Journal of Rural Studies 81 (2021) 315–323

Contents lists available at ScienceDirect

Journal of Rural Studies

journal homepage: www.elsevier.com/locate/jrurstud

Securitising uncertainty: Ontological security and cultural scripts in smart farming technology implementation

Melanie Bryant [a,*], Vaughan Higgins [b]

[a] Tasmanian School of Business and Economics, Private Bag 84 Centenary Building, University of Tasmania, Hobart, TAS, 7001, Australia
[b] School of Social Sciences, Locked Bag 1340, University of Tasmania, Launceston, TAS, 7240, Australia

ARTICLE INFO

Keywords:
Smart farming
Technology implementation
Uncertainty
Meso-scale actors
Ontological security
Cultural scripts

ABSTRACT

Smart farming technologies are primarily associated with the transformation of agricultural productivity. Despite this, empirical research focusing on farm-level application of smart farming reveals a more complex and nuanced picture characterised by considerable uncertainty over its implementation and use. In this paper we seek to extend farm-level research by investigating two questions: how do perceived uncertainties destabilise *meso-scale actors'* routines and practices that are critical for 'supporting farmer learning about the nature of digital data and its interpretation' (Eastwood et al., 2019: 8); and, in what ways do meso-scale actors seek to re-establish a sense of stability and, in doing so, manage the uncertainty associated with smart farming implementation, and technological change more broadly? To address these questions we investigate the findings from a qualitative study of 20 meso-scale actors involved in the planning and implementation of smart farming technology in the Australian rice industry through an ontological security lens. We refer to meso-scale actors as farm advisors and agronomists whom we argue play a critical role in the uptake of smart farming technology. In applying this lens we argue that the perceived uncertainties related to smart farming de-stabilise or de-securitise actors' day-to-day roles and routines, impacting on who they are and what they do. We then demonstrate that actors draw upon two specific cultural scripts as a way to re-securitise their uncertainty. The first script seeks to securitise resource uncertainty by drawing upon known discourses surrounding farmer adoption of technology, while the second reproduces the importance of technologies that are easy to adopt while downplaying the importance of smart farming technology. While at face value these scripts can appear to create barriers to smart farming adoption, we argue that they can be a catalyst for developing solutions to uncertainty in terms of making smart farming more workable at the farm-level.

1. Introduction

Smart farming is an area of growing attention by rural social scientists (e.g., Eastwood et al., 2019; Higgins and Bryant, 2020; Carolan, 2018; Regan, 2019). Encompassing the use of 'sensors, machines, drones, and satellites to monitor animals, soil, water, plants and humans' (Klerkx et al., 2019: 2), the broad aim of smart farming is to improve agricultural productivity through identifying, monitoring, analysing and representing 'spatial characteristics of agricultural production in digital formats' (Ayre et al., 2019: 1). Smart farming technologies are widely expected to transform agricultural production, and food systems more broadly (e.g., Oliver et al., 2013; Gebbers and Adamchuk, 2010; Lindblom et al., 2017), as conventional farming processes 'become increasingly data-driven and data-enabled' (Wolfert et al., 2017: 70). However, empirical research on the farm-level application of smart farming reveals a more complex and nuanced picture characterised by considerable uncertainty over its implementation and use.

Similar to other new agricultural technologies, smart farming is argued to create uncertainty around costs and benefits, which delays or reduces the likelihood of farmer adoption (Eastwood and Renwick, 2020; Marra et al., 2003; Abadi Ghadim et al., 2005). This is because smart farming contributes to a 'change in mode of working for farmers, transitioning from experiential decision-making to data-driven processes' (Eastwood et al., 2017: 2). In such cases, farmers may be wary of changes that 'differ significantly from which they are familiar and comfortable' (Robertson et al., 2012: 194) and which involve a shift in their identity from cultivators to office managers (Tsouvalis et al.,

* Corresponding author.
E-mail addresses: Melanie.Bryant@utas.edu.au (M. Bryant), Vaughan.Higgins@utas.edu.au (V. Higgins).

https://doi.org/10.1016/j.jrurstud.2020.10.051
Received 3 August 2020; Received in revised form 20 October 2020; Accepted 27 October 2020
Available online 12 November 2020
0743-0167/

2000). This is likely to be exacerbated by negative experiences with smart farming technologies, such as problems with compatibility (Higgins et al., 2017) or access (Carolan, 2018), which may act to stall uptake from farmers who are already struggling with adaptation to new modes of working (Eastwood and Renwick, 2020). Meso-scale actors, such as farm advisors and agronomists, are identified as playing a critical role in managing farmer uncertainty to increase uptake of smart farming technology (Eastwood et al., 2017, 2019; Rijswijk et al., 2019; Ayre et al., 2019). Yet, there has been limited research to date on the ways in which meso-scale actors themselves experience uncertainty, and the implications for how they manage smart farming implementation. These are issues that we engage with in this paper.

