AN INTERPRETIVE STUDY OF GENDER DIFFERENCES IN THE USE OF FARM MANAGEMENT SOFTWARE

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Abstract. This paper reports on an interpretive case study which seeks to contribute to an understanding of the interaction between agricultural decision support systems (DSS) and women's roles as farm partners on Australian family cotton farms. More specifically, this paper provides advice to software designers and developers on how to make farm management software more suitable for the diverse farming community by exploring the social aspects of gender differences in farm management and technology use. The study reveals growing support for the theory of individual gender differences in situations where women growers perform certain tasks to which they are neither essentially predisposed nor socially compelled. In so doing, they enhance their value as members of the family farm management team.

Introduction

This paper seeks to contribute to a greater understanding of how technology enters the lives of Australian women cotton growers through the studying and theorising of gender, technology, and cotton farm management from an interpretive case study. The study found that farm management software are valuable tools for supporting environmental, economic and social sustainability principles, and for enabling women cotton growers to adapt to, challenge and influence farm management practices. The data from the case study which informed a doctoral thesis (Mackrell 2006a) have been revisited for the purposes of this paper.

Australian farmers are supplementing traditional practices with innovative strategies in an effort to survive recent crises in the rural sector. These innovative strategies include moving towards a knowledge-based farm management style through the use of technology. Innovative farm management software, such as the agricultural decision support system (DSS) *CottonLOGIC* are considered keys to the adoption of sustainable farming systems (Hearn & Bange, 2002). While the use of computers has become essential for farm decision makers, the low adoption rates of agricultural DSS have been reported (Cox 1996, McCown 2001). In many instances, farm women are the primary users of commercial-off-the-shelf software for accounting and other purposes although research suggests that farm women are hesitant to use computers for farm management. Furthermore, the decision making roles of farm women in rural society are unclear. This is a synopsis of the background of the study which is more extensively written up in Gartshore (2004a; 2004b), Mackrell (2005; 2006a; 2006b), and Mackrell and Nielsen (2007).

This paper explores gender differences in the use of farm management software by cotton growers as farm partners rather than the relationship between gender and technology. The findings of the paper are expected to provide some guidelines for the future design, development, and delivery of agricultural DSS. The problems to be addressed in this paper can be summarised by the following research questions.

Question 1. How do Australian women cotton growers interact with technology for farm management?

The second aim of this paper is to consider whether accepted theories of gender and IS, namely essentialism and social constructivism, adequately reflect the situation or whether the emerging theory of individual differences has relevance. This problem is represented by research question 2.

Question 2. Are there gender differences in farm management and technology use? If so, how are these explained?

While issues of gender differences (and similarities) will be explored in this paper, the third and final aim of the paper is to provide advice on how farm management software can be made more acceptable to the growing group of rural women users. Research question 3 signifies this aim.

Question 3. What are the implications for software designers and developers?

The structure of this paper is as follows. The literature review provides an overview of the scholarly literature and industry reports related to the research domains of the study, that is, gender, technology, and farming. The theoretical foundations sector contain the arguments pertaining to dominant gender theories while the research design and methodology sector describes the case study and data gathering methods. This is followed by the main section where interview data is interwoven with theoretical concepts from the literature and the findings are interpreted and explained within the identified research problems. In the conclusion, the study is reviewed and the findings are synthesized with the literature.

Literature Review

This section provides an overview of the research literature especially pertaining to women in farming and their use of computers for farm management decisions. The portrayal of women in farming has been the subject of many studies both in Australia and overseas. In research into the lives of Australian farm women, Alston (1990; 1993; 1995; 1998a; 1998b; 2000; 2003) argues that farm roles have developed based on gender stereotypes and that traditional divisions of labour prevail. Male farmers are participants in the 'more important' public sphere of outdoor work while farm women have become associated with the less visible private sphere of housework and children. This "domestic work has come to be devalued because it is unpaid and not directly geared to agricultural production and the marketplace" (Alston, 1995, p.24). The theme of the 'invisibility' of women farmers emanated from research by Sachs (1983) and has resonated through feminist studies of Australian rural women. James (1989), in studies of decision making in the family farm business, claims that despite the increase of legal farm partnerships, the participation of women in decision making on the Australian family farm is uncertain. Furthermore, Australian government reports from research and development found evidence that divisions of responsibility in farm management, largely based on gender, actually contribute to poor decision making (Daniels & Woods, 1997).

Farm women lead busy lives, and time is a major constraint in the performance of their many functions. Their roles are described as caterer, receptionist, secretary, bookkeeper, household manager, farm manager, farm labourer, tree planter, tractor/header driver as well as carer of children and often the elderly (James 1989; Board 1997). It must be noted that some male farmers, to compensate for the increased involvement of farm women in the running of the farm business, are making greater contributions to domestic tasks and childcare. In the main, however, male farmers are concerned with the production and marketing aspects of farm life (Kilpatrick, Johns, Murray-Prior & Hart 1999).

