Learning through techno-human entwinement: Implications for the adoption of technologies drawn from agricultural and ICT interventions in the Philippines

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A thesis submitted in fulfilment of the requirements for the award of the degree Doctor of Philosophy

Faculty of Education and Social Work

University of Sydney

March 2017
AUTHOR’S DECLARATION

This is to certify that:

i. This thesis comprises only my original work towards the Doctor of Philosophy degree;

ii. Due acknowledgment has been made in the text to all other material used;

iii. The thesis does not exceed the word length for this degree;

iv. No part of this work has been used for the award of another degree;

v. This thesis meets the University of Sydney’s Human Research Ethics Committee (HERC) requirements for the conduct of research.

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Date: March 2016
Abstract

In developing countries, such as the Philippines, there is great concern among educational, government and non-government organizations regarding the implementation of agricultural technologies delivered through Information and Communication Technologies (ICT), at both regional and national levels. While these types of introduced technologies are discussed in the literature of organizational practice, they are largely absent in studies of management and informal education. This study seeks to address this paucity by investigating the entwinement (i.e. process of interweaving) of humans and this type of introduced technologies through the theoretical perspectives of sociomateriality (i.e. interweaving of human and technologies) and sensemaking (i.e. giving meaning to experience). More specifically, it examines how farmers learn through a process of interweaving with one specific intervention – use of ICT to learn agricultural technologies.

Using the theoretical perspective of sociomateriality (Orlikowski, 2008; Leonardi, 2012) to examine farmers’ views on the affordances of interventions, this study illustrates how their learning is bound up in an ever-deepening entwinement with the technology through which it is delivered. In addition, this study investigates the processes, which lead to its adoption, through the perspective of sensemaking (Weick, 2005).

Conducted as an ethnographic case study, this research draws on observations of farmers’ practices for over four months in two Farmers Information and Technology Services (FITS) centres in Region XI, in the Philippines. These centres aimed to deliver agricultural technologies through ICT. Data were collected using semi-structured interviews, observations, and document analysis. Participants included 32 farmers, two FITS managers,
an instructional designer, five FITS/village staff members, a farmer scientist, and three community and farmer group leaders.

As to the findings related to the possibility of an action to an object, it indicates that participant’s perspectives can be grouped in three distinct ways namely: as a bundle of technical features inherent in the properties of technological tools (e.g., sending email, viewing diseases), as design features of the services provided and as relations between these features. These perspectives appear to build on one another, resulting in ongoing improvement and the emergence of new technologies, routines, affordances, and the altered perception of new constraints. This expansion of perception results in a shift from individual to group affordances.

Through the perspective of sensemaking (Weick, 2005), this study identifies two types of sensemakers among the farmers: minimal sensemakers and reflective sensemakers. It also reveals two new influences, previously unrecognized in the literature which resulted to limited sensemaking: a) external affordances (e.g., subsidies) and b) the emergence of a cultural trait, “gaya-gaya” (i.e. imitation). Moreover, these results further illustrate how the sensemaking process is made visible when viewed from a sociomaterial perspective.

Using the assumptions of the sociomaterial perspective that learning is made visible in practice, this study found that participants progressed through three stages, namely: figuring, configuring and reconfiguring. Findings indicate that during ‘figuring’, the farmers engaged in various learning processes by observing others and engaging in verbal exchanges (e.g., linking new abstract ideas with material objects, organizing ideas, and verbal referencing). In ‘configuring’, farmers learned by experimentation, storytelling, group learning and the integration of sociomaterial objects in farming routines. During ‘reconfiguring’, farmers
engaged in experimentation that focused on the creation of new knowledge and understanding, and the manipulation of new artefacts.

The findings of this study are vital for understanding how an individual’s perspectives, sensemaking and ways of learning lead to adoption. It contributes to the literature new insights into the process of entwinement between individuals and interventions using the perspectives of sociomateriality and sensemaking in the context of informal education in a developing country.
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Chapter 1. Introduction

1.1 Rationale, purpose and research questions

Agriculture is a vital sector for the sustained growth of developing countries such as the Philippines. Equally important, a significant proportion of Filipinos depend on agriculture which accounts for a third of the nation’s total employment figures, despite being a GDP share of only one-eighth (Briones, 2013; Palis, 2006). This indicates the importance of the agricultural sector for food security and inclusive economic growth. The Philippines belongs to the 10-top rice producing countries in the world averaging 18 million metric tons per year. However, it was also the second ranked rice importer globally in 2014 averaging 1.8 Million metric tons per year (FAO, 2014). This indicates that even though the Philippines has a huge rice production volume, it is not sufficient to supply the demand of its population.

The high dependence on rice imports exposes the country to international market shocks and many serious risks for food security (Timmer, 2012). Self-sufficiency in agricultural production is one of the primary goals of the Philippines as it is directly related to the country’s struggle in minimizing hunger and poverty (Koirala, Mishar, & Mohanty, 2014). Thus, achieving self-sufficient food production for the government is essential because of the lack of revenue to finance international rice importation. However, with an annual population growth rate of 2% and a steady increase in per capita rice consumption, agricultural imports will likely continue to play an important role in meeting the domestic demand for rice.

Consequently, there are two options the country may pursue: either increase areas of agricultural production or improve productivity of existing agricultural rice growing areas by
encouraging adoption of technologically oriented agricultural interventions\(^1\). The first option is most challenging, because of the growing number of competing uses for land. For example, conversion from agricultural to commercial and residential uses. Given this constraint, the Philippine government continually seeks ways to raise crop yields without using additional land.

Burney, Davis and Lobella (2010), argued that land can be used more intensively as well as more sustainably under innovative farming practices like precision farming, integrated pest management, agroforestry, and aquaculture. Burney, et al. (2010) also claimed that sustainable land intensification, in which yields rise but negative environmental impacts, are curbed which provides a potential answer to food security and poverty reduction challenges. This type of approach however, cannot occur unless farmers are able to obtain information on new agricultural technologies and change farming practices (World Bank, 2008).