Smart farming involves a significant shift in what Ingram (2008) terms 'farming paradigms', and a departure from routine advisory practices that creates considerable 'uncertainty … and complexity in integrating scientific and technical knowledge with farmers' own knowledge in the new topic area' (Nettle et al., 2018: 21). While this may be addressed through meso-scale actors adapting or forming new advisory routines, identities and practices (Eastwood et al., 2019; Ayre et al., 2019), it is recognised that greater attention is needed to the 'uncertainties of change' for meso-scale actors, and 'the challenges of integrating new knowledge and information into services' (Nettle et al., 2018: 26). This paper contributes to knowledge in this area by addressing two research questions: (1) how do perceived uncertainties destabilise meso-scale actors' routines and practices that are critical for 'supporting farmer learning about the nature of digital data and its interpretation' (Eastwood et al., 2019: 8); and, (2) in what ways do meso-scale actors seek to re-establish a sense of stability and in doing so manage the uncertainty associated with smart farming implementation, and technological change more broadly?

In this paper we engage with these questions using the theoretical lens of ontological security. Ontological security refers broadly to an individual's sense of feeling safe in the world, including their level of trust for other people, and in established routines and relationships in which they engage (Giddens, 1991). Giddens (1991) argues that high modernity in the form of globalisation, forced migration, or privatisation (see also Kinnvall, 2004), has led to the creation of new risks and dangers that are not only experienced at a societal level, but also 'intrude deeply into the heart of self-identity and personal feelings' (Giddens, 1991: 12). These risks and dangers create ontological insecurity through destabilising existing social norms and practices. Consequently, individuals seek out trusted means to neutralise or *re-securitise* such threats (Kinnvall, 2004; Kinnvall and Lindén, 2010). An analytical focus on ontological security provides a conceptually coherent approach for addressing the research questions and contributing to understanding the role of meso-scale actors in smart farming, in two important ways. First, it enables a more sustained emphasis on how 'changes in the way farming is conceived and understood' (Nettle et al., 2018: 21), involve fundamental disruption to existing routines and roles for meso-scale actors. Second, it shows that efforts by meso-scale actors to manage uncertainty within 'new professional situations' (Cerf et al., 2011: 10) created by these changes, are tied to re-establishing a sense of ontological security. This has important implications for the ways in which meso-scale actors respond to and deal with uncertainty in a smart farming context.

In developing our arguments, we draw on the findings of a qualitative study of 20 meso-scale actors – including managers, consultants, agronomists, and researchers – involved in the planning and implementation of smart farming technology in the Australian rice industry. Throughout this paper we refer to these actors as 'industry stakeholders' or 'stakeholders'. Specifically, in applying an ontological security lens to the research findings we highlight firstly the perceived uncertainties that de-stabilise or de-securitise industry stakeholders' day-to-day roles and routines, impacting on who they are and what they do, thus, creating a sense of ontological insecurity. Secondly, we examine the different ways in which these stakeholders engage in a process of securitising and creating a sense of ontological security. We show that the use of established cultural scripts about farmers and technology adoption is central to the process of securitising uncertainty. Following Vanclay and Enticott (2011: 260), we define a script as:

> …a culturally shared expression, story or common line of argument, or an expected unfolding of events, that is deemed to be appropriate or to be expected in a particular socially defined context and that provide a rationale or justification for a particular issue or course of action.

Two types of cultural scripts – *commonly used lines of argument* and *socially perceived routines* (Vanclay and Enticott, 2011) – are argued to be particularly critical in securitising uncertainty by providing industry stakeholders with predictable and familiar ways of managing technological change.

2. Ontological security

Ontological security is largely associated with the work of scholars such as Laing (1960) and Giddens (1991) and has been applied to a number of disciplinary contexts. Giddens (1991: 38–39) defines ontological security as a 'person's fundamental sense of safety in the world [including] basic trust of other people. Obtaining such trust becomes necessary in order for a person to maintain a sense of psychological well-being and avoid existential anxiety'. Laing's (1960) work focused on the context of psychiatry in which he argued that an individual's sense of insecurity was heightened by the biomedical approach to treating mental illness. By medically categorising the experience of illness, individuals were more likely to experience being 'differentiated from the rest of the world' (Laing, 1960: 41), as opposed to having their illness viewed and treated as a subjective experience. In comparison, Giddens views ontological security as a consequence of high modernity in which transformation within the social environment impacts on an individual's sense of self (Giddens, 1991: 12). Central to these approaches is the 'fragility of the self … which prompts the desire for a secure identity' (Newton, 1998: 420).

We are particularly interested in Giddens' approach to ontological security in this paper, and fundamental to his arguments are the dual nature of structure and agency. Rather than structure existing externally to individual action, humans 'create meaning and social reality from within social settings, and, therefore, social forms such as institutions and structures have no existence apart from the activities they embody' (Layder, 2006: 164). This means that transformation in the social environment and transformation of the self are inter-related reflecting 'the two poles of the dialectic of the local and global conditions of high modernity' (Giddens, 1991: 32). Therefore, societal change – ranging, for example, from globalisation, through to forced migration or privatisation (Kinnvall, 2004: 743) – is reproduced in actors' self-identity, everyday language, and behaviours. As Kinnvall argues, globalisation has led to greater linkages between nations, economies, and politics, meaning that events that happen elsewhere have become increasingly localised. Consequently, different types of social transformations – regardless of how significant or insignificant they seem – have implications for ontological security for they introduce new elements of risk, which in turn impact on an individual's sense of trust and reliance upon trust mechanisms (Giddens, 1991). As a result, roles, routines, and relationships become destabilised, impacting on reliance upon known outcomes.