Stewart (1997), in a case study which explores the gendering of interactive communication technologies (ICT) in use on Australian family cotton farms, found that both technology and farm roles are gendered according to whether they are used predominantly indoor or outdoor. For instance, mobile phones being either hand-held or located in vehicles are considered a masculine device, while telephones and personal computers, based in the farm house, are associated with women. Stewart's study was conducted within a feminist framework using Connell's (1987) theory of the gender relations in which he identifies three main social structures: the division of labour; the exercise of power; and 'cathexis' which encompasses the domain of sexual social relationships. From the study, Stewart (1997) highlights the difference between male farmers and farm women in their patterns of computer usage. She found that male farmers are more likely to make sophisticated use of computers for the purposes of farm decision making and management while farm women are almost invariably recognised as lesser status, data entry operators. Even so, there is evidence that many rural women are increasingly aware of the possibilities of computers for decision making, encompassing new and innovative farm management practices.

Bryant (1999) studied the impact of personal computers on farm management and found that the use of software reflects the traditional gender divisions of labour on farming properties where farm women are associated with financial data entry and record-keeping, while male farmers analyse and plan the farm business. Bryant (1999) contends that many rural women are increasingly aware of the decision making and farm management possibilities of computer software but depend on the male farmer, with his more detailed day-to-day outdoor farm knowledge, for the input data. The male farmer's reluctance to provide this data often frustrates the farm woman's attempt to use computers for farm decision making and management tasks. For a workable outcome, the report by Bryant (1999) recommends that farm men and women work collaboratively to enter data, analyse, interpret it, and make decisions.

Kilpatrick, Johns, Murray-Prior, and Hart (1999, p.7) in Australian studies on the relationship between learning and farm management determine that "to survive, farmers of the future must recognise that farming is more than just a way of life. It is now a high technology, high risk business, requiring access to good

information and demanding not only sound business management skills but a higher level of skills than before". The early emphasis of farm management on production planning and financial budgeting has been deemed too limiting. According to Bamberry, Dunn, and Lamont (1997), a comprehensive, whole of farm approach is more appropriate for the multidisciplinary nature of farm management. There is a need for management skills in human resources, finances, marketing, risk and change management to compliment traditional skills in crop and livestock husbandry. Most importantly, good farm management relies on the information processing skills of the whole farm management team.

Bellamy, Webb, Mayocchi and Leitch (2002) of the CSIRO Sustainable Ecosystems published a report of a cross-industry rural Australian study exploring the use of technologies for improved natural resource management. The report found that 70% to 80% of women in rural industries self-reported as jointly involved in major (strategic) decision-making with their farm partner/spouse and/or other family members (Bellamy et al. 2002, p.58). Bellamy et al. (2002) also found that the quality of those relationships was crucial in helping to foster greater involvement in on-farm decision-making. These findings indicated an increase in women's participation since reported by Daniels and Woods (1997, p.5) when 63% of women farm partners in the rural sector claimed to be involved in strategic decisions. Paradoxically, according to Bellamy et al. (2002), only ten percent of cotton women participated in joint decisions at an operational level compared with those in other rural industries such as beef and grains where 60% of women self-reported to contribute. This meant that the women in the cotton industry appear to be much less involved in the day-to-day decisions associated with production or marketing than in other rural industries. The reasons for this have not been fully explored, but these figures mean there is scope for women to increase their involvement at this level of decision-making.

This overview of the literature reveals a paucity of recent Australian rural studies of farm women and technology use. Furthermore, with the exception of the study by Stewart (1997) and Bellamy et al (2002), sociological studies of IS in the context of the Australian cotton industry are lacking.

Theoretical Foundations

The information systems (IS) tradition has been predominantly positivist (functionalist and deterministic), especially in North America. Now, in line with the European tradition, anti-positivist (subjectivist and interpretivist) approaches are becoming more widely accepted, although, according to Nandhakumar and Jones (1997, p.110), "IS researchers have tended to make limited use of 'engaged' data-gathering methods through which researchers have extensive contact with the research phenomena". Adam, Howcroft and Richardson (2004, pp.222-223) in ongoing studies of gender and IS claim that gender is a vital social

factor shaping organisational life and therefore, the interaction of users with IS must inevitably be shaped by gender. Adam et al (2004) argue that the social and organisational context has often been disregarded in research on gender and technology through a preoccupation with resisting functionalism and deterministic views of technology. The consequence is that the topic of gender and technology is "inadequately studied and theorised" in the IS literature particularly from the interpretivist paradigm.

In this section, three contrasting information systems theoretical perspectives on gender and technology usage are reviewed. One view, proposed in early studies by Turkle (1984), and more recently by Venkatesh and Morris (2000), is the essentialist argument that recognises intrinsic cognitive differences as the basis for observed gender differences in women's interaction with technology. The second perspective is based on an understanding of gender and technology as socially constructed (Wajcman 1991; McKenna 2000; Trauth, Nielsen & von Hellens 2000). This approach focuses on technology being socially shaped as a male domain. The third perspective is that of individual differences of gender and technology. Trauth (2002) rejects the essentialist view and proposes that individual characteristics as well as environmental influences are responsible for the manner in which women interact with technology. These theoretical perspectives are explained more fully below.

