

Structuration bridging diffusion of innovations and gender relations theories: a case of paradigmatic pluralism in IS research

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Abstract. *This paper discusses the adoption of a pluralist theoretical framework – one that is also multiparadigmatic – for conducting and publishing information system (IS) research. The discussion is illustrated by a single case study involving the Australian cotton industry. The theoretical framework is informed by three sociological theories, each with its particular paradigmatic assumptions: structuration theory as a meta-theory, and diffusion of innovations and gender relations as lower-level theories from notionally opposing paradigms. Theoretical pluralism helped to produce rich findings, illuminating both the social nature of women farmers' roles, the materiality of the cotton farming context, the characteristics of the decision support systems in use and the recursive way in which human agency and institutional pressures shape each other. Because users of so-called divergent paradigms often face criticism based on the incommensurability issue, one of the main contributions of this paper is to discuss the value of a pluralist and multiparadigmatic theoretical framework in dealing with complex IS social phenomena.*

Keywords: structuration theory, diffusion of innovations theory, gender relations theory, multiparadigm, pluralism, technology-in-practice

INTRODUCTION

The issue of pluralism in information systems (IS) research has been contentious, with some authors fearing that the discipline may not survive without conformity to consistent research

foundations and others arguing that diversity is a source of strength (Lee, 1991; Benbasat & Weber, 1996; Robey, 1996; Chen & Hirschheim, 2004; Hassan & Will, 2006). Not all pluralist research is multiparadigmatic, as researchers may use a plurality of methods or theories that still fall within the same paradigm. The adoption of more than one method or theory is indeed commonplace, but it might be problematical when underlying philosophical assumptions belong to more than one paradigm. In that case, the issue of incommensurability may be raised to argue that methods or theories associated with different paradigms cannot be used together in a single study in a meaningful and consistent way.

While much IS research has contemplated epistemological and methodological pluralism (Tashakkori & Teddlie, 1998; Niehaves, 2007), this paper reflects on theoretical pluralism and the construction and use of a multiparadigmatic theoretical framework to address a specific research problem in an empirical study. The empirical study explored the extent and effect of women's participation in family farm partnerships and their acquisition of technological skills through the use of an agricultural decision support system (DSS) in the Australian cotton industry.

The researchers initially approached the study from a nominalist perspective, viewing as socially constructed the 'reality' of women's use of farm management software – a DSS – and their roles in cotton farm management, while endeavouring to build knowledge from first-hand perceptions of the actors involved. A structurationist approach to technology – a stream of research derived from structuration theory (ST) that has already established a tradition in the IS field (Jones & Karsten, 2008) – provided the initial guiding framework. Therefore, the *CottonLOGIC* DSS was explored through a structurationist lens, wherein a given technological artefact is seen with its enabling and constraining structural properties, that is to say, constraining in terms of some of its functionalities, and enabling in the way it might enhance decision-making and farm management. As the field work evolved, three reasons motivated the researchers to consider whether more than a single theoretical lens could be helpful for understanding complex research problems. These were (1) the perceptions held by many of the farm women of the DSS as an immutable tool influencing, and even determining, their lives; (2) the imperative for cotton growers to accommodate their practices to the natural and social environment as well as industry targets; and (3) the women farmers' concerns regarding gender matters, i.e. their roles as team members alongside their male farm partners on their family farms. In other words, topics that were not specifically addressed by ST emerged as important, namely, technological determinism and gender relations.

A pluralist theoretical approach was gradually developed, elevating ST to a meta-theory, and integrating diffusion of innovations (DOI) and gender relations as lower-level theories. Aware that these theories do not share ontological assumptions, we persevered. ST is often seen as 'bridging the gap' between conflicting paradigmatic zones (Gioia & Pitre, 1990, p. 577) in order to honour demands for meta-theoretical pluralism, thus enabling us to frame diffusion and gender theories in justifiable and cohesive ways. The resulting pluralist theoretical framework – multiparadigmatic – proved to be valuable in helping us reach a better understanding of the social phenomena under consideration. At the same time, this raised the question of incom-

measurability among paradigms and the significance of this issue for IS research. In this paper, we present and illustrate the value of adopting a pluralist and multiparadigmatic theoretical framework combining conceptual approaches often considered in the literature as incommensurate because of distinct ontologies, epistemologies and even methodologies. Two research questions guided our inquiry:

- 1 What are some of the threats and promises of adopting a multiparadigmatic theoretical approach?
- 2 How can multiparadigmatic theoretical pluralism be operationalized to make possible a plausible interpretation of complex IS social phenomena in a single case study?

The structure of this paper is as follows. The next two sections provide a literature background and describe the rationale for building a multiparadigmatic theoretical approach. In the research strategy section, we present a summary of data collection methods and analysis, then an overview of the case study, describing the Australian cotton industry, the cotton growers and the agricultural DSS *CottonLOGIC*. Next, we present instances of the type of findings the framework helped us to produce, illuminating both the social nature of women farmers' actions and roles, the materiality of the cotton farming context and the DSS, and the recursive way in which such agency and structural pressures shape each other. In the discussion section, we address the two research questions. The final remarks section is the conclusion where we highlight the insights gleaned from the study and point towards some avenues for future research.

THREATS AND PROMISES OF EMBRACING MULTIPARADIGMATIC AVENUES

Diversity and pluralism – and their implications for theory building – are two controversial themes that have been at the heart of intense discussions in the IS research literature (Robey, 1996; Galliers, 2011). With them, almost invariably, the paradigm debate arises and ends up occupying an important place. One of the reasons is Burrell & Morgan's (1979) four-paradigm grid and its set of interrelated philosophical assumptions – ontology, epistemology, methodology and human nature – which is recognized as one of the most influential frameworks regarding the whole area of sociology and organizational analysis.