Ontological security has been discussed in a variety of settings, which have relevance for our paper. Within the organisational context, scholars such as Knights, Willmott (Knights and Willmott, 1997; Willmott, 1990) and Alvesson (Alvesson, 2010; Alvesson et al., 2008; Sveningsson and Alvesson, 2003) have explored insecurity in relation to identity construction, drawing attention to the multiplicities of selves and the ambiguity and insecurity that these can create in organisational settings. This is reiterated in Collinson's (2003: 541) work in which he draws attention to the important insight that investigating insecurities and identities can provide in relation to how individuals engage in and reproduce power relations. Other scholars focus specifically on insecurity experienced by managers. Garsten and Grey (1997) draw attention to attempts to assuage insecurity caused by widespread organisational change through providing managers with skills to control and normalise anxieties. Gagnon (2008) found that managers engage in identity regulation processes to alleviate insecurities, while Thomas and Linstead (2002: 87) argue that the blurred boundaries associated with the role of middle manager contribute to managers' insecurity in relation to their identity. Ontological security has also been discussed at length in disciplines such as security studies and international relations. For example, Croft (2012) investigates ontological insecurity in the context of British Muslims, demonstrating how their positioning by non-Muslim British groups can cause the insecuritization of identity. In comparison, Kinnvall (2004) highlights the rise of religious nationalism and the re-affirmation of national identity as a way for some nations to address the insecurity caused by the introduction of Western ideas and the perceived decline in ethical values caused by globalisation. Finally, in her work, Mitzen (2006) draws attention to ontological security in world politics, arguing that by attempting to make themselves more ontologically secure, nation states can find themselves in irrational physical conflict with other states.

Regardless of the circumstances in which ontological security has been discussed, at the centre is the importance of an individual's sense of self, which is reliant upon 'the development of a consistent feeling of biographical continuity where the individual is able to sustain a narrative about the self' (Kinnvall, 2004: 746). However, the ability to maintain a stable narrative is compromised by change. A way of tempering the consequential insecurity is to engage with established patterns and routines, including cultural scripts, that provide individuals with tools to make sense of and 'unintentionally reproduce the structures of their worlds' (Speed and Luker, 2006: 696). This is particularly evident in Rossdale's (2015: 327) summary below:

> Ontological security depends on our ability to have faith in those social narratives and routines in which we are embedded and through which our self-identity is constituted … While we can reflect upon such narratives (whether legal, cultural, existential), a certain measure of taking them for granted allows for a sense of agency, for a sense of identity from which we can engage socially … The answers on which our ontological security rests are not stable and enduring truths of the self, but are produced and enshrined by routinized practices (Rossdale, 2015:: 372).

We argue that the significant shift in farming paradigms (Ingram, 2008) associated with smart farming, and the identified need for meso-scale actors to change or adapt their routines and practices accordingly (Eastwood et al., 2019), presents a threat to social narratives that are embedded in their role, their sense of legitimacy and sense of agency. As part of establishing ontological security, these actors are therefore likely to engage in processes that downplay risk and uncertainty, while simultaneously playing up activities that reflect established routines and a sense of stability. We argue that cultural scripts are a key vehicle through which uncertainty is managed and ontological security re-established. We specifically focus on these points throughout the remainder of the paper.

3. Methods

The findings presented in this paper are derived from a larger research project that focused on social issues surrounding the implementation of technology in the Australian rice industry. The project was specifically interested in investigating concerns around low levels of adoption of technologies including smart farming technology. We developed the research from a social constructionist approach (Patton, 2015) in which the focus was on investigating how individual participants experienced and interpreted the program of technology change within the specific context of their roles and interactions with rice growers. In using this approach, our interest is not in attempting to generalise findings across a large sample of participants or across specific occupational or demographic categories. Rather, the strength of the social constructionist approach is that it enabled us to study the unique interpretations and constructions of change that each participant experienced. We recruited 20 participants from across the three primary rice growing regions in Australia, including the Murrumbidgee Irrigation Area (MIA), the Murray-Valley Irrigation Area (MVIA), and the Coleambally Irrigation Area (CIA), all of which are located in South-West New South Wales (NSW). Participants were broadly derived from four occupational groups (see Table 1): management, consultants, agri-service personnel, and research/policy. All participants played a direct role in the technology change either through development and planning of the change and/or implementation.

Several participants were initially identified and recruited across the different occupational groups using purposive sampling. From here, snowball sampling was used to further identify appropriate participants who had been involved in the development and/or implementation of technology change within the rice industry. It is important to note that although we provide information about the occupational groupings of our participants, we have not analysed the data across these groupings, or across different roles or any other participant demographics. From a social constructionist approach, it is important that we focus on the unique experiences that are reported by each participant rather than

Table 1
Participant information.