The first perspective is the essentialist argument that inherent, natural, psychological and biological differences determine reality and where both gender and technology are perceived as fixed and immutable. This approach generally adopts a quantitative and functionalist stance where studies are statistical, and male and female characteristics are dichotomised.

A great deal has been written by academics about the noticeable gender differences in the use of technologies. Turkle (1984), in early publications of work on children and computing, describes the innate cognitive differences between male and female interactions with computers. She used the core terms of 'hard' and 'soft' respectively to identify this gendered distinction. 'Hard mastery', or the need to control the computer, is associated with the masculine and the implied 'correct' way to use computers. By contrast, 'soft mastery', or a communicative and interactive style, is associated with the feminine, inferior style of computing (Turkle 1984).

Spender (1995), in her study of women and cyberspace, highlights the distinct contribution that can be made by women despite the fundamental differences between the sexes. In the context of women's relationship with computers in an operational context, Spender (1995) refers to women's fear of causing pain and inconvenience if they crash a system; of their need to know all the instructions and rules first; and to have contingency plans in place. This manner of operating is at odds with the masculine way of operating where men are socialised to achieve, be assertive and take risks and to display courage.

Recent research continues to advocate that inherent biological differences between the sexes explain the disparities in the use of technology. Inherent gender differences are emphasised in IS research by Venkatesh and Morris (2000). Their study examines gender differences in technology acceptance and usage behaviour in the context of underutilised IS. The findings of this research suggest that men and women are inherently different with respect to technology adoption and usage. Perceived usefulness is identified as a strong determinant for men. The research implies that women typically display lower computer aptitude and higher levels of computer anxiety than men. Hence women are influenced by perceived ease of use and even subjective norms (the influence of others). The recommendations are that to increase women's computer self-efficacy, computer systems designers and trainers should emphasise productivity-related factors for men, and a more balanced analysis for women which incorporates user-friendliness and peer acceptance.

The study was continued by Venkatesh, Morris, Davis and Davis in 2003 when they developed a unified technology acceptance model based on the original technology acceptance model (TAM) by Davis (1989). In their earlier research (Venkatesh et al. 2000), inherent gender differences had been stressed. In the later study, Venkatesh et al. (2003, p.449) were more circumspect with statements such as "gender schema theory suggests that such differences stem from gender roles and socialization processes reinforced from birth rather than biological gender per se". This suggests a revised approach to gender differences in the adoption of technology which leans towards a social constructivist stance where gender differences are not grounded in biology but recognised as learned behaviours.

Juxtaposing the essentialist argument is social constructivism. Social constructivism is a sociological theory of knowledge made prominent by Berger and Luckmann (1966) that considers how social phenomena develop in particular social contexts. This approach is associated with the interpretive paradigm for informing the manner in which individuals and groups participate in the creation of their perceived social reality.

Until recently, many public domains were, and some still are, dominated numerically by men. Cockburn (1992, p.39), in a study of gender, technology, and power, states that "… men as a sex dominate women as a sex, a relation in which technology is implicated". The knowledge constructed supposedly reflects the male view of reality since men's experiences are generalised as the norm. Thus, the distinct character of women's experience is less visible. Wajcman (1991), an extensive researcher of gender and technology, claims that women's experiences are both inadequately recognised and inappropriately valued. Furthermore, both Wajcman (1991) and McKenna (2000) argue that gender stereotypes are deterministic and serve to reinforce the traditional notions of masculinity and femininity.

The social shaping of technology as masculine is based on the understanding of knowledge as socially constructed, namely, both gender and technology are socially constructed. (Cockburn 1992) A growing body of feminist literature has examined the gendering of technologies in a variety of contexts (Wajcman 2000). Recent research amongst computing professionals confirms that, although technology is presented as gender neutral, closer investigation reveals a male bias and "technology is far from neutral" (Cockburn 1999, p.127).

Pringle (1988), in Australian studies of workplace technologies, observes that the assumptions and characteristics attached to women and men are also attached to the technologies they use. Consequently, technologies are allocated on the basis of assumptions related to gender appropriateness. For instance, typewriter and piano keyboards are considered appropriate for women by being associated with feminine interests and nimble fingers, while technologies of war and production are equated with masculine virility and power. In European studies of workplace and household technologies, Cockburn and Fürst-Dilic (1994) affirm the distinction that women and femininity are reproduced as domestic, thereby representing repetitive and low value work. Wajcman (1991) claims that defining technology as masculine is fundamentally responsible for the existing gender division of labour. Cockburn (1983) identifies women's exclusion from technology as a consequence of the gender division of labour and the male domination of the labour market.

The individual differences approach to gender and technology usage is more recent and still emerging. Responding to the claim by Adam et al (2004) that the topic of gender and IT is understudied and undertheorised, Trauth (2002; 2006) identified the need for an alternative theory to explain the underrepresentation of women in IT. According to Trauth (2006), individual differences theory represents the middle ground between the essentialist argument and the social constructivist perspective. Trauth (2006) asserts that individual gender differences exist on a continuum since women are individuals, have distinct personalities, experience a range of socio-cultural influences, and exhibit a range of responses to the social construction of technology. In other words, the theory enables the investigation of "the individual variations across genders as a result of the combination of personal characteristics and environmental influences … with the focus on within rather than between genders" (Trauth 2006, p.1156). Subsequent work focuses on refining this theory of individual differences (Trauth, Quesenberry & Morgan 2004; Quesenberry, Trauth & Morgan 2006; Trauth 2006).