To address this issue, the Philippines focused efforts on its Millennium Development Goals (MDG) set to be achieved within 2000 to 2015, through the Agriculture and Fisheries Modernization Act (AFMA) of 1997. This act specifically included modernizing through a rationalized technology extension system to address poverty and hunger (PIDS, 2000). To achieve this, the Department of Agriculture (DA) and the Department of Science Technology (DOST) found an opportunity in utilizing Information and Communications Technologies (ICT) in the dissemination of Agricultural Technologies (AT).

The agricultural sector has been utilizing ICT in its operations for some time. The Open Academy for Philippine Agriculture (OpAPA) is one of the projects being implemented nationwide along with e-agrikultura (e-agriculture) and the Farmers’ Information and

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\(^1\) Interventions in this study refer to introduction of both Information and Communication Technologies (ICT) and Agricultural Technologies (AT)
Technology Services (FITS) centres (Manalo & van de Fliert, 2011), to facilitate a wide dissemination of agricultural technologies to farmers. One of the services these projects provide is the Farmers’ Text Centre (FTC) of PhilRice. This centre reported a count of 70,000 text messages from 2006 to 2009 related to problems in rice farming (PhilRice 2010, cited in Manalo, et al., 2011). In addition, more than 800 FITS centres across the country were established (PCARRD, 2016) to disseminate agricultural information and technologies among farmers through the use ICT and Information, Education and Communication (IEC) materials. Nationwide, OpAPA has cyber-communities to provide Internet access to Filipino farmers.

An example of FITS centre ICT services is videoconferencing, where rice experts in the PhilRice Central Experiment Station communicate with farmers in distant provinces (Manalo, Layaoen, & Parac, 2009). Services also include the Pinoy Rice Knowledge Bank, which contains information that farmers require about rice farming (PinoyRKB, 2016). These services help disseminate agricultural technologies to help farmers increase their production.

The FITS concept of disseminating information to farmers has become increasingly integrated with ICT. Village cybercoms have been established in some municipalities around the Philippines to provide information for education, agriculture and other fields. Equipping farmers with knowledge and skills they require through improved communication and learning enables increase production.

For agricultural and rural development in developing countries, program implementers (municipal agricultural officers, agricultural technicians) perceived FITS to be crucial in facilitating communication and access to information. This is because of the FITS centre intervention potential as a tool for farmer economic transformation. The establishment of village cybercoms was also considered to enhance timely access to information (Manalo, et al., 2011) regarding pests, diseases, weather conditions, new
varieties of rice among others. Thus, deploying ICT as a developmental tool for creating awareness among farmers of new agricultural technologies to improve productivity and income had been enhanced by establishing village cybercoms in farming communities. Walker, Voce, and Jenkins (2016), mentioned that use of technology among universities in UK enhanced the quality of teaching and learning in general. They found that the application of technology improved the access to learning and learning materials and helped create a common learning experience among users. However, they also found some challenges in the promotion of the use of technology for learning, such as, lack of academics’ knowledge on the use of technology, lack of time, lack of staff development opportunities, institutional culture and lack of incentives.

Intervention adoption in the Philippine agriculture sector has not been easy; however, and more often than not, problematic. Although various agricultural technologies have been developed over the past half-century, many can still be found only in scientific journals and are not being engaged with by their target users (Palis, 2006) such as the farmers themselves. Unwin (2009) as cited in Manalo et al. (2011) pointed out that reasons could range from technological to social considerations. With respect to ICT, some studies show that the use of English in most websites creates a barrier for non-English speakers (Klimaszewski & Nyce, 2009; Taragula & Gelb, 2005). As most Filipino farmers are not native English speakers, they might not understand the content. Other scholars identified socio-economic factors that affect intervention adoption such as: age (Jegede, Dibu-Ojerinde, & Ilori, 2007), time (Malasa, Loresca, & Baltazar, 2007) and money (Manalo et al., 2011).

This study is therefore interested in understanding the process of intervention adoption, specifically exploring the farmer’s perspectives toward interventions. As highlighted by Oster and Thornton (2011), understanding the process adoption of
interventions can assist in: (a) predicting adoption patterns; (b) supporting adopters to sustain the process; and (c) knowing the most favourable way of promoting and implementing new interventions.

Based on an examination of the literature on intervention adoption, most studies appear to focus on management, rather than adoption processes (Orlikowski & Scott, 2008). Orlikowski et al. (2008) observed that 95% of the literature in organizational management does not take into account the role of technology. When they examined four leading journals, they found that of 2,027 articles, only 4.9% directly addressed the role and influence of technology in organizational life. It is therefore apparent that, while technology is present in organizational practices, examination of its role is largely absent in most management studies, thereby technology is treated as a specific or relative distinct entity that interacts with various aspects of the organization. Due to this, technology is treated as an independent variable (e.g., type, cost, techniques, etc.) effects in the analysis. This can be observed in the work of Griffith (1997) on meaning and attitudes towards computing, communication and decision making at individual or group level (Trevino, Webster, & Stein, n.d.). On enterprise improvement linked to level of adoption and investment on technologies (Kraut, 1990), and attribution to widespread diffusion of new technological capacities (Malone, Yates, & Benjamin, 1987). Apparently. These studies cannot give me the needed information to understand more deeply the process of technology adoption and learning.

As various organizations move to become globally competitive, or simply to improve local efficiency in agricultural production, interventions are becoming critical to improve agricultural performance (Pehu, Belden, Majumdar, & Jantumen, 2012). Although it may be important, Barley and Kunda (2001) cautioned that too much focus on the physical aspects of technology use (i.e. as a tool for acquiring information from the internet) could lead to overly
focus on technological effects. They further argued that if studies were to focus on social aspects, this could lead to reliance on culture as a primary driver of change in individuals and organizations. To address the above-mentioned issues, Orlikowski and Scott (2008) proposed that instead of focusing on how interventions influence people, the intrinsic significance of the interventions to everyday activities needs to be examined. This can be achieved by considering people and an intervention as one, then observing practices resulting from this amalgamation (Leonardi, 2012; Orlikowski & Scott, 2008).