The four paradigms are mutually exclusive . . . they offer different ways of seeing. A synthesis is not possible . . . one cannot operate in more than one paradigm at any given point in time, since in accepting the assumptions of one, we defy the assumptions of all the others. [Burrell & Morgan, 1979: p. 25]

The authors' positioning is well-known for their firm opposition to paradigmatic pluralism and compelling claims that not only are paradigms irreconcilable and incommensurable but any attempt to combine theories or methods across paradigms is unsound due to their conflicting basic assumptions. Revisited by Hirschheim & Klein (1989), the four-paradigm grid intensified the debate in the IS field around the so-called dichotomies, particularly the subjective-objective

one (Chen & Hirschheim, 2004; Cordoba *et al.*, 2012). Besides a few expressions of support – like researchers advocating the importance of a dominant paradigm (e.g. Donaldson, 1985; Pfeffer, 1997) – a number of refutations, criticisms and other forms of sharply worded discourses have shaped the paradigm controversy.

We find several management researchers vigorously refuting the incommensurability criterion. Cox (1979: p. 3) criticizes Burrell & Morgan for claiming to have found ‘four hermetically sealed and mutually exclusive “paradigms”’. Willmott (1993) and Reed (1997) refute the division of social science into four mutually exclusive paradigms, although the former accepts that continuity as well as incommensurability between competing paradigms characterizes theory development, while the latter develops epistemological arguments in defence of a pluralism that supposedly secures greater intellectual freedom and choice. Reflecting on the impact of ‘quick categorizations’, Deetz (1996: p. 203) remarks that researchers ‘missed much’ with such a prescriptive grid view and that the subjective-objective problem is simply boring and misleading and reproducing simplistic distinctions and that it is not a very interesting way of thinking about research programme differences. Finally, Weber (2004: p. xi) describes multiparadigmatic divisions as ‘spurious’, ‘outdated’ and ‘misplaced’, arguing that whether researchers believe in an objective or a socially constructed reality, ‘research is a continuous journey to find improved ways to understand this reality’.

From the IS side, arguments against incommensurability are approached mainly through diversity and pluralist lenses. Benbasat & Weber (1996: p. 398), although cautioning that high levels of diversity in many forms pose major threats, end by accepting that ‘diversity has its place’. Robey (1996: p. 403) declared that ‘diversity in IS expands the foundation upon which knowledge claims in the field are based’, which means that more relevant and practical knowledge is created by examining the phenomena from multiple paradigms rather than building knowledge more narrowly and directly, one piece upon another. Goles & Hirschheim (2000: p. 250) opined that ‘on the whole, the field of IS can be characterised as diverse and pluralistic. There is a diversity of ideas and problems addressed; diversity of theoretical foundations and referent disciplines; diversity of paradigms and diversity of research methodologies’, such that it is becoming accepted that multiple paradigmatic perspectives provide a more comprehensive outlook. Chen & Hirschheim (2004: p. 229) acknowledged the value of paradigmatic pluralism as allowing ‘alternative approaches to help build the IS discipline’s body of knowledge’. Finally, Boland & Lyytinen (2004: p. 54) argued ‘we now find a more secure appreciation of a “both/and” approach that is inclusive and values the mutually informing capabilities of multiple research methods and traditions [. . .] and we are pleased to note that the IS field offers an almost bewildering diversity of theoretical perspectives [. . .]’.

While debates over incommensurability persist, we align ourselves with calls for enriching our sensemaking with diverse theoretical views that, sometimes, are also multiparadigmatic (Lewis & Grimes, 1999). A diversity of assumptions, interests, practices and approaches leverage researchers to a richer position to explore IS-related organizational complexity. The core question is to answer *how to do this*.

Multiparadigmatic roots

Although we believe that arguments for pluralism and diversity are gaining increasing support, nevertheless, to encourage multiparadigmatic approaches does not mean to dismiss their risks and threats. On the contrary, while the coexistence of multiple paradigms might result in vibrant fields of inquiry, such coexistence might be also 'ambiguous and fragmented' (Lewis & Grimes, 1999: p. 673). How to cope with multiparadigms without losing coherence and plausibility? In order to revisit some alternatives involving complementarity, conciliation or integration of multiple paradigms proposed over the last two decades, we adopted Lewis & Grimes' (1999) classification of multiparadigm debates.

The first angle of classification regards *multiparadigm reviews*, which reveal the impact of theorists' underlying assumptions on their understandings of organizational phenomena. Two approaches are recognized: paradigm *bracketing* and *bridging*. Paradigm bracketing means making differing assumptions explicit, like Burrell & Morgan's (1979) four-paradigm or Deetz's (1996) linguistic-oriented grids, while paradigm bridging suggests the mobilization of 'transition zones', i.e. theoretical views that span paradigms, like Gioia & Pitre's (1990) metaparadigm perspective or Cook & Brown's (1999) possession-practice generative dance. Interestingly, a recent article by Thompson (2011) provides guidance for paradigm bridging by showing the importance of aligned ontological and epistemological shifts when minor theoretical adjustments occur.