Individual differences theory, which assumes an interplay of individual personal characteristics with social and environmental influences, suggests some parallels with the duality of structure from structuration theory where institutional properties of social systems are shaped recursively and reflexively as the result of human actions, which in turn reshape human actions through effective

communication. Structuration theory, developed by social theorist Giddens (1984), is purported to be a means of breaking free from the weaknesses of functionalism that underplay the importance of human action, and the contrasting interpretive sociology that is "strong on action, but weak on structure" (Jones 1999, pp.106-107). While Giddens does not explicitly mention gender in his writings on structuration theory, in his later works (2001), he reveals attitudes sympathetic with gender theorist, Connell, and his theories of gender relations (1987, 2002).

The three theoretical perspectives on gender and technology form the conceptual framework for the analysis of the data from the case study along with references to Connell and Giddens whose views on gender provided additional insights.

Research Design and Methodology

The research methodology for the study was qualitative and ideographic where the world of cotton growing is understood through obtaining first-hand knowledge of participants and the context of the study by adopting an empathetic epistemology. It was anticipated that an in-depth, subjective study using selected information-rich cases would provide deeper understanding than gathering standardised quantitative data from a large sample of the population. Data was collected from 32 participants in the Australian states of southern Queensland and northern New South Wales over a three year period from a pilot study, two main field studies, and one telephone study. Participants were clustered into two stakeholder groups: the members of the first group were family cotton growers, mostly women; the members of the second group were cotton industry professionals.

The members of the first group were purposefully selected based on the following criteria: 1) farmed in the Australian eastern states of Queensland or northern New South Wales; 2) were responsible for - owned or managed - family farms irrespective of size (as distinct from farms owned by large corporations); 3) indicated an awareness of environmentally sustainable and high-technology farming practices; and 3) were registered on a Wincott (Women in Cotton Network) and/or *CottonLOGIC* database. *CottonLOGIC* is a farm management suite of software programs, developed in Australia at the Australian Cotton Research Institute (ACRI) in the late 1990s and the early 2000s, to aid the management of cotton production. *CottonLOGIC* consists of record-keeping and decision support modules to assist cotton growers and their advisors in the management of cotton pests, soil nutrition, and farm operations. It provides for the recording and reporting of crop inputs and yields, insect populations, weather data, and field operations such as fertiliser and pesticide applications. As well,

CottonLOGIC enables the running of insect density prediction and soil nutrition models for decision support (CRDC 2005).

The second group of participants were agronomists and consultants, rural extension officers, researchers and educators, rural experimental scientists, and *CottonLOGIC* developers who were also located in Queensland or New South Wales. As cotton industry professionals, all these participants had some knowledge of agricultural DSS either through development, usage, research, or teaching. In addition, the professionals had some understanding of and had observed and/or advised the activities of cotton growers.

The interviews were semi-structured with the average duration of an hour and were recorded with the consent of participants. At the interview, each participant was given a paper-based Information Statement (to retain) and a Consent Form (to sign and return to the researcher). On the Consent Form, participants were invited to enter voluntarily their personal characteristics which many of them did. These included age, highest level of education completed, the ages of their children (if any), and their occupation. These statistics have been compiled into Table I attached. The unit of analysis was at the individual level, the Australian women cotton growers. In a sense, the farm is also a unit since the women together with their farm partners represented the farming enterprise, whose activities were explored. As soon as possible, the interviews were transcribed from audio tape into Microsoft Word. Because the quantity of interview data was workable and because of the need to stay closely connected with the data, manual analysis rather than computer-assisted analysis was used. Hand coding was done with codes, themes, concepts and comments written into the margins of the transcripts and key passages highlighted with variously coloured pens. The outcome is rich insights into the lives of participants.

Analysis of Farm Management and Technology Use

In this section, gender differences in farm management practices and technology use are drawn from the interview data. While essentialism and social constructivism were difficult to categorise, they were also found to be inadequate in explaining what was taking place, thus prompting the authors to consider the emerging theory of individual gender differences.

Inherent Gender Differences

The essentialist approach to gender differences is based on the view that intrinsic biological differences determine gender differences. Turkle (1984), and Venkatesh and Morris (2000) claim that inherent differences between the sexes are responsible for the different behaviours between men and women in the use of technology. Giddens (2001) and Connell (1987, 2002) both reject the validity of

this view since they claim that it neglects the important role of social interaction in shaping human behaviour (Giddens 2001, p.108). In the study, the essentialist approach was well established especially in discourse on the distinct ways that men and women used technology, performed office tasks, and communicated.