Researchers have claimed that social and technical elements in an organization mutually shape each other, and thus must be jointly designed (Davis & Taylor, 1986). Scholars such as Orlikowski (2000) and Leonardi (2012;2013a) refer to this as *constitutive entanglements or sociomateriality*. The notion of constitutive or sociomaterial entanglement presumes that material and the social (the technology and the human) are inextricably related. As Orlikowski (Orlikowski, 2007) puts it: “there is no social that is not also material and no material that is not also social” (p. 1437). For example, if a plough is lying in the field, it may not have any meaning without the presence of a farmer; likewise, farmers without their farming tools.

Using the notion of *sociomateriality*, it may be possible to explore the process of intervention adoption by focusing on farmer practices. By doing this we shift the focus in from deterministic *social* and *technological* approaches to seeing the social and the technological as a single entity (Leonardi, 2011).

To achieve an understanding on the process of intervention adoption, Leonardi (2011) suggested that exploration may take place by looking at the relationship between the intervention and individuals. This relationship maybe used in explaining an individual’s perceptions of an intervention in terms of possibilities for action, which (Gibson, 1979)
termed ‘technology affordance’. Leonardi and Barley (2010), Markus and Silver (2008), and Zammuto, Griffith, Majchrzak, Dougherty, and Faraj (2007) claimed that affordances have a nature that creates an equal treatment between the material and social. These scholars highlighted that using affordance as a way to explore sociomaterial relationships may overcome social and material separation which is one of the main issues of other approaches in research.

While using the perspective on affordances, it may allow a more balanced approach in the understanding of intervention adoption among farmers, this study is also interested in how farmers make sense of an intervention. Moreover, this study also argues that in order to have a deeper understanding of why farmers adopt a particular intervention, we need to explore how they make sense of the technology’s affordances. By examining this process, we may account for the actions farmers take when presented with an intervention, and observe the sequence of events that is triggered when new interventions are faced, all termed by Weick, Sutcliffe, and Obstfeld (2005) as the ‘sensemaking process’.

In the context of informal education, implementers may not know what learners will do with interventions: how they will use them, in what manner they will engage with an intervention and most importantly, the conditions that may lead towards its adoption. By identifying what learners will do and the conditions essential to successful adoption, we may be able to understand how the relationship between an individual and intervention could be strengthened and sustained.

Thus, the main purpose of this study is to explore the process of entwinement between farmers and intervention by using three theoretical perspectives, namely: affordances, sensemaking and learning utilizing the assumptions of sociomateriality. The
process of entwinement could be traced by looking at how affordances are perceived by farmers and how they make sense (i.e. the process of learning) of these affordances. In addition, this study would specifically look at the importance of sensemaking process in emergence of shared affordance, which would lead to the production of new affordances not only for the individual farmers but also affordances that are shared among them. In doing so, this study will be able to explain the reasons of ignoring or rejecting the technology, the reasons why and how technology interventions are modified, and the factors why the farmers’ practices are changed.

1.2 Research questions

This study aims to answer three research questions in the context of farmers’ interaction with technology in selected FITS centres in the Philippines, specifically this study intends to answer the following:

1. How do technology and individuals entwine?

2. How do individuals make sense during the process of an intervention adoption?

3. How do individuals learn in their interaction with interventions within a sociomaterial context?

The first question focuses on how humans and interventions are entwined by considering the affordances of the intervention and by identifying the conditions that lead to adoption or non-adoption. This question is the first step in answering how human and intervention entwinement is dependent on farmers’ perspectives on affordances of ICT. This answer will help understand the process of technology adoption by the farmers. By understanding the process of entwinement, this study will provide an explanation on how
people’s existing experience of technology in the context of their normal work and their social networks affects the way they perceived and used the newly introduced technologies.

The second question is designed to illuminate how farmers make sense of an intervention leading to adoption or non-adoption. Specifically, this question focuses on how farmers make sense of intervention affordances through the perspective of sensemaking (Weick, 1995). By incorporating sensemaking and learning perspectives, this study will be able to see how new affordances emerged, used and retained in organizations through learning practices that affects future actions.

The third question focuses on how farmers learn and how their learning enables the emergence of new practices, routines, and new objects. Specifically, the answer to this question aims to contribute to the development of the concept of shared affordance as it is used in organizational analysis. By this, the study will shed light on how shared affordance emerges.

1.3 Methodology

According to Mutch (2013), a sociomaterial approach is married to the ethnographic form of inquiry, as it what people actually do, their skills, knowledge, and practice, that comprises their routine work (Barley & Kunda, 2001). This research utilized an ethnographic case study to gain a better understanding of the farmers’ perspectives of technology affordances, as well as the sensemaking process leading to technology adoption and learning practices, all shaping a sustainable adoption of the intervention over time.

I combined ethnography and a case study in this research to facilitate data gathering and analysis. Ethnography was used as an approach and a method for gathering the data for this study by observing and interviewing research participants, and collecting relevant
documents from the FITS centre where they are members. Case study techniques were used to analyse the data and gain insights on participant perspectives, as well as identify patterns and generalizations from the data.

Ethnography is a form of inquiry that produces thick descriptions of a phenomenon (Denzin, 1997). Using ethnography in a sociomaterial study allows the researcher to draw out ordinary aspects of everyday practice (Hopwood, 2010) as a result of sociomaterial entanglement (Dean, 2015). In addition, a case study was used to reveal descriptions of relationships that exist in reality (Galliers, 1992) and detect, develop, and refine perspectives regarding the local situation.

I conducted my fieldwork in a province in Region XI of the Philippines for a period of four months. Specifically, I observed farmers, FITS managers, community and organization leaders, an instructional designer, and FITS staffs. I immersed myself in the FITS centre to observe the farmers, and shadowed some for a period to gain insights in their practices. In addition, I conducted semi-structured interviews to gain further insights on the farmers’ perspectives. To achieve credibility and trustworthiness, I triangulated their responses with organizational documents, field notes, and verbal accounts of other participants (Eisenhardt, 1989).

I engaged with the FITS centres for more than two years prior to conducting this study. I served as Regional Techno-Gabay coordinator for the FITS centres in this region – which allowed me to gain the trust of the participants. My long engagement with the farmers helped me understand and respect their culture and provided a familiarity with the context of study. Using an ethnographic case study, it allowed me to immerse myself for four months, shadowing the activities of farmers and FITS centres.
To avoid possible insider bias, I have reported my observations in full, describing what participants have said and done in precise detail. To accomplish this, I made a detailed reflection of the research process, with close awareness of my own view and potential concern about a researcher being an insider. The core ingredient I believe in enhancing credibility regardless if the researcher is an insider or an outsider, is the ability to be open, authentic, and interested of the experiences of research participants and the researcher’s commitment to accurately and adequately represent this experience. A detailed discussion of this study’s design and methodology is presented in Chapter 4.

