main objectives: (1) identifying the main contextual conditions that drive automotive manufacturing organizations to digital transformation of their businesses, (2) examining the underlying mechanisms (such as organizational responses to the phenomenon) that must be considered to understand how digital transformation of business occurs, and (3) investigating the intermediate and long-term outcomes of digital transformation in automotive manufacturing organizations that are being rebuilt for the digital age.

By applying such a configurational perspective, this thesis aims to explain how a combination of certain mechanisms, in given contextual conditions, may lead automotive manufacturing organizations to embark on sustainable digital transformation of their businesses. Understanding these issues through a configurational perspective is important because greater knowledge about the drivers of this phenomenon would be highly valuable for researchers and practitioners confronted by the complexity of managing such transformations (Henfridsson and Bygstad, 2013).

Moreover, this thesis aims to contribute to research in the fields of IS and organization science. Concerning the IS community, this thesis provides new insights for research in three intertwined areas: IT-enabled business transformation (e.g., by shedding light on the role of digital technologies and IT as a trigger for new dynamic cycles of value creation and capture), digital innovation (e.g., by illustrating new challenges concerned with disruptive changes that involve the established ecosystem and business model of incumbent players), and the emerging field of digital transformation (e.g., by providing a holistic configurational view on the phenomenon examined in an under researched context).

In terms of organization science, this thesis considers organizational capabilities rooted in the established theories of organization adaptation that are associated with digitally related transformative change. It also proposes new insights on how they can be configured in order to enable a sustainable digital transformation of business in automotive manufacturing organizations. By embracing and extending IS and organization science literature, this cumulative thesis engages in an interdisciplinary, scholarly conversation that should also cater to practitioners' needs for a better understanding of and response to the digital transformation of their businesses.

I.2 Research Questions

To comprehensively explain the phenomenon of digital transformation of business in the context of the automotive industry, this thesis follows a configurational perspective based on the explanatory scheme of context-mechanism-outcome (CMO) from Pawson and Tilley (1997) (see Section A.III). Therefore, the research objectives outlined above are divided into three parts, each representing a particular research question.

In the first part, this research focuses on identifying the major contextual conditions that enable incumbent automotive manufacturing organizations to digitally transform their businesses (a detailed explanation for the concept of contextual conditions is given in Subsection A.III.1). Recent studies have proposed a number of current events that have been triggering industries to rethink their businesses for the digital age. For example, the emergence of fast-paced digital technologies, such as cloud computing and mobile technologies, has been seen as helping to create more turbulent environments that are fundamentally altering business dynamics, ecosystems, and the rules of competition (Bharadwaj et al., 2013; El Sawy et al., 2010; El Sawy and Pereira, 2013; Lucas and Goh, 2009; Nambissan, 2013; Yoo, 2013). Another example can be related to the development of computing in everyday life. As daily activities are merged with digital technologies, consumers are increasingly influenced by their experiences with easily accessible and relatively cheap digital technologies. This results in greater expectations for products and services, thus pressuring organizations to constantly adapt their offerings to meet the rapidly changing digital lifestyles of the consumers (Gregory et al., 2014; Lucas et al., 2013; Setia et al., 2013; Yoo, 2010; Yoo et al., 2012).

In prior studies concerning the automotive industry, these events were also observed as triggers for digital innovations that require incumbent organizations to rethink their core competences, the logics of their physical product architectures to allow for digital integration,

as well as the established structures of their still-functioning business models (Henfridsson and Lindgren, 2005; Hildebrandt et. al, 2015; Hylving and Schultze, 2013; Hylving and Selander, 2012; Svahn et al., 2009). Although previous research related to the phenomenon of digital transformation has proposed a number of events to be triggers of this overarching phenomenon, no empirical study has focused extensively on examining the contextual conditions that cause this phenomenon. This leads to the first research question:

RQ1) What are the main contextual conditions that lead automotive manufacturing organizations to digital transformation of their businesses?

In the second part, this research seeks to examine the underlying mechanisms that must be considered to understand how digital transformation of business in automotive manufacturing organizations occurs. In short, mechanisms can be used to explain the success or failure of an observed phenomenon, such as activities or any step that brings about change (Pawson and Tilley, 1997) (a more detailed explanation on mechanisms is given in Subsection A.III.2). Thus, the way organizations react to digitally related transformative changes in their businesses can be understood as the underlying mechanisms they apply to cope with this phenomenon.