Participant code	Gender	Position/ Occupation	Role in Change Process
1	M	Management	Development of broader change strategies across the industry
2	M	Management	
3	M	Management	
4	M	Consultant	Private consultancy in relation to implementation of technology
5	M	Consultant	
6	M	Consultant	
7	M	Consultant	
8	F	Agri-service delivery	Broader agricultural advice including technology adoption but also related to change adoption in farming and business processes
9	M	Agri-service delivery	
10	M	Agri-service delivery	
11	M	Agri-service delivery	
12	M	Agri-service delivery	
13	M	Agri-service delivery	
14	M	Agri-service delivery	
15	F	Agri-service delivery	
16	F	Agri-service delivery	
17	M	Research/ Policy	Research and development of new technologies; development and implementation of policy.
18	F	Research/ Policy	
19	M	Research/ Policy	
20	M	Research/ Policy	

seeking to generalise our findings. Each participant took part in a semi-structured interview of up to 1 h in length. Interview questions were divided into specific themes including participants roles and experiences within the rice industry, what participants through were the most important technologies for the rice industry, key barriers and enablers for technology change, any perceived gaps between technologies currently being used across the industry and what should be used, support across the industry for technology implementation, rice grower input into technology change processes, and how technology changes were communicated across the industry. We analysed the data by initially developing open codes that focused on descriptors. Subsequent to this, we engaged in axial coding so that we could investigate contextual relationships between and across codes established through open coding (see for example, Gibbs, 2018; Silverman, 2015). This then formed the basis of a broader thematic analysis across the participant reports so that we could investigate commonalities across the data (Patton, 2015). Two broad themes relating to uncertainty emerged from this analysis. Following the work of Meijer et al. on how perceived uncertainties influence innovation decisions and transition processes (Meijer et al., 2007a, 2007b; Meijer and Hekkert, 2007), we label these themes as *resource uncertainty* and *technological uncertainty*. Meijer et al.'s work has previously been applied to examine how uncertainty impacts farmer adoption of smart farming approaches (Eastwood and Renwick, 2020). However, it has not yet been applied to meso-scale actors involved in smart farming implementation. In the following sections of the paper, we unpack how these two forms of uncertainty contribute to an ontologically insecure environment for participants, and the cultural scripts that they draw upon to re-establish a sense of ontological security, and to thereby securitise those uncertainties.

4. Constructing an ontologically insecure environment

4.1. Resource uncertainty

The first theme derived from the data analysis relates to the uncertainty, and subsequent disruption to roles and routines, created as a consequence of the restructuring that took place in the NSW Department of Primary Industries (DPI) in 2013. This change was reported as having a significant impact on agri-service delivery in terms of drastically reducing the number of publicly funded agri-service providers such as extension officers and agronomists who were previously available to assist growers with changes to their farming systems at little to no cost. We term this *resource uncertainty*, which is defined by Meijer et al. (2007a: 523) as 'uncertainty about the amount and availability of raw material, human and financial resources needed for the innovation' and includes 'uncertainty about how to organize the innovation process'.

The impact of cuts to agri-service delivery is evident in the following participants' comments:

> I was part of the [public] extension structure before … I was a district horticulturalist; my job was no longer there which was a fairly stressful time for everyone when you're going from 400 jobs to probably 50. (11)

> There are now three or four extension people that service an area that used to have 16 extension people … You can't operate the same way as you used to when you've probably got less than 25% of the staff you used to have … [The rice industry] is filling that void by putting extension people out there. But they … won't always be the technical expert on issues, they'll have competencies in that area, but they'll often then call in someone else who's got the [expertise]. (9)

> I think we've now got two agronomists, two extension people … and a graduate trying to answer a lot of questions that public agronomists used to answer … we can't provide the service to growers that we used to. (17)

In this resource-constrained environment, the rice industry attempted to find a solution by relying on and upskilling commercial agronomists to assist in smart farming implementation. However, this created a paradox for participants. Paradoxes are common in environments in which social, political and environmental forces are at play simultaneously (Smith and Tracey, 2016; Battilana and Dorado, 2010), and they require the 'ongoing management of tensions between opposite elements' (Hargrave and Van de Ven, 2017: 321). Participants expressed widespread concern that commercial agronomists were unlikely to prioritise smart farming in their agri-service delivery. For example:

> A lot of agronomists they're really time poor and not very many of them have an interest in sitting in front of a computer processing digital maps, so there is a constraint there that a lot of agronomists aren't really pushing their clients down this path. They're not encouraging them at all to look at [smart farming]. It has mainly been the farmers dragging the agronomists along. (5)

> That's the issue isn't it? They're time poor, and some don't understand [smart farming technology] so they don't push it so hard. 6).

> [Smart farming is] probably a lot of work for not a lot of monetary gain; it's still a service but it can really restrict your ability to get around [to other growers] to do other things. (12)

At the same time, participants reported a knowledge gap in relation to smart farming that created additional barriers for widespread implementation. One of these barriers expands on earlier reports related to the capacity within the rice industry to provide agri-service delivery specifically for smart farming.