Technology Use

George, a cotton industry professional, had retired from his role as an independent rural industry consultant. From 1999 to 2003, he had been commissioned by the Australian Cotton Research Institute (ACRI) to provide feedback in the form of several reports regarding the impact of *CottonLOGIC* on the cotton industry. During that period, George had consulted numerous cotton growers, agronomists, extensions officers and agribusiness staff, and had formed very clear opinions on how cotton growers interacted with technology.

> **George (professional)**: In general, women are less interested in seeing how it works than in what it can do. Men are very much interested in how it works and what technology problems it has … and how to get the data in and out [of the computer]. When the data goes in and out, it's in analysing the data that the women come in.

Nicole and Helena, both cotton growers, had identified gender-defined tasks associated with the farm office. For example, male farmers seemed reluctant to prepare farm accounts or fill out forms. Nonetheless, it was uncertain whether this was due to an innate inability or, as more likely, an unwillingness to work inside in the farm office because of a fondness for spending time outside.

> **Nicole (grower):** Men don't like that sort of stuff. Men can't handle bookwork.
>
> **Helena (grower):** Fellows won't do it – fill out forms like gun licences.

The avoidance tactic was identified by Julia, another grower. She deduced that perceived inherent differences may just be a convenient excuse for avoiding unpalatable tasks, and that men, in fact, can perform office work such as preparing government fuel rebates when it suits them or when there is no option.

> **Julia (grower):** So yeah he [male farm partner] will do things...so I mean he doesn't touch too much of the paperwork cos he... but fuel rebates or things like that. I think that is only because I said that you [male farm partner] can do that one.

Communication Skills

Some participants in the study attributed women with distinct gender-based qualities. Naomi, a cotton extension coordinator with the Queensland Department of Primary Industries (DPI), had amassed valuable insights into the use of decision support tools, computer-based or otherwise. She identified that male and female agronomists have each acquired the same knowledge, skills and experience, yet there appeared to be essential differences in how they communicated and in how they went about accessing information.

> **Naomi (professional):** It's really interesting actually because there's a lot of women working in cotton. If you look at agronomists, then male and female, there's no difference in the information acquired. There's differences in how they interact and how they seek information.

Ben, a male educator teaching cotton courses in a Queensland rural university, described alleged inherent gender differences from his observations of male and female students in his classes. Ben thought that male students were keener to socialise than the female students. He felt that female students overall were more able, confident, and conscientious than many of the male students who had a tendency to mask their lack of knowledge and ability with social chat. This did not deceive potential employers. Consequently, female graduates were in more demand as consultants than male.

> **Ben (professional):** The female students tend to be very confident and some clients prefer to have access to the female consultants. A lot of male students tend to rely on the gift of the gab or the bullshit factor to communicate with growers whereas female students don't tend to be comfortable with that and they rely on ability. With some of the male students, they use the art of conversation to mask lack of ability whereas the female students are a little more honest and rely on their knowledge skills.

In summary, distinct gender differences in farm management functions and technology use were reported. For instance, some interviewees were convinced that certain traits were male or female, such as the male propensity to avoid office work and women's tendency to keep financial records. However, the reasons for tasks being gender-defined were not clear and may have been due to the fact that roles had been socially constructed in the context of the family farm or due to individual preferences. As the following section shows, gender-defined roles can be reversed.

Socially Constructed Gender Differences

There are several viewpoints to the social constructivist perspective of gender differences. One is the belief that gender is culturally learned and sex is biologically determined. Both Connell (2002) and Giddens (2001) reject this approach as unsustainable since people are not passive but active agents "who create and modify roles for themselves" (Giddens 2001, p.108). That is, people often make their own decisions regarding their gender roles despite social coercion from family, peers, and communities (Connell 1987). There is a second approach that regards both gender and sex as entirely socially constructed with no biological basis. Namely, the human body is both agent and object of social practice since societal forces and choices variously shape and alter it (Connell 2002, p.40; Giddens 2001, p.109). This argument is also untenable since sex may be indeterminate. Thirdly, there is the social shaping of technology approach which focuses on technology (and farming which is also male-dominated) being socially shaped as a male domain (Wajcman 1991; 2000; Cockburn 1999; McKenna 2000). In order for women to be successful with technology, they must adapt to a masculine bias (Trauth, Nielsen & Hellens 2000). The social shaping standpoint is examined below.

According to the Australian rural literature (James 1989; Board 1997), women's roles extend from household and farm worker/manager to carer of children and elderly. Men's roles are traditionally associated with agricultural production and marketing aspects of farming with more time spent outside (Alston 2000). Stewart (1997) found that ideologies of both technology and family farming are socially shaped. In essence, both technology and farm roles are gendered according to whether they are predominantly based indoor or outdoor. Sarah and Helen are both growers. Assuming that technology is gender-defined, Sarah and Helena each expressed their preference for tasks classified as female, such as maintaining accounting records and up-to-date inventories for seeds, fertiliser, chemicals, and spray regimes, rather than outside jobs.

> **Sarah (grower):** I like keeping records not changing siphons. By law, you need to keep records [sprays and notifications of intent to spray].

> **Helena (grower):** I want to keep records. I like keeping records.