1.4 Significance of the study

Drawing on a sociomaterial perspective and sensemaking, this study adds a number of new insights to the body of knowledge on understanding technology adoption in the context of developing countries like the Philippines. The investigation of two FITS centres contributes to understanding technology adoption as it complements existing research in the field of informal education and lifelong learning in developing countries. This study is significant to both knowledge and practice, particularly where the literature is limited, as detailed in the following paragraphs.

1.4.1 Practice

The investigation conducted on the two FITS centres utilizing sociomateriality and sensemaking perspectives assists in answering a question posed by intervention implementers, ‘What is going on during the adoption process of an intervention?’. By answering this question, implementers may be able to understand the reasons for the adoption or non-adoption of an intervention, why farmers change or hold-on to their practices, and why they hold-on to or change their beliefs. The findings of this study offer
knowledge base for implementing similar intervention programs within similar contexts in the Philippines.

In FITS centres across the Philippines, the results of this study may be used to understand why some FITS centres were more successful in implementing their programs compared to others and what kinds of changes may help to enhance practices in less successful FITS centres. Considering that there have been more than 800 FITS centres established across the country that uses similar approach in the implementation, these findings have the potential to inform changes nationwide.

1.4.2 Knowledge

This study contributes to the studies of technology adoption in developing countries and reinforces findings on the processes and results of sociomaterial entanglements of individuals and technologies. This is evidenced by showing how noticed constraints could lead to change in technology, while noticed affordances could lead to change in practice. What is new in this study is the integration of three theoretical perspectives in tracing the learning path of individuals. It shows how a continuous enactment of shared affordance and sensemaking eventually change farmers’ practices and routines. This is explained further in Chapter 3, section 3.1.

1.5 Definition of terms

To assist readers in remembering the terms and acronyms used in this thesis, a summary of the main definitions is presented below:

Agricultural Technology (AT) refers to new information, farming methods, new processes or innovation to increase productivity in agriculture (e.g., integrated pest management, Palay (rice) check practices, new farming practices).
**Concoctions** are natural extracts from plants or animal wastes processed through fermentation that are used as a substitute for inorganic fertilizers or as insect repellents.

**Entwinement** refers to two entities that are interwoven, twisted, joined or merged to each other e.g., the joining (farmer and intervention) in this study is unplanned from the individual farmer’s point of view, because interventions were not introduced to them ahead. From the government’s or implementers’ point of view, this was planned since they formulated the strategies on how these interventions would be implemented. Unlike imbrication, entwinement is focused on the individual, not on the organizational structure.

**Information, Education and Communication (IEC)** refers to printed information materials aiming to reinforce information given to farmers during training, seminars and video conferencing.

**Farmer Scientist** is an outstanding farmer in the area who is successful in their use of Science and Technology-based (S&T based) and indigenous technologies. The Farmer Scientist complements the FITS centre by providing the following services: serve as an expert during training, clinics and seminars, provide technical assistance and hands-on training during visits by other farmers, promote S&T based farming, which showcases the effectiveness of S&T in improving farm productivity and income, and extend farmer-to-farmer advisory services.

**Farmers’ Information and Technology Services (FITS) centre** is known in the field as Techno Pinoy centre. It serves as a one-stop service facility to farmers, entrepreneurs, and other clients in a given municipality. It provides fast access to agricultural technologies and information appropriate to the farmers’ needs such as: technology
training, technology clinics, linking clients to experts and financial institutions, technical assistance and consultancy, support to enterprise development and linking with sources of planting materials, animal stocks and agricultural inputs. Information services include agricultural technology information in various multi-media formats, exhibition of new ATs and products, internet services and Short Message Service (SMS).

**Group affordance** refers to how the affordance is perceived collectively by farmers. This is also characterized by affordance shared by members of the group.

**Human agency** refers to the ability of a person to act, make choices and realize goals in a given environment (Leonardi, 2011). For example, a person may ask a question because he wants a response or use a word processing program to produce a report.

**Individual affordance** refers to the affordance perceived by individual farmer.

**Information and Communications Technology (ICT)** refers to an umbrella term that includes any communication device or application, including cellular phones, computer, network hardware and software and so on, as well as associated services and applications such as videoconferencing and distance learning. In this research, ICT is used to refer to computer, network and software used by farmers in their farming activities.

**International Rice Research Institute (IRRI)** is a research organization dedicated to reducing poverty and hunger through rice science. This organization is also committed in improving the health and welfare of rice farmers and consumers, and protecting the rice-growing environment for future generations. IRRI is an independent, non-profit, research and educational institute founded in 1960 by the Ford and Rockefeller foundations with support from the Philippine government (IRRI, 2016).
**Intervention**, in this research, denotes the introduction of both ICT and AT to farmers and farmer organizations. It is aimed at promoting new farming practices and technologies in agricultural production utilizing ICT.

**Learning**, in this study, refers to the development of knowledge and skills by farmers as they interact with technology.

**Materiality** refers to the inherent properties of a given technology that is physical and/or digital. These properties are fixed and are perceived important by users for some period of time (Leonardi, 2012).

**Municipal Agricultural Officer (MAO)** refers to the head of the municipal agriculture office of a given town.

**Nutrient Manager for Rice (NMRice)** refers to the computer and mobile phone based software applications, providing rice farmers with a personalized crop and nutrient management guidelines that compute fertilizer requirements of a given rice field (IRRI, 2016).

**One Town One Product (OTOP)** is inspired by the Japanese One Village One Product Movement of 1979. The Philippine OTOP program is a promotional program of the government of the Philippines, which aims to promote goods and products of Filipino towns, cities and regions, and provides funding for small businesses (Parilla, 2013).

**Palay** is a Filipino or Tagalog term for ‘rice’.

**Pinoy Rice Knowledge Bank (PinoyRKB)** is a website hosted by the Philippine Department of Agriculture which provides a source of rice production information for rice farmers (PinoyRKB, 2016).