The second angle of classification regards *multiparadigm research*, which shows how to apply divergent paradigm lenses empirically. Lewis & Grimes (1999) identify, basically, two strategies of conducting research using multiple paradigms: *parallel* or *sequential*. An illustration of a parallel study is provided by Hassard (1991: p. 294), who demonstrated how 'contrasting images of the subject matter emerge' when investigations are based, simultaneously, upon diverse 'sets of meta-theoretical assumptions'. A sequential strategy is illustrated by Lee (1991), for whom the so-called differences between functionalism and interpretivism are 'vacuous' in that both approaches have the same fundamental goal of trying to enhance an understanding of the world. He proposes an integration of functionalism and interpretivism by using three converging levels of understanding: first, the 'reality' as it appears to human actors in their natural environment; second, interpretation by the researcher who enters the field; and third, abstraction by the researcher of the second-level interpretation.

A third angle of classification is called *metaparadigm theory building*, which describes how to accommodate opposing views within a same perspective. Lewis & Grimes (1999) identified two types: *metatheorizing* and *interplay*. The first – metatheorizing – helps to explore patterns that span conflicting understandings. An illustration is Grimes & Rood (1995) who deploy different paradigms as 'debating voices'. The second – interplay – helps to recognize contradictions and interdependencies, where one paradigm somehow needs the other to be meaningful. An illustration is Reed's (1997) analysis based on structure-action interplay.

The three angles are not mutually exclusive. For instance, an approach that is based on paradigm bridging can also mobilize interplay as a metaparadigmatic technique. The view and

vocabulary proposed by Lewis & Grimes (1999) will be used in the next section, to describe how we have built and applied a pluralist and multiparadigmatic framework.

BUILDING A PLURALIST AND MULTIPARADIGMATIC THEORETICAL FRAMEWORK

Boundaries between paradigms might be seen as transition zones where each paradigm can tap different facets of organizational phenomena and can produce markedly different and uniquely informative theoretical views of events under study (Gioia & Pitre, 1990; Lewis & Grimes, 1999). By using ST as a meta-theory, we claim to be purposively exploring a 'transition zone theory' that might consistently accommodate lower-level theories (mid-range) based on different ontological assumptions. Therefore, our framework promotes paradigm bridging, not bracketing. ST's meta-theoretical status allows 'its use as the keystone of a theoretically-based pluralistic approach' by integrating 'concepts across paradigmatic boundaries' (Allen & Ellis, 1997: p. 751). This role of ST as a meta-theory is supported by Jones & Karsten (2008), Weaver & Gioia (1994), Walsham & Han (1990) and Shanks *et al.* (1996, p. 4), the last claiming that 'structuration theory is intended as a broad theoretical framework within which other social theories can be located and to which other perspectives can be related'.

By offering the 'duality of structure' as a seminal concept in his social theory, Giddens (1984) was among several other breaking down a dichotomic logic (Pozzebon, 2004a). Giddens' work represents a reaction to the divisions and perceived deficiencies of the opposing prevailing schools of sociological thought – a means of breaking free from the weaknesses of functionalism that underplay the importance of human action, and the opposing interpretive sociology that is 'strong on action, but weak on structure' (Jones, 1999: p. 106). Indeed, *duality of technology* (Orlikowski, 1992) and, particularly, *technology-in-practice* (Orlikowski, 2000), provided the central concepts of our framework.

In sum, at the ontological level, ST plays an important role as a bridge between theories based primarily on different ontological assumptions (Weaver & Gioia, 1994). Regarding the other dimensions – epistemology and methodology – we have adopted a non-positivist, constructivist epistemology and an ideographic methodology. This is coherent with Giddens' position, which emphasizes 'ontology rather than epistemology' and adopts 'an eclectic approach to method, which again rests upon the premise that research enquiries are contextually oriented' (Held & Thompson, 1989: p. 296).

Epistemological and methodological shifts to align concepts espousing a different paradigm

In doing our empirical research, ST was helpful in framing our interpretations of emerging 'technologies in practice', but it was less helpful in investigating the first two key issues identified in the introduction: the deterministic nature of farmers' perceptions of their external

environment and the imperative to adopt a technological innovation, a DSS, to achieve industry objectives. Although ST accepts that structural properties influence and shape human action, it does not provide concrete and specific constructs to help researchers recognize more precisely what structural technological properties to analyze. As a meta-theory, ST offers a rationale for accepting that structural properties of a given artefact might shape people's actions and decisions, sometimes in a quite deterministic way. We use the term 'quite deterministic' because, under certain circumstances, opportunities and power for people to 'do otherwise' and escape from strong constraints imposed by structural properties are too small, sometimes virtually nil (Giddens & Pierson, 1998). This notion is not incompatible with a more subjective perspective where the social construction of reality, as constructed by a group of people living in a given situation, ends by building a perception of a 'reality' that is 'inescapable' and quite deterministic. In the context of the Australian farmers, who were forced to adopt *CottonLOGIC* and who perceived it as inflexible software determining their farm-related business processes, we perceived an opportunity to take into account one of the more influential theories regarding adoption of technological innovations: Rogers's (1995) DOI theory.

The influence of DOI theory has been immense, with thousands of citations in publications, especially regarding rural sociological research. For a study of the adoption of an advanced technology in a rural setting, DOI was a complementary theoretical choice, offering a pre-defined and rational set of characteristics and adoption stages through a prescribed innovation-decision process (Rogers, 1995). DOI is a comprehensive theory that views diffusion as an inherently social process and stresses that structures and processes in the social system can affect an innovation's diffusion. Although DOI carries functionalist assumptions, its concepts mesh well with the earlier framing of technology provided by ST. In our case, we decided to integrate DOI's concepts in our research protocol – particularly those helping to understand the influence of certain characteristics of innovations in the adoption process, like compatibility – without changing our epistemology and methodology. This means that the concepts were mobilized to make sense of our data under a structurationist rationale and not the purely functionalist rationale that DOI usually implies.