Julia, a grower, recounted her childhood experiences in a rural community which resulted in low self-esteem. She claimed that by developing useful computer skills with the support of her farm partner and despite the negative advice of her parents, she overturned that attitude. The argument that socially constructed traditional gender norms can be reversed was also demonstrated through family role models. Julia's male farm partner grew up accustomed to seeing his father cooking and did not associate the kitchen with being solely a woman's domain.

> **Julia (grower):** I think it helps that his father was a cook, was actually a baker as well but even though he [husband] was doing small cropping, so he grew up with the idea that the man of the house was making meals so it was not something that it was unusual. Whereas in some households the men do nothing and never go in the kitchen and the sons expect that's how it should be. So I'm lucky in that way.

The ability to alternate tasks makes each family member more valuable in the context of a family farm where a diversity of skills is a valuable asset. For her part, Julia preferred to drive a tractor than do housework and did not necessarily associate a tractor as being male technology.

> **Julia (grower):** If he needs me a bit, like if he's flat out. And I don't mind. I'm not a lover of housework. I've got a good excuse. I'd much rather go and sit on the tractor than do housework.

In brief, while there was strong support in the study for the social shaping theory, nevertheless it failed to completely explain not only the differences (and similarities) *between* genders but the differences (and similarities) *within* genders. The study revealed growing support for a theory of individual gender differences in farm management and technology use.

Individual Differences Approach to Gender and Technology

Responding to claims that the topic of gender and technology is understudied and undertheorised (Adam, Howcroft & Richardson 2004), and aware of the need for an alternative theory to explain gender differences, Trauth (2002) proposes the individual differences approach. This theory stemmed from findings in the "odd girl out" study by Trauth (2002) who contends that both individual characteristics and environmental influences are responsible for the manner in which each woman interacts with technology. In later papers (Trauth, Quesenberry & Morgan 2004; Quesenberry, Trauth & Morgan 2006; Trauth 2006), this theory is extended to comprise three general constructs. One construct is *individual identity* which includes personal demographic, lifestyle, and professional attributes such as age, race, job title, and the area of technical work. The second construct is *individual influences* or shaping factors. These personal characteristics are educational background, significant life experiences, and personal influences. The third construct is the *environmental context*, incorporating the influence of cultural attitudes and values. As Trauth (2006, p.1155) explains, women's relationship with technology looks to societal rather than biological forces. Individual difference theory proposes that collectively these constructs influence the individual relationships of men and women with technology (Trauth 2006).

Individual Identity: Age

With reference to Table I, the majority of study participants were in the age range 25 to 44. In exploring the age factor as an individual identity from the first construct identified by Trauth (2006), there is evidence that generational change is occurring. Over recent years, with the acquisition of material and intellectual freedoms from social conventions, women have also acquired opportunities freeing them from gender-defined roles. In the main, women no longer tolerate domination by men. Despite accelerating societal cultural changes, Selma, a grower, was outstanding. She worked a great deal in the farm office but her involvement in industry grower associations meant that her role on the farm extended beyond bookkeeping and human resources towards strategic production decisions. Selma was involved in marketing, selling and buying, as well as investment decisions, tasks which have traditionally been in the male domain. She had very firm views on the running of a successful cotton and cattle property, and the importance of good management. Therefore, it was Selma, not her farm partner Bill, who noted that he should have more involvement in farm management with a reduced emphasis on outdoor work. This comment implied a reversal of the commonly accepted attitude that inside office work (unlike outside physical work) is not considered to be real work.

> **Selma (grower):** I'll deal with interest rates. I'll sell cotton. I'll make decisions about options, and things like that. He'll [farm partner] have no hassles with that. He's a fair bit

more liberal than the traditional guys. We work as a team really. I'm more focussed on the administration side of things. Bill is more focussed on the day-to-day running, and keeping out of the office which he shouldn't do. He needs to be more involved. I think Bill's a bit different to most of the farm blokes around. I know blokes who don't let their wives get mail from the post office.

Researcher: Is that your age group?

Selma (grower): No, I'm talking another ten years older. Oh, yeah, twenty years older.

In some instances, the age factor impacted on cooperation and collaboration in farming operations, in other instances, it did not. Sigrid, an experimental scientist with the CSIRO, illustrated with an example of her own parents.

Sigrid (professional): I think each individual case is different. Some women have absolutely no idea what their husband is doing [on the farm]. Some work together, and some like Mum and Dad are more into collaboration. Dad's out there feeding the stock and Mum's doing the accounts. While he's on a tractor, she may be moving a mob of sheep, or she may have some cattle out on the road ….

The comments by Selma and Sigrid reinforce the findings of Bamberry, Dunn, and Lamont (1997) that a more comprehensive approach is now needed for farm management, and that multidisciplinary skills in human resources, finances, marketing, risk and change management are required to compliment traditional skills in crop and livestock husbandry, which may necessitate involving the whole family in the partnership.

Individual Influence: Educational Background

Educational background as an individual influence (second construct) was an important indication of how participants interacted with technology. With reference to Table I, the majority of interviewees had post-school education. Uma was married to a cotton grower and she had been tertiary trained as an agronomist. While many of the growers had some measure of difficulty using *CottonLOGIC*, because of her technical and rural background, Uma used *CottonLOGIC* with ease.