> If a grower wanted to adopt [smart farming technology] … in many cases, there just isn't anyone in their area so they've got to look further afield … we might be two or three hours away – which does limit the way you can work with [growers]. You can't afford just to be on their doorstep all the time. There'd be less than five businesses in Australia offering independent [smart farming] consulting; and that's restricting the growth. (5)

> Support for growers depends on the technology … Something like precision ag, there's a limited amount of consultants, whereas something like herbicides or nutrition, you've for all the agronomists giving advice and support. (16)

> I guess in a way the few [smart farming] businesses in Australia are partially a barrier because [growers] haven't got that service for support, it's not there as there are not many companies offering that independent support. (6)

The paradox of increased reliance on commercial agronomists who do not necessarily prioritise smart farming, and a lack of businesses offering specific smart farming expertise, created considerable uncertainty for participants over their capacity to contribute to implementation of smart farming technology in the rice industry. One of the participants summed this up well:

> We've got … two agronomists with the rice, or two extension people with the rice extension group and a graduate up there trying to answer a lot of questions that DPI agronomists used to answer. We've got retail agronomists that have filled some sort of gap which is great, but I think we've got a really big gap on what SunRice is trying to achieve and the growers' understanding of what SunRice are trying to achieve. And I think we need to get that relationship closer. (17)

In doing so, the capacity of participants more broadly to perform their role and contribute to implementation of smart farming technology in the rice industry was judged to be significantly compromised.

4.2. Technological uncertainty

Technological uncertainty is the second form of perceived uncertainty that emerged in participant reports. This is defined by Meijer et al. (2007a: 523) as including 'uncertainty about the characteristics of the new technology (such as costs or performance), uncertainty about the relation between the new technology and the infrastructure in which the technology is embedded … and uncertainty about the possibility of choosing alternative (future) options'. Uncertainty over costs or performance of smart farming technology was a key issue raised by participants. Given ongoing drought as well as water restrictions in the region, participants judged that perceived cost of technology represented a major challenge in promoting implementation of smart farming technology in the rice industry. For example:

> Cost is a big [barrier], perception. And when everyone thinks of new technology I think they would be thinking 'well, how much? This is going to cost me a bomb to do it' … and there's a whole range of things around all that, and can I be bothered? (5)

> I think the big challenge at the moment is how much of any [smart farming technology adoption] you can afford to do … if you own one 200 ha irrigated farm in this part of the world, you're struggling to be viable. It's only if you can increase your scale that you become more viable…. Cost is a big issue. (2)

In addition to uncertainty over cost, participants also identified a lack of smart farming-specific support on the part of machinery dealers. Such support is considered a critical part of the infrastructure for implementation of smart farming technology but was judged to be inadequate. For example, 'how successful this industry is comes back to the machinery dealers and the equipment that growers have got … that's been a massive hurdle in the past and is still a massive hurdle' (10). The specific hurdles reported by participants were related to a lack of understanding and knowledge of product. For example:

> So many machinery dealers really don't know their product capability … Farmers are very price sensitive, so dealers cut the pricing back but sell them a unit that has no upgrade pathway. And then, two years later the grower comes along and says, 'I'd like to do this', and you get, 'well, not with that you can't, it's just not possible'. So there does seem to be some kind of disconnect between the machinery dealers' understanding of what they're selling, and the machinery dealers have no appreciation of the agronomy, what actually happens afterwards. (7)

> There is a massive gap in their [machinery dealers] knowhow of how to couple one system with a compatible technology and getting equipment set up. (6)

> When [growers] buy one bit of gear from one manufacturer and then buy another bit of gear from another manufacturer, they're not compatible … and the software is confusing, and people were using technology to do [simple] stuff. There was a breakdown at the retail level. (20)

Technology suppliers have been identified as important knowledge 'translators', managing innovation uncertainty by 'supporting farmer learning about the nature of digital data and its interpretation' (Eastwood et al., 2019: 8). However, if these suppliers are perceived as sources of innovation uncertainty, this is likely to reinforce stakeholder uncertainty over the extent to which the industry is likely to benefit from smart farming technology.

The two forms of perceived uncertainty discussed above – resource and technological uncertainty – are intertwined with ontological insecurity for the rice industry stakeholders in our study. They disrupt existing roles and routines and destabilise reliance on known outcomes, which may have the effect of delaying or even abandoning innovation decisions entirely (Meijer et al., 2007a). However, threats to ontological security were not simply accepted. As we discuss in the following section, participants in our study sought to securitise uncertainty, and re-establish a sense of ontological security, by falling back on familiar cultural scripts.

5. Securitising uncertainty through cultural scripts

5.1. Securitising resource uncertainty

Despite the perceived resource uncertainties discussed in the previous section, when asked why smart farming had not been implemented more widely in the rice industry, participants typically reported growers' lack of willingness to change their attitudes, behaviour, and practices as key barriers. This is a type of script that can be classified following Vanclay and Enticott (2011: 260) as 'a commonly used line of argument (thread, theme) that is widely invoked in response to a particular issue or situation'. Identifying individuals according to their willingness to change is central to the social-psychological 'diffusion of innovations' approach developed by Rogers (2003) that historically has had a strong influence on extension theory and practice. This linear approach posits a five stage adoption process: knowledge, persuasion, decision, implementation, and confirmation. It is assumed that innovations are economically beneficial and farmers are economically rational actors.