The accommodation of DOI under a structurationist umbrella is possible because, as explained by Thompson (2011), DOI's constructs form a mid-range theory, i.e. they can be accommodated to a more structuralist realist logic while recognizing the socially constructed, dynamic nature of a social phenomenon. This led us to reflect on Lewis & Grimes' (1999) third angle: ST allows researchers to operate in a grey area at the ontological level but to privilege one side of a dualism (objective or subjective) at the epistemological or methodological levels. This is also coherent with Thomson's (2011) notion of philosophical 'shifts' to maintain alignment and consistency and to build a meaningful framework. To make our pluralist and multiparadigmatic framework coherent, we took advantage of DOI's mid-range features and did an epistemological and methodological shift (Figure 1). Although we have adopted DOI's concepts – prescribed characteristics of a technological innovation – we have retained a constructivist and ideographic approach to gathering data to permit first-hand understanding of the phenomena being studied.

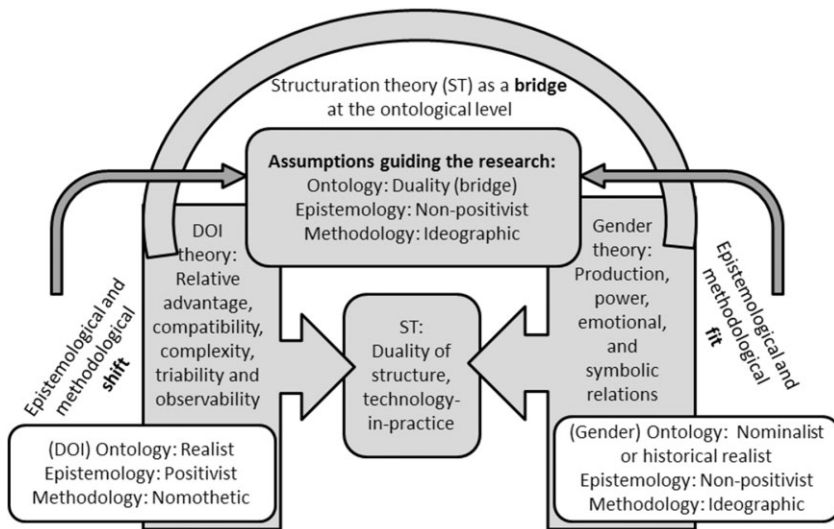


Figure 1. A pluralist and multiparadigmatic theoretical framework.

Epistemological and methodological fit that facilitates integration

Gender relations theory was a later choice, emerging out of partially analyzed gender data. Although DOI theory yielded useful notions for understanding how and why farmers were or were not adopting *CottonLOGIC*, it offered little guidance on gender and was not helpful in appreciating gender roles, which emerged as the third key issue during the data analysis. In his primary work, Giddens (1984) acknowledged that ST did not deal directly with gender issues, although in more recent publications such as *Modernity and Self-Identity* (Giddens, 1991) and *Sociology* (Giddens, 2001), his views were more explicit, showing sympathy towards feminist themes. In these volumes, Giddens supported Connell's (1987) theory of gender relations, attributing the disproportionate dominance of power, prestige and wealth by men to the gender-based division of labour both within the home (unpaid labour) and in the workplace (paid labour and market production). Murgatroyd (1989, p. 148), in a critique of ST, claimed that if gender relations were addressed within ST, it 'would yield insights of fundamental importance for critical sociology'.

Connell (1987, 2002) identifies four conceptual dimensions of gender for purposes of analysis: production, power and emotional and symbolic relations. Thus, Connell's social theory of gender relations was incorporated into the theoretical framework, providing a critical, emancipatory and subjective focus on gender issues. Hence, the researchers' decision to engage with an additional theoretical lens was based on our aim of increasing our understanding of practical problems, namely, how and why women were using *CottonLOGIC*, and the influence of their gender roles as farm partners in the context of the Australian cotton industry.

In the case of integrating gender theory into the data analysis, the potential problems with the underlying ontology, epistemology and methodology already in progress were not really

major. At the ontological level, critical theory often espouses historical realism or nominalism, and it was easily accommodated under a structurationist umbrella. Likewise, critical approaches often share a non-positivist/subjectivist epistemology and an ideographic approach to research methods (although variants exist). As summarized by Figure 1, ST served as a transition zone meta-theory in our theoretical framework, a bridge providing a communication channel at the ontological level between two other theories: DOI and gender relations. Regarding epistemological and methodological levels, only one of the theories – DOI – went through a shift to retain the coherence and plausibility of the research design.

RESEARCH STRATEGY

The empirical work was based on a qualitative case study (Stake, 1995), whose geographic boundaries encompassed the adjacent regions of southeast Queensland and northern New South Wales in Australia. The unit of analysis was individual, which is to say, the Australian cotton grower and activities associated with the adoption and use of farm management software. To further enrich the data collection and for triangulation purposes (Stake, 1995), a range of informed industry professionals were also consulted for their perceptions of growers' roles in DSS usage and farm management. We gathered the data predominantly through semi-structured interviews with the 32 participants during three main field studies and a telephone study over a period of 3 years (2002, 2003 and 2004). The final set of respondents included 14 women and 3 men cotton growers, as well as nine women and six men cotton industry professionals, such as DSS developers, rural extension officers, researchers, educators, rural experimental scientists, agronomists and consultants, all of whom advise cotton growers. There was a lesser reliance on participant observation and document analysis. Data collection information and a map of the research sites are presented in Appendix A.