Uma (grower / professional): It's not a difficult program to use really. I don't find it difficult.

Studies by Johnson and Powell (1994) and Powell and Johnson (1995) evaluate the psychology literature on the role of gender differences in managerial decision-making and risk propensity. One of the premises of their research was that gender differences have been ignored by the designers of DSS. The literature search by Johnson and Powell (1994) determined that pre-1980, the accepted view was that there were clear gender differences. Post-1980 literature implies that gender differences were in the degree of confidence in decision choices and in risk propensity. Powell and Johnson subsequently performed their own studies (Powell & Johnson 1995) which found that, despite stereotyping, gender is not explicitly identified as a moderating factor in the performance of cognitive tasks. Empirical evidence suggests that in a formally trained population, with similar

levels of experience and intellectual ability, and with equal access to information, gender differences in the nature and quality of decisions are not significant. In terms of this study, it appeared that appropriate and adequate formal training in agronomy reduced the gender distinctions in many cases.

This trend was confirmed by George who observed that gender distinctions were not especially apparent in the workplace although they were apparent in the context of the family farm where gender divisions of labour were more usually applied.

> **George (professional):** When the women have a professional background, the distinction between men and women disappears. If we look at the female consultants, they have the same issues as the men, generally speaking distinctions disappear. It's when they come back in the family roles …

For Reese, a young consultant, her agronomic training meant that *CottonLOGIC* was not difficult to use, was not just a software tool for men, and was an indication that women can succeed in science, even if the discipline has been socially constructed as a male domain.

> **Researcher:** With CottonLOGIC and the workshop, did you get out of it what you wanted?
>
> **Reese (professional):** Yes, I got a lot out of it. Because I basically taught myself how to use it, like just going in and mucking around and figuring out what different types were.

Environmental Context: Cultural Attitudes

The third construct is environmental context. While this construct is reminiscent of social shaping in social constructivism where the ideologies of both farming and technology are perceived as masculine, it remains today that only highly motivated and exceptional women will succeed as farmers. In response to a need for social networking and technical knowledge, women cotton growers have recently formed a women's network called Wincott. Wincott (2006) is an organisation that aims to "provide support, information and resources to encourage and empower women in the cotton industry to attain skills, confidence and to have an informed 'voice' in the agricultural sector". Membership is free and open to all who wish to participate. Diane, a grower service manager for an agribusiness, observed that, in the main, women continue to be excluded from rural decision making and leadership positions while they struggled with technical skills and agronomy know-how. Nevertheless, there was alleged opposition from some male farmers who felt threatened by the possible encroachment of the women on their farming sphere.

> **Diane (professional):** … however what they [male farm partners] don't realise is that a lot of women don't have that science and fulltime background, then they'll never be engaged as an equal in those sorts of the conversation, even if they do know exactly what they are talking about … some of the men are a little bit threatened about the formation of women's group. They don't know why they need to and they don't see that, cause the blokes aren't intentionally trying to cut people out of being involved in a grower's association or an area wide management group …. I know with the formation of the Wincott group up here, there's

been a few blokes, oh why do you need to do that, why do need something special for you guys?

George, an independent consultant, observed that in many cases, the perception of farm women is still unflattering since farming remains a male-dominated industry.

George (professional): The women are starting way behind the eight ball. Even if they are intellectually far ahead of the farmer, they are perceived as way behind the eight ball. Half of the time it's their [woman farm partner's] money which keeps the farm going, but they're [women] disempowered in other ways so if you can get this technology [CottonLOGIC] to redress the power balance…

Diane noticed that women were often just as interested in the more technical aspects of production as the men. They appreciated being able to learn and work alongside their male farm partner.

Diane (professional): The other thing I find interesting is when they have the IPM [Integrated Pest Management] courses, even leadership courses and things like that, it's never just the blokes that go, it's the blokes and their wives. I think that shows their interest.

Consequently, it is apparent that many of the farm women no longer regard skills in technology and farm management as solely a male's domain. Rather, the consensus is that the task should be performed by the person best suited to doing it. In reality, the onus is on the individual, within the bounds of abilities, preferences, farming demands, and family constraints, rather than broader societal expectations. This is a more reflexive and honest approach to relationships in gender, technology and farm management and is the one which offers farm management the most potential.

Findings and Discussion

Three conceptual perspectives on gender have been used to examine the interplay between Australian rural women, particularly women cotton growers, and farm management software such as *CottonLOGIC*. In response to the first research question proposed earlier in the paper, **"**How do Australian women cotton growers interact with technology for farm management?", the study revealed that women growers, as a rule, are hindered in their use of farm management software by their lack of agronomy knowledge rather than their computer skills. This conduct was exposed through the contrast with women industry professionals who were far more assured in their engagement with *CottonLOGIC*. Nonetheless, the women cotton growers displayed a preparedness to accept any challenge and surmount any obstacles for the sake of the family farm partnership, even to the extent of embracing farm management software. This finding is aligned with that of Bamberry et al (1997) that good farm management relies on the information processing skills of the whole farm management team.