**Sociomaterial** refers to the “inherent inseparability” of social and material aspects of organizational work (Orlikowski, 2008). For example, the practice of organic farming
(sociomaterial) inextricably connects farmers (social) to their use of organic inputs (material).

**Techno-Gabay Program (TGP)** is a Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) banner program to bring science-based information and technology services to the end-users in Agriculture, Forestry and Natural Resources (AFNR) sectors. Its overall goal is to hasten modernization of agriculture and natural resources sectors by enhancing access to knowledge and technologies of community extension workers, farmers and entrepreneurs. ‘Techno’ comes from the word ‘technology’, ‘Gabay’ is a Filipino term meaning ‘guide’(PCARRD, 2016).

**Village cybercom** is a facility in a village centre which serves as an extension of the FITS centre. This facility provides computers and internet connectivity to serve farmers in the village and is jointly managed by a municipal FITS centre and villagers.
Chapter 2. Research context

2.1 Introduction

Before I started this study, I served for two years as Regional Techno-Gabay coordinator for the Southern Mindanao Agriculture, Aquatic and Resources Research and Development Consortium (SMAARRDEC). This unit is hosted at the University of Southeastern Philippines (USeP), where I was employed. I directed the unit in conjunction with professionals and staff whose main goal was to implement the Philippine Council for Agriculture, Aquatic and Natural Resources, Research and Development (PCAARRD) ‘Techno-Gabay program’ under the Department of Science and Technology (DOST). At that time, my main task was to establish FITS centres in Region XI, comprising of 5 provinces, 6 cities and 48 municipalities (see Figure 2.1). The goal was to make Agricultural Technologies available to farmers in the region using ICT. When I assumed the role of regional coordinator, 22 FITS centres had been established. After one year, I was able to establish an additional 15 FITS centres in the region.

\[\text{Figure 2.1 Map of Region XI, Philippines (Wikipedia, 2013)}\]
The establishment of the FITS centre was by no means an easy task. A number of Municipal Mayors were hesitant in accepting the Philippine Government Techno-Gabay program. I can still remember one Mayor commenting:

“While the intention of the program is good, I do not have faith in national government programs, because most government programs are only good at the start. There is no continuity. Once the project is launched, everyone disappears.” (Municipal Mayor)

This comment made me ask myself. If the head of the municipality thinks this way about governmental interventions, what would the farmers think as the direct recipients? This motivated me to explore the farmers’ perspectives on interventions.

In the rest of this chapter, I will first present an outline of the Techno-Gabay program, followed by an explanation of the FITS and its services. Lastly, I will describe some issues I observed when working as the regional coordinator that led to the emergence of my research questions.

2.2 Techno-Gabay Program

The Techno-Gabay Program (TGP) was initiated by PCAARRD in 1998 to promote agricultural technology using ICT and facilitate knowledge sharing among community outreach workers and farmers (e.g., through video conferencing and SMS). TGP has four main components: a) FITS Centres that will be described in detail in the succeeding section, b) Magsasaka-Siyentista (MS) or Farmer-Scientists, who serve as a source of verified science and technology based practices, c) Information, Education and Communication (IEC) materials, that were distributed to farmers to reinforce training and seminars that were conducted, and d) ICT that serves as a platform to gather and share agricultural information.
Based on the Techno-Gabay framework as shown in Figure 2.2, the FITS centre serves as repository of AT, where farmers can access information from various agricultural research institutions and individuals. The ICT section of FITS centre supports its information services by providing internet connectivity to the facility and training to the farmers. In turn, the FITS provide farmer demographic data and agricultural information to the ICT component of TGP, which can be uploaded to a website where farmers are able to access.

The MS serves as the FITS centre experts in a specific field of agriculture (e.g., rice, livestock, organic farming) and must provide a demonstration farm for farmers to showcase an agricultural practice. The ICT, IEC section and the FITS centre support the MS by providing agricultural information they need such as printed agricultural materials, financial assistance and other MS needs to showcase agricultural practices. The MS in turn provides technical assistance to the FITS centre and provides the ICT section with agricultural information that
can be uploaded to a specific website. In addition, MS also provides content for IEC materials specifically, those practices utilized in the demonstration farm. The IEC component of the TGP is tasked to develop IEC materials (predominantly in printed form) to promote TGP activities to farmers and conduct needs assessments in order to align TGP interventions to the farmers’ needs.

Figure 2.2 shows the centre of the TGP program is the FITS centre, as it coordinates and supports all other TGP components. It serves as a link between farmers, research institutions and experts. And also a facility that supports learning in agricultural technologies.

2.3 The FITS centre

The FITS centres in each municipality are established in one of two ways: upon the request of the municipality to SMAARRDEC or inviting the municipality to establish FITS. Upon approval of the request or acceptance of an invitation, SMAARRDEC presents the program to the municipal council through its Techno-Gabay coordinator for support and complementary funding.

For SMAARRDEC to approve a FITS establishment, requesting or invited municipalities must provide the minimum requirements as shown in Table 2.1. The purpose of this complementary funding from the municipalities is to create a sense of ownership of the centre. Rather than it be seen as a ‘free’ program of the Philippine government, it is to be considered a partnership. In return, PCAARRD, through SMAARRDEC provides Php 100,000 ($3,000.00 AUD) and technical assistance to the municipalities.
Table 2.1 *Minimum requirements for establishing FITS centre in municipalities*

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical</td>
<td>Office floor space of at least 50 m² with at least two divisions/rooms and a FITS billboard (signage)</td>
</tr>
<tr>
<td>Furniture and Fixtures</td>
<td>Tables and chairs, display cabinets/shelves, infrastructure/communication support (electric power source, telephone lines)</td>
</tr>
<tr>
<td>Equipment</td>
<td>Computer (PC, Pentium or better) and peripherals, photocopier, TV and stand, DVD/VCD player, mobile sound system</td>
</tr>
<tr>
<td>Data/Information</td>
<td>Agriculture, Forestry and Natural Resource (AFNR)-related books, other publications, communication materials</td>
</tr>
<tr>
<td>Staff (part-time or full time)</td>
<td>Site Manager, Information Services Specialist, Technology Services Specialist</td>
</tr>
<tr>
<td>Funding Capability</td>
<td>Funds for establishment and maintenance of FITS Center (P100,000.00 ($3,000 AUD) or higher annual budget support from the municipality</td>
</tr>
<tr>
<td>Magsasaka Siyentista (MS)</td>
<td>A farmer who is an expert in the municipality’s focus or priority commodity, who shall be officially connected to the FITS Centre</td>
</tr>
</tbody>
</table>

Regarding physical requirements in Table 2.1, the FITS centres are usually located within the Municipal Agriculture Offices. However, in cases where the office space is small, the municipality must look for a space that can accommodate the equipment and fixtures and is accessible to farmers. Each FITS would usually have two computer units with internet connection. FITS are also equipped with photocopier, TV and sound system so that farmers may use them when needed.