The study was designed as longitudinal but not ethnographic because it was an in-depth study over an extended period of time not requiring the researcher to live *in situ*. The interviews were conducted at family farms or other locations. Each interview lasted at least an hour. All were recorded on audio tape and transcribed, as well as notes on each interview being written up the same night in an activity log. Codes used in the analysis were based on the theoretical framework, i.e. a word or short phrase related to concepts or themes drawn from the theoretical framework (Saldana, 2009).

Overview of the case

Social and environmental sustainability have become imperatives in the cycle of production and they are pushing innovation and change in Australian agriculture (McCown, 2002). Illustrative of these changes are the greater public policy emphasis on issues of sustainable farming practices, with less emphasis on problems of production, and government initiatives to reduce costs whereby many rural extension programmes have ended, to be replaced by

participatory on-farm research (McCown, 2001). Cotton growers and their advisors increasingly conform to self-regulatory best management practice (BMP) including integrated pest management (IPM). IPM is based on best management principles with a holistic view of cotton production that is more in harmony with the community and ecology. Information channels for the transfer of knowledge include Web-based agronomy tools, newsletters and agricultural DSS systems like *CottonLOGIC*.

CottonLOGIC was launched in 1998, representing a third generation of DSS for the Australian cotton industry. It is an advanced farm management suite of software programs developed in Australia by the Commonwealth Scientific and Industrial Research Organisation and the Australian Cotton Cooperative Research Centre, with support from the Cotton Research and Development Corporation (CRDC, 2005). The software consists of record-keeping and decision-support modules to assist cotton growers and their advisors in the management of cotton production, providing recording and reporting of crop inputs and yields, insect populations, weather data and field operations such as fertilizer and pesticide applications. In addition, *CottonLOGIC* enables the running of insect density prediction and soil nutrition models for decision support. By 2000, *CottonLOGIC* was distributed to over 1000 industry participants (The Australian Cottongrower, 2005). More recent advances are *CottonLOGIC* for in-field recording of insect data and *CottonLOGIC Tools on the Web* for online use. These developments are expected to increase the use of *CottonLOGIC* by both growers and consultants, especially for decision support (The Australian Cottongrower, 2005).

Cotton growers on family farms in Australia

Several industries as well as academic studies have explored the use of computers for farm management in Australia. On the one hand, Bryant (1999) and Stewart (2004) found that technology, like ideologies of family farming, was socially constructed as a male domain and that the use of software reflects the traditional gender divisions of labour on farming properties. For instance, farm women were associated with financial data entry and record keeping, while male farmers provided the input data, analyzed and planned the farm business. Bryant (1999) contended that while many rural women were increasingly aware of the decision-making and farm management possibilities of computer programs, there was still a high level of dependence upon the male farmer, with his more detailed day-to-day outdoor farm knowledge. On the other hand, a cross-industry Australian study of the use of technologies for natural resource management pointed out overall improved adaptive ability among farm women in farm management through increased use of computer-based decision support tools (Bellamy *et al.*, 2002). This confirmed the findings of an earlier study by Lewis (1998) of a strong association between innovative decision-making by women farmers and being better informed through the use of computer-based IS. Although farm women are still, to some extent, an underappreciated resource, their gaining of joint legal partnership status on many family farms appears to have propelled them from a predominantly supportive role to greater involvement with the business side of the family farm enterprise (Fisher & Hutchison, 1997).

ILLUSTRATION OF THE USE OF A PLURALIST THEORETICAL APPROACH

In this section, we illustrate, with excerpts from the interviews, how our theoretical framework helped in the production of our results, by shedding light on the influence of farm management software on women cotton growers' roles and practices.¹ As explained in the introductory section, three significant reasons motivated the integration of two different theories under a structurationist umbrella. These were (1) many farmers' perceptions of immutable properties inhering in farm management software and prevailing institutional conditions; (2) the need to adapt farming practices to the changing natural environment and community expectations and to comply with government and industry sustainability targets; and (3) the gender-related issues raised by women farmers regarding their roles as farm partners on their family farms. The pluralist and multiparadigmatic framework was particularly supportive in analyzing and explaining these different aspects of the case.

DOI

Rogers' DOI theory was helpful in illuminating the first and second points. By integrating DOI concepts into the theoretical framework, we improved our understanding of the adoption and use of the *CottonLOGIC* software. Rogers (1995) identified five characteristics of an innovation as: relative advantage, compatibility (or congruence), complexity, trialability (or divisibility) and observability. Drawing on these characteristics contributed to our grasp of how cotton growers took into consideration significant contextual factors and how the characteristics of *CottonLOGIC* affected their acceptance of *CottonLOGIC*, the use of which was endorsed by the cotton industry. For reasons of length, in this paper we have chosen just one characteristic of innovation – compatibility – to illustrate the complementarity of DOI in terms of enhancing the sensemaking process in the data analysis phase.

Rogers (1995: p. 224) defined compatibility or congruence as 'the degree to which an innovation is perceived as consistent with the existing values, past experiences and needs of potential adopters'. Building on DOI theory, Vanclay & Lawrence (1995: p. 102), in their studies of agroecology in Australian agriculture, defined congruence as 'compatibility with farm and personal objectives' when farmers are 'more likely to adopt that part of an innovation that they like or that is consistent with other farming goals'. These could range from short-term goals and personal needs to more strategic objectives such as improving resource sustainability on the farm by recognition and acceptance of industry-endorsed BMPs.

In the cotton industry, growers face escalating legal requirements to document chemical usage, by either paper-based or electronic means, in order to comply with industry BMP. The record-keeping modules of *CottonLOGIC* were designed for this purpose and were eminently suitable. Diane, a service manager for cotton growers, was cognizant of growers' obligations to maintain up-to-date records.