Lack of adoption is explained by the lag time in communication of the innovation from the extension agency to the individual farmer, in how long an individual farmer takes to try out an innovation, and whether the farmer is psychologically an innovator or laggard (Vanclay and Lawrence, 1995). Despite critiques (e.g., Röling, 1988; Ruttan, 1996; Buttel et al., 1990), this approach continues to be used extensively in explaining technology adoption and change processes within farming (e.g., Long et al., 2016; Barnes et al., 2019; Tey and Brindal, 2012). It also remains a prominent approach in extension practice, with Rivera and Sulaiman (2009: 268) arguing that 'most policy makers, ministry officials, research administrators and managers, economists and agricultural researchers cannot imagine any theory of innovation other than the linear model, and continue to adhere to it'.

In our research, the link between attitude of the grower and smart farming adoption is specifically highlighted in the following participant's comment:

> Growers have to have the right attitude to want to implement [smart farming technology] in the first place. And until you've got the attitude right it doesn't matter what we do … Understanding their attitudes and how we change those attitudes is essential. (5)

Attitudes towards engaging in current technologies were also reported by two further participants. For example:

> Growers could invest in new bit of kit that doesn't break down and is more efficient in what they do, yet they resist it and keep choosing to fix the old gear. Why? (13)

> I've got a couple of guys that don't have computers and refuse to use computers. They can't do anything without having to ring someone up and get them to do what they need. They are resistant to change. They do not want to change. (8)

These comments reflect what organisational scholars such as Erwin and Garman (2010); Kotlar and Chrisman (2019) describe as willingness to change, which specifically refers to the level of buy-in – both cognitively and emotionally – that individuals have in terms of specific change processes. The notion of willingness extends to willingness to engage with information about smart farming in the rice industry, as well as willingness to seek out and trust advice from a broad range of sources as is evident in the following quote.

> Some people just won't engage with information about [smart farming]. They are not coming to [grower] meetings, they should be coming to more meetings. They should be reading the information out there … There's a lot of information out there … there's a lot of stuff that just isn't being done. (15)

These views are also evident in participant reports in which older growers were assumed to be too tired to engage in smart farming or as 'set in their ways' (Iverson, 1996: 129), particularly in comparison to younger growers.

> I think as you get older, your appetite for change decreases, you get weary of it. (20)

> I think you'll find older growers are less likely to adopt new technologies. They're probably feeling quite tired by now. (19)

This view is expanded by a further participant who argues that growers who are seeking to exit the industry are less likely to adopt change on the basis that 'they're getting to the end of their farming lifespan …so they're not going to want to go out and buy or get into the new technology if it's only for a short period of time' (8). Further analysis of the data suggests that the routines associated with more traditional methods of farming are more likely to hold older growers back from being open to new technologies:

> Age is the biggest barrier. A lot of older growers … are still doing the same old thing and they haven't changed. But they've done pretty well out it for 20 or 30 years and they're happy. How do we change them? (17)

In comparison, participants judged that younger growers were more likely to implement smart farming technologies. For example, 'the young ones that are coming on are just willing to change tomorrow and adapt technology or adopt technology really quickly' (17); 'there's always more of an appetite [for change from] the younger guys' (20); 'the younger generation always push different change and different opportunities' (3). Several participants even indicated that smart farming technologies are better suited to younger growers. For example, one participant referred specifically to 'the sorts of people who take up technology they're probably the ones who are more familiar with using an iPad' (15) in his explanation of the younger demographic being an enabler of smart farming. The link between age and smart farming adoption is even more specific in the following comment: 'GIS is certainly a good fit for the younger generation who are apt at wanting to get hold of technology' (8).

5.2. Securitising technological uncertainty

Participant responses to resource uncertainty centre on the commonly used line of argument that grower attitudes, characteristics and practices are the principal barriers to adoption. Shifting the onus of change responses from stakeholders to individual growers is a key strategy for participants in securitising uncertainty and thereby contributing to a sense of ontological security. Similarly, perceived uncertainties around smart farming technology contribute to responses that emphasise the benefits of established technologies that are known to be easily adopted by growers, and which have a proven track record of delivering improvements in productivity. Following Vanclay and Enticott (2011: 260), we define such responses as a type of catch-phrase or commonly repeated statement – in this case, 'easy technology' – which 'is frequently cited in response to a particular issue or situation'. This is well illustrated by one participant:

> A norm in the industry is that if there really is a new technology which is obviously more profitable, follow on adoption at times, I think, has been remarkably quick in this industry. But it has to be something that's easy to adopt and easy technology; risk-free [and] obviously something that is clearly profitable; a good benefit-cost. (4)

The catch-phrase 'easy technology' accords with the emphasis on *compatibility* and *complexity* in extension theory and practice. Compatibility is defined by Rogers (2003: 15) as 'the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters', while complexity is defined as 'the degree to which an innovation is perceived as relatively difficult to understand and use'. These attributes are frequently invoked as key factors influencing adoption of agricultural innovations (e.g., Carruthers and Vanclay, 2012; Pannell et al., 2006; Robertson et al., 2012; Kuehne et al., 2017).

For the participants in our research, these factors were considered to be 'self-evident justifications for action (or inaction)' (Vanclay and Enticott, 2011: 264) in prioritising new rice varieties over other technologies.