The Municipal Agriculture Office usually provides AFNR materials (e.g., agricultural IEC, see Table 2.1) in the FITS centre. To have a continuous flow of current research based agricultural technologies, TGP adopts a mechanism in which consortium-member agencies actively involved in research.
As FITS centres are set-up under the Municipal Agricultures Office, the Municipal Agricultural Officers (MAO) are designated as managers of the FITS in most cases; however, there are several municipalities where agricultural technicians are appointed as FITS managers. The latter occurs when the MAO refuses to accept the designation or when the Municipal Mayor does not agree on the choice of MAO. The FITS manager designation is dependent on the trust and confidence of the Mayor as the head of the municipality. Withal, there are Information Service Specialists and Technology Information Specialists that supports the FITS manager.

Initial funding of a FITS centre amounts to $6,000 (i.e. $3,000 from the TGP and $3,000 from the municipal government). With the fixtures, equipment and AFNR materials, the funds are sufficient to start FITS activities.

2.4 Overview of the FITS centres in this study

The two FITS centres chosen for this study are in the Province of Davao Oriental, Region XI, the Philippines. These are referred to as FITS A and FITS B. The province was chosen as it has hosted the most successful FITS centre in the Region. By choosing the most successful FITS for this study, I expected to be able to gather rich data set thorough observations of these farmers, who successfully engaged with the intervention. In addition, the proximity of the FITS centre to my own residence minimized the expense of conducting this study and made it affordable to conduct. By having a less successful FITS centre in this study, I expected to be able to compare stories of farmers from those who had been already engaged with the interventions and those who were about to engage in the interventions. In doing so, I will be able to compare stories of farmers from a successful FITS centre which is expected to be historical accounts to those accounts of farmers in less successful FITS.
2.4.1 FITS A

FITS centre A was established in 2003 in a municipality with a population of more than 35,000. The main source of income for the majority of the population in this municipality is derived from rice farming. The municipality comprises of 14 villages with a land area of 41,930 hectares.

Two years after its establishment, FITS A developed dissemination strategies to reach farmers in distant villages. One of its strategies was the establishment of the first village cybercom in the Region. A village cybercom is an extension of the FITS centre that was intentionally established in the village so farmers could access agricultural information through ICT without the need to visit their town hall. FITS A also established a mobile internet van to reach other farmers in the municipality (see Figure 2.3). The mobile internet van moves from village to village each week promoting FITS centre services and providing computer training and internet access to farmers in different villages.

Because of this innovation in delivering agricultural information through ICT, in 2009 the Department of Agriculture (DA), through the International Rice Research Institute (IRRI)
at the University of Southeastern Philippines (USeP) lent its support to FITS A through the establishment of five additional cybercom villages in the municipality. These village cybercoms were envisioned to invite more farmers to use ICT in learning agricultural technologies and provide farmers with access to agricultural information through ICT use. Each village cybercom was provided with computers and internet connectivity and are jointly funded by the villagers and the Philippine Government.

FITS A is a multi-award winning² centre and is recognized as one of the premier FITS centres in the country. It was able to win funds and equipment to help improve its services and now serves as a model to other FITS centres both regionally and nationally. From a macro perspective, FITS A could be considered successful as it was able to innovate and to improve the implementation of TGP and change farmers’ practices. On the micro-level, there are a number of issues which FITS A encountered. These are discussed in detail in the succeeding section.

FITS A was chosen to be part of this study to explore the processes that led to intervention adoption—as most of its members are adopters of the intervention. Thus, their stories were considered potentially significant in understanding perspectives, sensemaking and learning processes that lead to intervention adoption.

2.4.2 FITS B

FITS B was established in 1998 in a municipality with a population of more than 60,000. The municipality is comprised of 21 villages with a land area of 86,639 hectares. Its population’s main source of income is farming, specifically fruit and vegetable production.

² FITS center A was awarded as the most outstanding community Ecentre of the Philippines in 2012, and was a finalist in the 2010 search for most outstanding Ecentre in the Philippines.
Unlike FITS A, FITS B was less successful in implementing the TGP’s aims. When it was established in 1998, the computer unit that was designated to be used by its farmers was deployed to other municipal agencies. In 2011, there had not been a single unit assigned to the centre for more than 10 years. The physical requirement was also reduced after the launch of the program. Instead of a 50 square meter office for the centre, only a single table office was provided in one of the corners of the Municipal Agriculture Office and the MAO was not designated as the FITS manager. The budget for the centre was also scarce after a year of operation, and the centre became dependent on funds allocated by the Municipal Agriculture Office, which in most cases is insufficient. The reason for these occurrences was due to the change of municipal leadership. When leadership in municipalities changed, some programs are left behind because of the change in priorities of the new leader.

When a new Mayor was elected in 2011, FITS B had some improvements made; it was able to acquire a new office in accordance with the requirements in Table 2.1 and was provided with five used personal computers and internet connectivity. It was also able to establish one village cybercom located in one of the farthest villages in the municipality. FITS B was less successful in disseminating TGP programs as most of the farmers in the area were located in far-flung villages.