¹A complete account of this research project was reported elsewhere (references could be added later).

A lot of the recordkeeping they [growers] concentrate on at the moment is what they have to do, generally for compliance, Bollgard², and for using things [sprays] like endosulfan. You can't use more than three sprays in a year. [Diane]

Major decisions in the cotton industry revolve around adapting to industry, environmental and community pressure to reduce chemical and water usage. The release of transgenic cotton seed varieties such as Bollgard had impacted on users' perceptions of the suitability of the insect prediction modules of *CottonLOGIC* to forecast insect densities and the need to use insecticides. Julia, a grower, and her farm partner husband, had reflected on the implications for their young family and had made a conscious decision to abide by industry guidelines for chemical applications, embedded in *CottonLOGIC* as BMP.

. . . but we have made a decision ourselves that we would do the right thing [limiting the spraying of toxic chemicals]. [Julia]

To sum up, data analysis using prescriptive DOI concepts of which 'compatibility' was but one, provided salient details on the situated use of *CottonLOGIC*. Although there was an initial feeling of being compelled to use the software, especially for record keeping, compatibility with stakeholders' objectives materialized as an important usability feature of the software that helped farmers cope with that imperative. These understandings were extremely valuable for our research results and probably would not have surfaced without the help of DOI concepts. DOI provided an excellent springboard for our comprehension of *CottonLOGIC*'s characteristics and rational adoption and use, but our information was fragmented and incomplete. We lacked knowledge of the more subtle and sensitive aspects of gender relations in family farm partnerships as well as of the interactivity between *CottonLOGIC* as technology and cotton growers as actors.

Gender relations

There has been ongoing research into the success and, especially, the failure of agricultural DSS and the issues associated with addressing the needs of users (McCown, 2001; 2002; Hearn & Bange, 2002; Mackrell *et al.*, 2009). Nevertheless, the gender of the user has not intentionally been a consideration in any of these studies. Our study found that the woman farm partner was significant on many occasions and would often be consulted regarding strategic decisions as a contributing member of the farm management team.

Hence, gender relations theory by Connell (2002) was helpful in understanding the third point: the importance to women of their roles as farm partners on their family farms. Connell's notion of 'production' was most evident in the conversations although all the dimensions – power, emotional and symbolic relations – are intertwined with production. From a gender theory perspective, production relations pertain to gender divisions of labour both at home and in occupational employment (Connell, 2002). The importance of production derives from the

²Bollgard is genetically modified cotton seed developed by Monsanto to produce a natural pesticide for controlling the heliothis pest. Bollgard is also called a transgenic seed variety.

fact that family cotton farms are commercial enterprises. If production ceases, so eventually will the farm as a business unit. Despite limited training in agronomy, many women growers have successfully assumed the role of farm record keeper.

I like keeping records [in CottonLOGIC] not changing siphons. By law, you need to keep records [sprays and notifications]. [Sarah]

As one of the motivations for carrying out this research was to discover whether and how women's roles were affected by the use of DSS, it became evident that many couples in family farm partnerships acknowledged the value of teamwork. Meg, a grower, explained that her role on the 'team' was as the farm bookkeeper. Although office work may now be considered conventional for most women, taking control of the farm and family accounts is a more recent development.

You were asking about women's roles but in the cotton industry, it's more of a team. The bookkeeping is the biggest factor [of my role]. We use the computer for that. I do all the bookkeeping. [Meg]

Women seem to get their power and ability to make decisions on the farm because they know exactly what the budget was, because they've done the budget. A lot of the men wouldn't have a clue. [Sigrid]

In brief, the gender relations concepts from Connell's (2002) social theory of gender relations facilitated a critical and subjective analysis of our data. The gender lens offered a glimpse of the roles of women farmers in day-to-day farm practices, including their ability to keep accurate financial and production records using software as a basis upon which many strategic farm decisions are made.

ST: technology-in-practice

ST as a meta-theory allowed a broader view of the social setting and played an important role linking two theories – DOI and gender – from acknowledged opposing paradigms. Drawing on the *duality of structure* (Giddens, 1984) and the *duality of technology* (Orlikowski, 1992), Orlikowski (2000) constructed a theoretical framework to illustrate the recursive nature of technology design and use as *technology-in-practice*. The technology-in-practice model enabled an accurate depiction of *CottonLOGIC* usage whereby the technology (and the institution of farm management) were dynamically constructed and reconstructed by users, just as the technology was shaping and reshaping the lives of the farm women, thus reflecting the core principle of ST that social life is recursive. This is illustrated in Figure 2.

To clarify in structurationist terms, novel practices of farm management (social structures in ST), often instigated by the women growers (interactions revealed using gender relations theory as a lens) through the adoption and use of resources and facilities such as agricultural DSS *CottonLOGIC* (features revealed by the constructs of DOI theory), are progressively constituted and integrated into cotton farm management. The features of *CottonLOGIC* embed

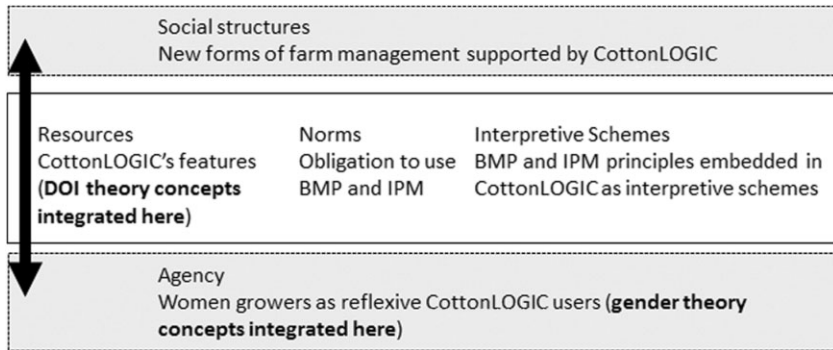


Figure 2. Integrating DOI and gender relations concepts with ST's duality of structure.