At the time of our research, the development and implementation of new varieties was a key funding priority in the Rice Industry R&D plan, occupying 50% of the total research and development budget compared to 15% for precision farming (Australian Government, 2011). Participants argued that an emphasis on varieties over other technologies – such as smart farming technology – was justified as they were familiar to growers, known to have tangible short-term benefits for on-farm rice yield, and likely to be widely adopted by growers. For example:

> The most visible [technology] and the one that we put the most money into is varieties, and growers take up those varieties very, very quickly … They're quickly adopted for a couple of reasons; people have faith that the new variety is always better than the old one because it performs, and … they're well tested … There's a great degree of trust that variety shall deliver. (20)

> New varieties…. People will take them up; and they're limited as well [with] varieties. There's three or four varieties for each valley that are grown so it's very limited. So if a new variety comes out, and they're always limited because seed's scarce, everyone wants it [because] it's a new thing. (14)

> Anything to do with varieties [growers] are always very interested in, and they're always pretty quick at adopting. (9)

New varieties were also argued to have high compatibility with existing farming systems due to their proven benefits in managing variable climatic variations – a characteristic feature of Australian farming – and particularly restricted access to irrigation water for growing rice. For example:

> I think far and away the most important [technology] is delivering improved varieties to growers. The reason that is so fundamentally important is that there is enormous competition for water … There's less [water] because of the Commonwealth entitlement buy-back. (1)

> We need to keep making step changes in varieties.… I think the other one is probably; we talk about aerobic rice and cold tolerance … And I know it's related to varieties, but if we can improve the cold tolerance … once we get to that, we may open up a whole lot more area that can be cropped and also marry in with other farming systems. (17)

In contrast, two participants emphasised that 'easy technology' did not apply to smart farming as it was perceived as more complex technology for growers to adopt, and its applicability in the context of local farming systems was not yet well understood. For example: '[Technology such as] precision ag is [harder to adopt]. They're just in the pilot [stage] we've got going at the minute' (14); and 'I think the [smart farming] technology is difficult. I don't think it's been thoroughly demonstrated yet that there is an advantage …. We don't know how you can make use of it to easily make improvements on the farm' (19).

6. Discussion

Transitions involving the implementation of new technologies are recognised as being surrounded by uncertainty within a farming context (e.g., Koundouri et al., 2006; Moschini and Hennessy, 2001; Marra et al., 2003), and in other sectors (Meijer et al., 2006, 2007a). The transition from experiential to data-driven decision-making associated with smart farming is no different and creates considerable uncertainty for farmers (Eastwood et al., 2017; Eastwood and Renwick, 2020). However, in studying the relationship between smart farming and uncertainty, we have argued that little attention has been paid to the 'uncertainties of change' (Nettle et al., 2018: 26) experienced by meso-scale actors as they seek to assist farmers in managing this transition. Applying the theoretical lens of ontological security, this article contributes to knowledge in this area by investigating two research questions: (1) how do perceived uncertainties destabilise meso-scale actors' routines and practices; and, (2) in what ways do meso-scale actors seek to re-establish a sense of stability and in doing so manage the uncertainty associated with smart farming implementation, and technological change more broadly?

In addressing Research Question 1, we have drawn on the innovation uncertainty framework developed by Meijer et al. (2006) to identify two forms of uncertainty that destabilise meso-scale actors' routines and practices, and thereby create ontological insecurity – resource and technology uncertainty. In doing so, our research complements and builds on Eastwood and Renwick (2020) who apply the Meijer et al. (2006) framework to farmer adoption of smart farming technology. We argue that *resource uncertainty* contributes to ontological insecurity over the capacity of (a) rice industry stakeholders involved in our study, and (b) other stakeholders who provide support to rice growers – such as agronomists and smart farming specialists – to adapt their roles and routines so as to contribute to successful implementation of smart farming in the rice industry. In contrast, *technology uncertainty* contributes to ontological insecurity over the cost of smart farming technology to growers, and how stakeholders might best manage the industry transition to new technology in a way that takes into account the high capital investment costs at a farm-scale. It also contributes to insecurity over the perceived lack of support to growers from smart farming technology retailers, and a sense of powerlessness for stakeholders in working effectively with growers to implement smart farming technology without this crucial support.

Changes in the social environment and within institutions, such as those described by participants above, create ongoing uncertainty as to whether such changes will have stabilising or destabilising outcomes for the industry, and in what form these outcomes may take. Viewed from an ontological security lens (Giddens, 1991), such changes significantly interrupt established processes, routines or goals within the rice industry. For example, destabilising changes across the industry, such as those reported by participants, have an impact on participants' ability to provide advice, their available resources, their legitimacy in relation to their role, and even the relevance of their knowledge, creating a crisis in terms of self-identity as a change agent or even increasing feelings of insecurity (Garsten and Grey, 1997; Collinson, 2003). Giddens (1991) argues that although crises can be normalised, their uncertain nature means that they cannot be routinised and we argue that this creates a lack of capacity for industry stakeholders to adequately predict and manage the potentially destabilising effects of social and institutional changes across the rice industry. This leads to a further challenge in which the unknown stabilising/destabilising effects combined with an inability to routinise means that they increasingly experience a lack of control over the direction and outcomes of change. Such threats to ontological security are likely to further add to challenges for meso-scale actors in 'managing the proliferation and multiplicity of digitised forms and effects that characterise digital innovation' (Ayre et al., 2019: 11), and smart farming more broadly.