From previous studies associated with digital transformation of business (such as IT-enabled business transformation and digital innovation), we have learned that different sets of organizational capabilities have been implemented by organizations as a response to digitally related transformative changes in their environments (e.g., Gregory et al., 2015; Lucas et al., 2013; Pavlou and El Sawy, 2010). For instance, the organizational capability of ambidexterity (e.g., Gregory et al., 2015) was investigated in various contexts and separately acknowledged as relevant in evolutionary, intraorganizational levels of transformation (Venkatraman, 1994). Therefore, this thesis argues that previously identified capabilities must be reviewed or even extended for the context of revolutionary, interorganizational levels of transformation (i.e., concerning changes related to the redefinition of business network and scope) that are more related to the phenomenon of digital transformation of business. Due to the lack of empirical studies in this context, specifically within industrial-age manufacturing organizations, more guidance for a better understanding of organizational responses and capabilities – i.e., the underlying mechanisms – used for coping with the digital transformation of business is particularly necessary. Accordingly, the second research question is derived as follows:

RQ2) Which mechanisms must be considered to understand how the digital transformation of business in automotive manufacturing organizations occurs?

Finally, the third part this research concentrates on the investigation of the main intermediate and long-term outcomes of digital transformation of business in automotive manufacturing organizations, i.e., the intended and unintended consequences of a particular phenomenon (Pawson and Tilley, 1997) (a more detailed explanation on outcomes is given in Subsection A.III.3). Literature related to digital transformation that applies the same configurational perspective as proposed in this thesis provides characteristics that help define successful outcomes.

For example, in their study concerning digital infrastructure evolution, Henfridsson and Bygstad (2013) consider outcomes to be successful when they could survive in a turbulent digital environment by filling a relevant role over time. Moreover, while analyzing innovation trajectories in institutional entrepreneurship, Henfridsson and Yoo (2014) define a successful outcome as a new innovation trajectory, i.e., a new direction of activities intended to develop new products and services that are embedded into existing institutional practices. These examples of successful outcomes have been described by prior studies based on the interactions between their contextual conditions and mechanisms employed. Outcomes can be observed by examining the micro-level dynamics of a phenomenon in action (Henfridsson and Yoo, 2014); thus far, however, little is known about the possible successful outcomes of digital transformation of business in automotive manufacturing organizations. Therefore, this thesis addresses the following research question:

> *RQ3) What are the main intermediate and long-term outcomes of digital transformation of business in automotive manufacturing organizations as they are rebuilt for the digital age?*

It is important to note that only by combining the three research questions presented above can this cumulative thesis provide compelling results on the phenomenon of digital transformation of business within the lens of a configurational perspective.

I.3 Structure of the Thesis

This thesis is cumulative in nature and consists of three chapters – Chapter A, Chapter B, and Chapter C – as illustrated in Figure A.1. Chapter A presents the foundations of this thesis. It begins with the motivation for this research work (A.I.1), followed by an introduction of the research gaps and the resulting core research questions of this thesis (A.I.2). Subsequently, the structure of this work (A.I.3) as well as the research design containing the epistemological positioning of its research studies are described (A.I.4). Section A.I closes by suggesting the anticipated contributions of this thesis (A.I.5).

The next section (A.II) sets this thesis in the application context of the automotive industry, providing an overview of this industry (A.II.1), including its structure, key stakeholders, and the emerging forces in automotive manufacturing organizations that are leading them to digital transformation. In addition, this section provides a theoretical foundation for a comprehensive understanding of the phenomenon of digital transformation of business (A.II.2). Section A.II ends with an overview of the current understanding of digital transformation of business in automotive manufacturing organizations (A.II.3).

Section A.III introduces the foundations used for addressing the research problem as well as the research questions of this cumulative thesis. This thesis follows a configurational perspective and uses the explanatory scheme of context-mechanism-outcome from Pawson and Tilley (1997) as a basis for advancing knowledge to understand how digital transformation of business in automotive manufacturing organizations occurs. Each of this scheme's components (i.e., contextual conditions, mechanisms, and outcomes) is explained in greater detail in Subsections A.III.1, A.III.2, and A.III.3, respectively.

Chapter B corresponds to the main body of this cumulative thesis, comprising five scientific studies that address the phenomenon of digital transformation of business in general. Table A.1 provides an overview of these studies, including their outlets and corresponding ranking, the current publication status, as well as a summary of their main contribution to this thesis. This chapter is subdivided into three sections. Section B.I is related to Research Question 1, which concerns the identification of contextual conditions that lead automotive manufacturing organizations to digital transformation. Here, three studies were conducted in a multi-level perspective (Geels, 2002) to provide answers to this research question. The first study (1) elaborates on the initial contextual conditions of digital transformation of business by taking a macro-level perspective that does not limit its findings to a specific kind of industry. The second study (2) sheds more light on the contextual conditions of the phenomenon examined through a meso-level (sector-specific) perspective, concentrating on changes in personal urban mobility resulting from digitalization. Lastly, the third study (3) elaborates on further contextual conditions and specific challenges of digital transformation of business within a micro-level perspective, i.e., focusing on incumbent automotive organizations.