In this study, FITS B was purposely chosen to explore stories and perspectives of farmers in FITS A prior to adoption of the interventions. Unlike farmers in FITS A, some of the farmers in FITS B came to know of the FITS centre services for the first time through this research. Most of them had not used ICT in learning agricultural technologies or ever used a computer or the internet. In this way, I would not be gathering the ‘historical’ reflections of the farmers but instead, gathering first impressions about the FITS interventions.
2.4.3 Evaluating FITS performance

FITS centres across Region XI are evaluated quarterly by SMAARRDEC for their performance in relation to the objectives of the TGP. During the evaluation, FITS are required to submit reports of activities conducted in relation to TGP. Reports usually include the number of IEC materials developed and distributed, the number of farmers who visited the FITS centre to acquire new information, the frequency of seminars/trainings/workshops being conducted on agricultural technologies and ICT use, linkages with other government and non-government organizations, as well as awards and recognition received by the FITS centre and farmers (Appendix A).

It should be noted that the criteria used in evaluating FITS centre performance focus on figures (e.g., number of farmers trained, number of IEC materials developed, etc.). Less attention is placed on its effect to the farmers. For example, FITS services effect on the farmer’s productivity or change of beliefs and practices.

By using this type of evaluation, implementers would not have access to an in-depth understanding of why some FITS are less successful than others. Although success can be attributed to a combination of factors such as budget, leadership, support, access and others. It can be argued that a farmer’s circumstances (e.g., practices, values, education and skills) and perspectives (e.g., perspective of the affordance of the intervention) are equally important contributing factors in the understanding of FITS success.

By examining farmers’ circumstances and perspectives, not only the successful FITS may be determined, but also an understanding of how interventions are adopted and how farmers learning may be obtained. The purpose of using two FITS centres in this study is not to compare them but rather to understand how farmers – who embraced technologies to
different degrees within their farming practices – are entwined with technologies. This allows us to get an insight into farmers’ views of affordances of technology and into their learning paths. Moreover, the choice of having an unsuccessful FITS centre allows us to triangulate the findings and verify prior perceptions of farmers before their entwinement with the intervention.
Chapter 3. Literature Review

This chapter presents the literature reviewed to provide guidance in answering the research questions of this study. This chapter is divided into four sections. The first section presents a broader theoretical context and overviews some classical theories that are often used in technology adoption studies and summarises their criticisms. Then, the rest of the chapter introduces a sociomaterial perspective for studying technology adoption that was constructed and used in this thesis. The second section introduces the notion of affordance and presents the different perspectives of technology affordance and how it can be used as a lens to study sociomateriality. This section specifically discusses how affordance is used to *embody sociomateriality* and how it explains conditions of sociomaterial entwinement. The third section explains the concept of sensemaking by presenting a brief history, the various perspectives, stages and forms of sensemaking. This is followed by exploring the relationship between culture and sensemaking and by discussing how sociomateriality could be embodied in sensemaking processes. The fourth section discusses learning in a sociomaterial context, where stages of learning are discussed. Finally, drawing on these four sections, the theoretical framework used in this study is presented.
3.1 Overview of studies in technology adoption

This section will discuss some classical studies in the field of technology adoption. First, I will discuss the theory on the Diffusion of Innovation (DOI), which will be followed by Technology-Enhanced Learning (TEL) and lastly, I will present a brief overview on the theory of Workplace Learning (WPL).

3.1.1 Diffusion of Innovation

The diffusion of innovations (DOI) is one of the most mature theories of adoption and diffusion of technologies (Rogers, 2004; Straub, Jr. & Burton-Jones, 2007). It has been broadly used across disciplines such as marketing, agriculture, medicine, and education to understand how innovations are adopted and diffused. According to Rogers (2004), diffusion is a “process in which an innovation is communicated through certain channels over time among the members of a social system” (p. 5). From this definition, the four key elements of the diffusion of innovations can be drawn: the innovation, communication, time, and the social system.

The diffusion of innovations postulates a theoretical explanation for technology adoption and describes an innovation as an idea, practice, or an object that may be new to an individual. Its significance is not whether the idea is objectively new but that the adopter perceives newness and reacts accordingly to that idea (Baskerville & Pries-Heje, 1998). In relation to this study, the newness of the FITS – even if it is viewed as a mature technology applied elsewhere – is perceived and experienced by farmers in the community to be new because they were not accustomed to this kind of technology.

Communication deals with the mutual understanding of individuals in a social system that may lead to the convergence or divergence of the meanings that individuals ascribe to events (Baskerville & Pries-Heje, 1998). For example, Rogers (2004) recognised two types of communication channels that could help propagate the diffusion of an innovation, they are: mass media, and interpersonal. Mass media is useful in disseminating information about the innovation and reach as many population
as possible, while interpersonal communication rely on peer networks consisting of interconnected individuals.

Time is related to the period in which individuals’ progress from knowing about the innovation towards the adoption or rejection of the innovation (Rogers, 2003). Time is exhibited through the rate of adoption, the innovation-decision process, and the individuals’ innovativeness.

Subsequently, the social system should be carefully understood to ascertain what sociocultural elements (e.g., norms, values and existing practices) may or may not influence the innovation during diffusion.

Although diffusion of innovations is a well known theory that many researchers have applied, it also attracts a significant amount of criticism. Diffusion of innovations theory is criticised for a pro-innovation bias, individual-blame bias and recall problem.

Pro-innovation bias is acknowledged as one of the most serious critiques of the diffusion of innovations theory (Rogers and Shoemaker, 1971 cited in Rogers, 2003). Pro-innovation bias implies that an innovation is something good that should be adopted and diffused because it is a ‘sure-fire’ (assumed to be accepted without resistance) improvement of existing practice (Keller, 2005). Pro-innovation bias also suggests a separation of different members of the social system hailing the group of superior adopters while alienating an inferior group of laggards (McMaster & Wastell, 2016). The pro-innovation bias leads us to think that change is inevitable when in fact not all changes are necessarily healthy and resistance, may be desirable and useful because it helps clarify how the innovation is opposed (Blin & Munro, 2008). Consequently, the pro-innovation notion introduces a tendency not to explicate and understand how and why some innovations fail. Hence, in this study the pro-innovation bias is countered by the inclusion of the non-adopters’ perspective to explicate reasons of rejection that may (or may not) run counter to the justifications of adoption.