interpretive schemes, namely, BMP and IPM. These interpretive schemes provide stocks of knowledge to support appropriate responses and shared meanings in the production and reproduction of the cotton industry's environmentally sustainable practices to become 'norms' as widely adopted cotton industry standards. Although sometimes perceived as onerous, *CottonLOGIC* is modified by resourceful users for their own purposes, often in ways unanticipated by the software development team, and their use of the technology empowered the women in their farm relationships. Extensive record keeping, especially by the agency of women growers, together with information from insect prediction models, facilitate and innovate farm management. Women growers are both knowledgeable and reflexive users; hence they are enabled and constrained by the use of technology, just as the technology is constructed and reconstructed through ongoing use.

CONCLUDING REMARKS

The operationalization of a pluralist and multiparadigmatic framework enabled the drawing of insights from the data that would most likely have remained concealed if the researchers had adopted a single paradigmatic approach to the complex social and technical activities embedded in the empirical study.

We have already answered our first research question in the second section – *What are some of the threats and promises of adopting a multiparadigmatic theoretical approach?* The threats are mainly represented by incoherence, fragmentation and implausibility, as claimed by a certain number of authors, whereas the promises are chiefly expressed by a richer, diverse, plural and multidimensional understanding of a social phenomenon, a stance we presume to be dominant nowadays. From our viewpoint, despite the threats of using theories from more than one paradigm, we see the promises as quite appealing. We support Gioia & Pitre's (1990, p. 599) claim: 'multi-paradigm approaches to theory building can generate more complete knowledge than any single paradigmatic perspective'.

Concerning the second research question – *How can multiparadigmatic theoretical pluralism be operationalized to make possible a plausible interpretation of complex IS social phenomena in a single case study?* – we fill a lack in the literature: although the paradigm controversy has been intensively debated over the last 30 years, the concrete operationalization of multiparadigmatic theoretical approaches has remained poorly described and under-theorized. In this paper, we claim that the use of ST as a bridge is *one way among others* of dealing with multiple paradigms. As a meta-theory, structuration might be applied in conjunction with lower-level theories, particularly when epistemological and methodological shifts, when needed, are possible. We are in line with Thompson (2011) who noticed the danger of ‘drifts’, of serious misalignments, when the necessary ‘shifts’ are not purposively managed. ST breaks down dichotomies at the ontological level by accommodating and bridging theories with coherence. We could argue that we kept the ontological level as a ‘transition zone’, a ‘grey area’ (Lewis & Grimes, 1999) under which DOI (inherently realist) and gender (which accepts both historical realism and nominalism) concepts worked in synergy to make sense of different aspects of the phenomenon being analyzed. In the epistemological and methodological areas, ST allows a researcher to privilege one side of a dualism, the choice of a more subjective view being the most frequent among structurationist IS researchers (Jones & Karsten, 2008).

One could ask what this theoretical illustration of multiparadigmatic pluralism would look like without ST. Our answer would be that when paradigm bridging is the ‘technique’ applied to operationalize paradigmatic pluralism, other meta-theories with a similar ontological nature to Giddens’ ST could be mobilized. For instance, Bernstein’s code theory, Bhaskar’s critical realism and Bourdieu’s practice theory are examples of meta-theories (Pozzebon, 2004a) that could work as transition zones for bridging lower-level, mid-range theories to enrich the sensemaking of a given information and communication technology (ICT)-based phenomenon, particularly if the required ‘shifts’ and ‘fits’ to accommodate those lower-level theories preserve the internal coherence.

It is also important to stress that we are providing one illustration of operationalization that is coherent with our research design – a single case study. Different strategies in terms of multiparadigmatic building could call for different research designs and vice versa. Parallel or sequential strategies using multi-methods are examples of well-known options. In our study, we decided to cope with ideographic homogeneity and constructivist logic, where the researchers’ in-depth immersion in the contextual setting of a single case study allowed first-hand, rich and nuanced appreciation of the subject under investigation.

Finally, in terms of the outcomes of multiparadigmatic research, we claim that theoretical pluralism increases the richness of the sensemaking process. By bridging theories espousing different paradigms, we provide an illustration that although they could conflict or contradict with each other, separately, they provide only a partial understanding of an ICT-based phenomena like the one we were investigating. Together they provide a more comprehensive understanding of ICT-based phenomena. Still, the mobilization of theories that espouse different paradigms added complexity due to the potential risks. However, if researchers are conscious of those risks and manage them, the final research design is fully defensible. We argue here that the use of DOI and gender concepts under a structurationist umbrella helped

us to understand how the use of *CottonLOGIC* by women farm partners changed their everyday practices as well, allowing the emergence of new social structures that are provoking long-term changes in the Australian cotton industry. Consistent with our philosophical assumptions, we also claim that the value of our results cannot be evaluated using traditional positivist criteria – like external validity – but by using critical interpretive criteria, particularly that of plausibility (Pozzebon, 2004b). Walsham (1993, p. 80) claimed that researchers using a structurationist framework are not ‘striving for universal laws’, but looking for another type of ‘generalization’, one where the findings may, with caution, be applicable beyond the case to similar contexts (Lee & Baskerville, 2003, p. 230). The changing role of Australian women cotton growers was an inspired finding that has transferable qualities. Despite the recognition of some gender inequalities, women cotton growers are not passive agents in family farming relationships and are taking responsibility for their lives with the confidence gained through involvement in interpersonal networks and the acquisition of technological skills. This empowerment process can be ‘generalized’, transferred with caution from the specificity of cotton to the broader context of Australian farming, with a message for the future of the rural sector.