Section B.II addresses Research Question 2, which refers to the analysis of underlying mechanisms that explain how digital transformation of business in automotive manufacturing organizations occurs. One comprehensive study was conducted to answer this research question. This study (4) builds upon the insights on the contextual conditions and uses specific theoretical lenses to derive an integrative model containing the mechanisms and their relationships that help explain the phenomenon examined in this cumulative thesis.

In Section B.III the final research question of this thesis is approached, which aims to identify the main intermediate and long-term outcomes of digital transformation of business in incumbent automotive manufacturing organizations undergoing reorganization for the digital age. One study (5) was directed to answer Research Question 3, elaborating on suggestions of possible intermediate and long-term outcomes of the phenomenon analyzed by illustrating them through various patterns of business model change.

Table A-1. Overview of studies included in this thesis

No.	Outlet	Ranking	Status	Section	RQ	Main contribution
1	Internationale Tagung Wirtschaftsinformatik 2015	C	Published	B.I	1	Insights into initial contextual conditions of digital transformation of business within a macro-level perspective – not limited to a specific type of industry – focusing particularly on the changes in the producer–consumer relationship.
2	Multikonferenz Wirtschaftsinformatik 2016	D	Published	B.I	1	Insights into contextual conditions of digital transformation of business within a meso-level perspective, concentrating on the changes in personal urban mobility resulting from digitalization.
3	International Conference on Information Systems 2015	A	Published	B.I	1	Insights into contextual conditions and the specific challenges of digital transformation of business within a micro-level perspective, focusing on automotive manufacturing organizations as well as the identification of organizational ambidexterity for coping with the challenges.
4	Information Systems Research	A+	Under Review	B.II	2	Integrative model containing the underlying mechanisms that explain how digital transformation occurs in automotive manufacturing organizations, as well as recommendations for building digital transformation capabilities.
5	Internationale Tagung Wirtschaftsinformatik 2015	C	Published	B.III	3	Suggestions for the main intermediate and long-term outcomes of digital transformation of business in incumbent automotive manufacturing organizations, which are illustrated in business model change patterns.

Note: The ranking is based on the VHB Jourqual 3 ranking (*http://vhbonline.org/service/jourqual/vhb-jourqual-3/*)

Lastly, Chapter C provides a summary and a reflection on the findings of all five scientific studies in the context of digital transformation of business in automotive manufacturing organizations (C.I), then deriving implications of this work for both theory and practice (C.II). This chapter closes with a presentation of concluding remarks, indicating the limitations of this cumulative thesis as well as possible avenues for further research in this area (C.III).