Although transformational change in the social environment is a normal consequence of high modernity (Giddens, 1991), the uncertain nature of such changes means that they cannot be readily routinised. Meso-scale actors' biographical continuity and capacity to make sense of change is reliant upon access to establishing a sense of routine and predictability. As other scholars have argued, this poses challenges for these actors as smart farming involves a significant departure from routine practices (Nettle et al., 2018). Greater collaboration between public and private extension roles is identified as one way of addressing such challenges (Eastwood et al., 2017, 2019). However, in addressing Research Question 2, we contend that collaboration may be difficult to achieve without first recognising and working with the cultural scripts that are used by meso-scale actors to securitise uncertainty. As we have argued, industry stakeholders in our study stabilise uncertainty, and re-establish a sense of ontological security, by falling back on familiar cultural scripts. Drawing upon Vanclay and Enticott (2011), two distinct scripts are evident in our research.

The first of these is a commonly-used line of argument in which stakeholders repeatedly refer back to the attitudes and age of growers as the principal barrier to or enabler of smart farming adoption. This may provide stakeholders with a sense that certain aspects of technological change are controllable, which is important for aspects of introducing, promoting and implementing change (Vardaman et al., 2012). By singling out growers, stakeholders can also draw upon 'their experience in relation to identity, power … [and] ideology' (Scarduzio and Geist-Martin, 2010: 6) to provide a sense of certainty in terms of how and whom they believe will respond to change in particular ways. That is, stakeholders can seek out growers they identify as being likely to champion change in the rice industry by positioning them as innovators, while downplaying the roles of others whom they assume are unlikely to adopt, slow to adopt, or not adopt at all.

The second script drawn upon by stakeholders is a catch-phrase or commonly repeated statement, in this case an emphasis on 'easy technology' – prioritising those technologies that are known to be more easily adoptable by growers and have clear short-term benefits. This type of script enables stakeholders to 'get on with the job' of what they know already works, and to maintain a routine around technology research and development that avoids the perceived uncertainties associated with the cost of technology and lack of retailer support for smart farming technology. These scripts can also provide a sense of familiarity, order, and routine to actors who – for an array of reasons including skill-based, personal, or resource-based – may not be ready to engage with smart farming technologies. Consequently, cultural scripts related to easy technology can be drawn upon to justify decision-making about smart farming technology, and specifically why a particular course of action has or has not been taken. In doing so, actors can reduce any uncertainty associated with adopting smart farming technologies and re-securitise their positions by reproducing the norms associated with their own roles and routines. Actors can also use these scripts to 'generate command over people and actors' (Giddens, 1984: 33) particularly actors such as farmers who may regularly seek out their advice.

7. Conclusion

This paper has argued that cultural scripts are critical for meso-scale actors in creating a sense of ontological security, and thereby securitising uncertainty. However, in what ways does the process of securitising uncertainty provide insights into the capacity of meso-scale actors to facilitate smart farming adoption? At face value, the two cultural scripts discussed are counter-productive to establishing the collaboration between public and private extension viewed as central to enhancing meso-scale actors' capacities to manage the innovation uncertainty experienced by farmers (Eastwood et al., 2019). The focus on growers as barriers or enablers to adoption, and the emphasis on 'easy technology', are both inward-looking and industry-focused with seemingly limited scope for collaboration. This is consistent with Vanclay and

Enticott (2011: 267) who observe that scripts 'limit the range of options that individuals might perceive are available to them in specific situations'. In this sense, cultural scripts can be argued to act as a barrier to collaboration and further implementation of smart farming technology by placing the responsibility on growers for adopting or not adopting, and prioritising technologies that are perceived as being easier to adopt.

An alternative view is that cultural scripts are useful for 'devising better solutions to rural problems' (Vanclay and Enticott, 2011: 268). From this perspective, while scripts might limit collaboration, they are potentially important for making smart farming workable in the context of familiar patterns and routines. Although scripts do not reflect the complexities of institutional and technological change, they provide meso-scale actors with tools for re-establishing their sense of self and role and, thus, their legitimacy as change agents. As such, scripts can potentially help inform the co-design of digital governance strategies, supporting meso-scale actors in reflecting on how they can integrate smart farming tools into their routines and patterns and increasing 'their capacity to engage with digital innovation in smart farming contexts' (Ayre et al., 2019: 2). This is an area requiring further research. Understanding meso-scale actor's cultural scripts undoubtedly contributes to new ways of engaging these actors in supporting smart farming innovation but can also highlight the ways in which reliance on familiar routines and roles may impose limits on integration of smart farming knowledge and technologies at an industry scale.

CRediT authorship contribution statement

Melanie Bryant: Leading the creation, development, Writing - original draft, including the initial draft, Conceptualization, particularly with reference to the application of ontological security, Methodology, Data curation, Formal analysis, Funding acquisition. **Vaughan Higgins:** Writing - review & editing, Writing - original draft, Development, Methodology, Data curation, Formal analysis, Supervision, Funding acquisition.

Acknowledgements

The research was funded by AgriFutures Australia (formerly Rural Industries Research and Development Corporation) grant ID: PRJ-009181.

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