This paper makes three main contributions to research. The first is to revisit the paradigm debate from a more contemporary perspective, showing that voices defending pluralism and diversity are growing in both management and IS research. We contend that approaches that embrace non-dichotomist logics should be viewed as valuable attempts to purposely explore new understandings of IS-related phenomena rather than continuing to nourish dualistic debates. Commensurability – or perhaps meaningful communicability – depends more on speakers’ and listeners’ openness to each other’s views than on the ‘paradigms’ themselves. We argue that dichotomous ways of framing research have the potential of precluding the emergence of other ways of thinking about theory building, which are sometimes more creative, opportune or simply different. Second, and more importantly, we provide a concrete illustration of the operationalization of a pluralist and multiparadigmatic theoretical framework, describing clearly the mechanisms adopted to build a coherent framework, namely *bridging* at the ontological level and *shifting* at the epistemological and methodological levels. Third, our study is, to our knowledge, possibly unique, in combining structuration, DOI and gender relations theories in a single empirical study. More than putting together these three distinct theories, we are opening doors for other researchers to adhere to diversity and pluralism in order to produce richer sensemaking of ICT-based phenomena. Briefly, our results are not only about increasing the understanding of a given, localized ICT-based phenomenon, but also about reviewing how IS researchers have been approaching multiparadigmatic research and mainly helping to advance new trajectories for future multiparadigmatic research.

In terms of limitations, we outline the brevity of illustrations we have provided about the empirical work (which was published elsewhere and is available upon request). This is mainly for reasons of length because, in order to deepen the theoretical discussion, we have abbreviated much of the description of the case and the rich empirical data we have gathered and analyzed so as to keep the focus on the theoretical discussion of the value of adopting a pluralist and multiparadigmatic framework. Another limitation that points a way for future research, is the fact that we have discussed one among several other types of pluralist and

multiparadigmatic approaches. Epistemological and methodological pluralism, for instance, were not objects of discussion. Future research might also explore other types of operationalization of a multiparadigmatic framework. We are aware that we have provided one specific strategy of accommodating different paradigms, while several others exist and deserve investigation.

Our paper resonates with messages from a number of IS publications arguing that pluralism in its various forms – ontological, epistemological, methodological, paradigmatic, theoretical – should not simply be tolerated but be a goal that the IS community should strive for (Robey, 1996; Goles & Hirschheim, 2000; Chen & Hirschheim, 2004; Hassan & Will, 2006; Becker & Niehaves, 2007). Pluralism helps in the recognition of the intrinsic complexity and diversity of issues faced by the community of IS researchers. As Langley (1999) said, in her influential work about theorizing from process data, sensemaking is the objective: let us make sense the best way we can.

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Biographies

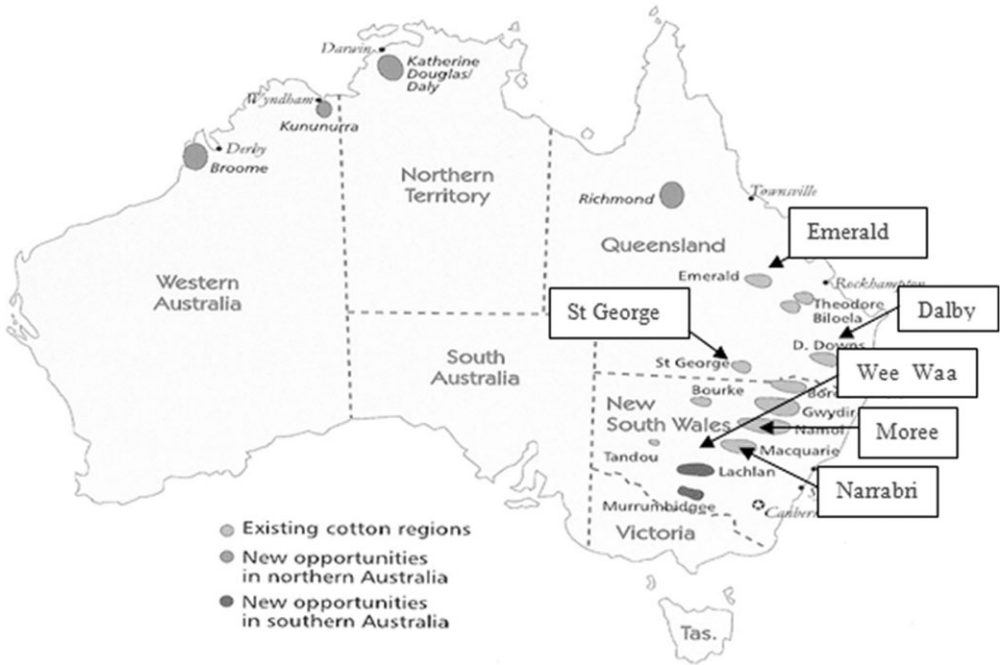
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APPENDIX A

Map of cotton producing catchments in Australia and towns in study



Location	Cotton growers		Industry professionals	
	Female	Male	Female	Male
Dalby	4	1	3	
Wee Waa	1		3	
Moree	1			
Narrabri	2	1	2	3
Emerald	3		1	2
St George	3	1		1
Total	14	3	9	6