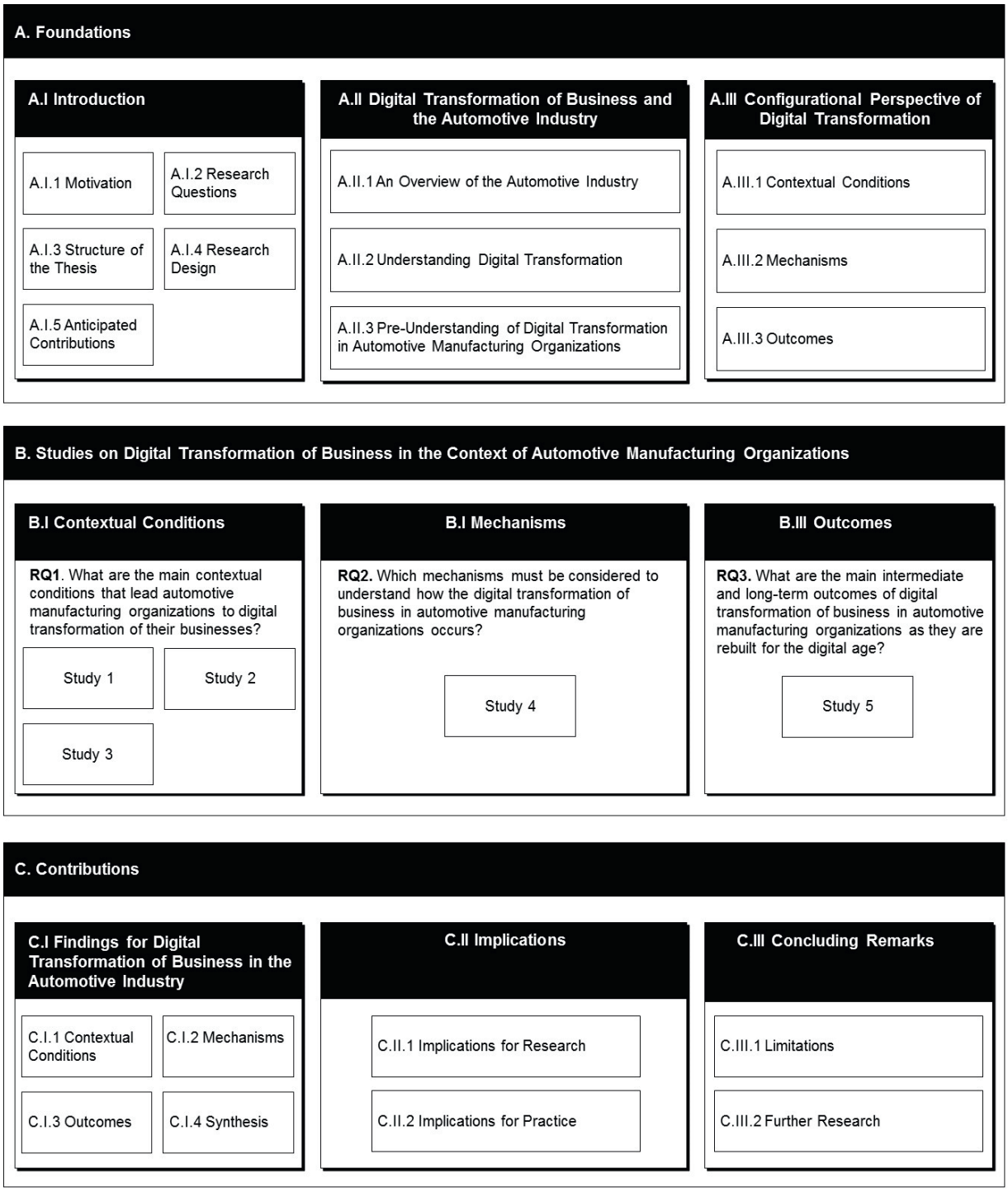

Figure A-1. Structure of the thesis

I.4 Research Design

Information systems research reflects the potential to inform managers and researchers about "how to understand, interpret, adapt to, and effectively manage technologies that have been and currently are in use, as well as emerging technologies whose impacts are just being felt" (Banker and Kauffman, 2004, p. 294). While investigating the evolution of information systems literature, Banker and Kauffman (2004) identified five major streams of IS research drawing on the reach of theoretical perspectives and methodological paradigms used to approach

important managerial issues. These five major streams are: (1) decision support and design science (i.e., studies on the application of computers in decision support and control), (2) value of information (i.e., studies on relationships established based on economic analysis of information as a commodity in the organizational management), (3) human-computer systems design (i.e., studies on the cognitive foundation for effective systems design), (4) IS organization and strategy (i.e., studies on explanatory models of individual, group, and organizational behavior associated with the management of IS), and (5) Economics of IS and IT (i.e., studies that apply theoretical views and methods from analytical and empirical economics to managerial problems involving IS) (Banker and Kauffman, 2004).

This thesis is positioned on the research stream of IS organization and strategy as it focuses on understanding organizational behavior associated with the management of digital technologies and the emerging phenomenon of digital transformation. This research stream is also characterized for spanning different levels of analysis (such as individual, groups, business units, and organizations), for utilizing a blend of qualitative and quantitative methods, and for relating to organizational theories and strategic management (Banker and Kaufmann, 2004).

In terms of the epistemological positioning (i.e., how reality is grasped by the researcher [Trang, 2015]), there are three main classifications in the IS research: (1) positivist, (2) interpretivist, and (3) critical studies (Orlikowski and Baroudi, 1991). Positivist research caters primarily to test theory, attempting to increase the predictive understanding of a phenomenon (Orlikowski and Baroudi, 1991). In this positioning, the research has a neutral and passive role in the investigation, objectively evaluating actions or processes, without expressing their subjective opinion (Orlikowski and Baroudi, 1991). Positivism believes on an ontology that reduces reality to a conjunction of cause and effect, having little regard for mechanisms connecting them (Wynn and Williams, 2012).

Differently, in interpretive research the research has an active role, i.e., subjectivity is important to understand how people construct and reconstruct their reality, and therefore, researchers always intervene to shape their analysis (Orlikowski and Baroudi, 1991). Thus, the reality can only be understood through an investigation of actors' meanings and actions (Wynn and Williams, 2012). Appropriate research methods that produce valid interpretative knowledge are field studies, as they can examine actors within their social setting (Orlikowski and Baroudi, 1991)

Finally, the critical research (also known as critical realism or realism [Maxwell and Mittapalli, 2010]) is positioned as alternative to the previous presented paradigms, leveraging elements of both to offer new approaches for knowledge development (Wynn and Williams, 2012). In particular, critical realism recognizes "the role of subjective knowledge of social actors in a given situation and the existence of independent structures that constrain and enable these actors to pursue certain actions in a particular setting" (Wynn and Williams, 2012, p. 788). Hence, with this positioning researchers can provide more detailed causal explanations of a phenomenon in terms of both the actors' interpretations and the structures and mechanisms that interact to generate the outcomes in question (Wynn and Williams, 2012). Furthermore,