The response to the second research questions, “Are there gender differences in farm management and technology use? If so, how are these explained?” is complex with no simple answer. Adam et al (2004, p. 235) refer to the tendency in IS research to dichotomise gender through a preoccupation with intrinsic male and female characteristics. The study revealed that some participants perceived distinct gender traits in the conduct of men and women cotton growers. For example, females were reputed to be less interested in technology per se and more conscientious students than males. The basis for gender distinctions was not clear and may have been due to the fact that roles had been socially constructed along traditional lines in the context of the family farm. By and large, the women growers worked in the home office while their male partners appeared to be more comfortable away from the house and out in the fields, confirming the findings of Stewart (1997) that both technology and farm roles are socially shaped. Nevertheless, while there was strong support in the study for the social shaping theory, it also failed to completely explain differences within and between genders. Some women growers were exceptional in their individualistic approach to technology and farm management. Evidence from the study suggested that social influences such as age, education, and cultural attitudes helped to shape these outstanding women.

The response to the third research question, “What are the implications for software designers and developers?” has the potential to provide guidelines to software designers and developers on making farm management software such as *CottonLOGIC* more acceptable to rural women users and users overall. This is apt since the Australian cotton industry is currently reviewing its investment in computer-based decision support (The Australian CottonGrower 2005) and adoption rates of agricultural DSS remain disappointingly low (Cox 1996, McCown 2001). All the same, this paper is in no way a business plan for the implementation of a future cotton DSS program. Some of the suggestions, based on findings from the study and with a particular focus on the societal aspects, are:

- Involve women cotton growers in the design, construction, testing, promotion, delivery and evaluation stages of farm management software development
- Consider the notion of multidisciplinary teamwork which suggests that a diverse range of skills and experience are valuable for the family farm business
- Note the importance of education and consider communication through a variety of industry channels such as *CottonLOGIC* courses. Topics to consider are:

    - Include an agronomy component for women cotton growers

- Conduct some courses through Wincott, the organization to which many of the women cotton growers belong
- Conduct gender-aware workshops (some with farm partners and some without)
- Offer distinct workshops for novice (cotton growers) and experienced (professionals) users
- Increase interactivity in workshops, possibly linking with field days and family participation

As the study by Bellamy et al. (2002) found, there is scope for women in the cotton industry to increase their involvement at all level of decision-making on family farms, especially on a day-to-day basis, if they choose. After all, this is only fair.

Conclusion

This paper has provided an interpretive account of the social aspects of information systems (IS) use by exploring the interplay between Australian rural women, particularly women cotton growers, and farm management software such as *CottonLOGIC*. The study documents growing evidence of individual differences in the interaction of men and women cotton growers with technology and farming. This tendency was noticeable when individuals performed certain tasks for which they were neither inherently endowed nor socially obliged. For instance, several women displayed radical choices in performing tasks such as irrigating or selling cotton that had traditionally been male roles while men ably assisted in household duties when necessity dictated. By supplanting the essentialist and socially constructed approaches to gender differences, the study gave validity to the emerging concept of individual differences by Trauth (2002; 2006).

Adam, Howcroft and Richardson (2004) claim that there is a dearth of interpretive literature on gender and technology. This paper fulfils the criteria by being an interpretive case study that seeks to understand how women cotton growers use agricultural farm management software and the implications for their roles in the family farm partnership as a business enterprise. Furthermore, this study has broader significance by providing guidelines on how farm management software can be made more acceptable to the growing group of rural women users.

In conclusion, this paper responds to issues raised by Trauth and Howcroft (2006). It responds to the methodological challenge for reflexive inquiry by (Trauth & Howcroft 2006, p.287) through a critical examination of the social aspects of IS use. This paper also responds to the theoretical challenge (Trauth & Howcroft 2006, p.288) by shifting away from essentialist theories which

dichotomise men and women towards a recognition of the value of diversity. While gender divisions of labour still exist, there is evidence that individual differences harnessed prudently are integral to the survival of farm partnerships

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Table I: Aggregated Data: Demographics of Participants in the Field Studies*								
Participant's Attributes	**Number of Women**				**Number of Men**			
	P	**E**	**N**	**B**	**P**	**E**	**N**	**B**
Age Under 25	1							
25-44	6	3	6	4			4	1
45-64	1		2			1	1	
Over 65								
N/A						1		1
Children's Ages PreSchool	1	2	2				1	
Primary	5	1	3	2			2	
University			3				1	
Independent	1		4			1		
N/A	2	1	3	2		1	2	2
Highest Education Level Achieved Primary								
Secondary	5		1					
Certificate/Diploma	2	1	3				1	
Degree		1	4	1			1	
Postgraduate Degree	1	1				1	1	
N/A				3		1	2	2
Occupation Grower	6	2	3	3			2	1
Professional	2	1	5	1		2	3	1
	23				9			

*Field Studies P = Pilot Field Study in November 2002
E = Emerald Field Study in June 2003
N = Narrabri Field Study in April 2004
B = Phone Interviews incorporating DSS Business Plan Consultancy for the CRDC in July 2004