Individual-blame bias is the tendency to place blame on the individual as solely responsible for his/her predicaments leading to non-adoptions rather than a system. In contrast, system-blame bias is also a potential problem because a system may be considered at fault and so, the responsible
for the problems of individual members is within the system (Tatnall, 2000). Lastly, diffusion research is dependent on recall data from participants as to when they adopt the new idea or at what stage do certain actions related to adoption occurred (Rogers, 2003). As a means of reconstructing the past, participants are often asked to recall their innovation experiences which make it problematic because retrospection is not accurate (Rogers, 2003).

3.1.2 Technology-enhanced learning

The term technology-enhanced learning (TEL) is used to describe the application of information and communication technologies to teaching and learning. TEL incorporates the older term ‘e-Learning’, which was used with a confusing variety of meanings (Guri-Rosenbli & Gros, 2008). However, it is rare to find explicit statements about what TEL means. Most frequently, TEL is considered synonymous with equipment and infrastructure. For example, the UK Universities and Colleges Information Systems Association (UCISA) provides only a technical definition of TEL as any online facility or system that directly supports learning and teaching (Walker et al., 2016).

Literature suggests, that the concept of TEL had been used as a tool in variety of ways by different organizations, for example, it was used as a strategy for professional development (McKenney, Boschman, Pieters, & Voogt, 2016). In higher education across United Kingdom, TEL was utilized as a strategy for assessment, enhancing learning and teaching, improving access to learning off campus and helping teachers to create a common learners’ experience.

Based on the definition given to TEL, the emphasis of the theory is on the role of technology as a support mechanism for the already-existing educational activities of teaching and learning (Price & Kirkwood, 2011). For instance, the Universities and Colleges Information Systems Association (UCISA) surveys from 2008 to 2012 describe TEL as encompassing any online facility or system that directly supports learning and teaching. This may include a formal VLE, an institutional intranet that has learning and teaching components, a system that has been developed in-house or a suite of specific individual tools. The word ‘enhancement’ in TEL assumes that a pre-existing set of practices which are not in any need of radical shift or displacement are present, and are being made better by
the sensible application of a little (in this case technological) assistance. TEL studies primarily focus on investigating how technology could be used to enhance different aspects of learning: how assessment practices can be aided and enabled by technology; or how make access to learning materials easier for users. These aspects are important for institutions and for lecturers that aim to improve assessment and feedback or offer more flexible course provisions.

TEL’s emphasis is on the role of technology as a supportive mechanism to existing educational activities. With this stance, it is perhaps useful to ask what alternative frameworks can be used to understand better how technologies are adopted. In the context of TEL, what is material is often taken to be the background against which educational practice takes place or within which it sits, and material artefacts are often taken to be simply tools that humans use or objects they investigate, therefore, this theory tends to assume that humans are separate from the material. This TEL’s positioning introduces a deeper critique of the failure of much educational research to give a proper account of the human subject and how it is constituted in intimate relation to its material contexts. Sociomaterial approaches (Orlikowski, 2008; Leonardi, 2012) argue against the isolation of society from technology, and human subjects from non-human objects, revealing how each is constituted by the other. The concept of sociomateriality also problematize dependence on certain conceptions of what it means to be human, suggesting that ‘human’ functions (like learning) are not pre-existing attributes of the individual separable from its social and material contexts, but are rather brought into being via a complex assemblage of the human and the non-human.

3.1.3. Workplace Learning

Workplace learning (WPL) is defined as both formal and informal learning and focused on improving conditions and learning practices in a work setting (Li et al., 2009). Marsick (2009), defines formal as a structured learning that takes place outside of the work environment, for example, a classroom-based formal education. On the other hand, informal learning is an unstructured, unplanned, unorganized activity and is considered happening spontaneously without stated learning
outcomes (Kyndt, Dochy, Onghena, & Baert, 2013). Workplace learning is identified as not only a learning environment, but also as a culture and social interaction (Kessler, Horton, Gottlieb, & Atwood, 2013).

In relation to technology adoption, technologies, such as ICT, serve not only to promote collaboration between employees, but also as a method on how individuals learn during work (F. Jones, 2007). Kessler, Horton, Gottlieb, and Atwood (2013) identify employee acceptance of technology as key to implementation of a workplace learning system. In their study of an implementation of a workplace learning program, they found a close relationship between learning culture and technology acceptance.

Although, the notion of WPL is broadly used in studies of learning in the workplace, WPL is not a single pedagogical approach or paradigm (Griffin, 2011). Workplace learning has generally been aligned with the experiential knowledge and learning rather than with the theoretical knowledge and learning (Song, Hoo, & Chermack, 2009). As a result of this there has been the lack of recognition of learning that occurs in the workplace. Instead WPL has tended to be seen as a part of “getting to know the job” or “climbing the ladder”. In other words, learning that transpires in the workplace has generally been about the work rather than learning (Billett, 2004). Learning has also been marginalised because the people most likely to be participating in workplace learning programmes are motivated by extrinsic rewards (e.g., credit, qualifications, promotions and subsidies) rather than intrinsic interests (e.g., improve productivity, profits).

With this inclination, WPL studies often look at learning as a social phenomenon that is generally independent of the technology. Technology here is often considered as a simple tool to facilitate the learning process and its adoption is not an important concern.

3.1.4 Synthesis

In summary, although these theories are well established and some had been widely used in the studies of technology adoption and learning, they primarily focus either on technology (DOI, TEL) or on social aspects (WPL). They provide limited explanation of how technologies (material) and
human (social) are intrinsically constituted a shape each other during learning. To get a deeper insight, learning and process of adoption should be considered using the lens that allows us to look at the entwinement of human and technology.

3.2 Technology affordance

The notion of affordances is influenced by ecological psychology originally conceptualized by Gibson (1979). It has been extended since by a number of ecological psychologists (Chemero, 2003; K. S. Jones, 2003; Sanders, 1997; Turvey, 1992) and sociologists (Hutchby, 2001). The term affordance was developed by Gibson (1979) to emphasize a reciprocal and immediate relation between an organism and the environment. In his basic relational proposition: Gibson (1979) explains that when explaining perceptions and how species including humans orient themselves to objects in their environment; it can be viewed in terms of possibilities for action. For example, a smartphone affords different possibilities for action. To a child it is a device for playing games, compared to an adult, which may see it as device to communicate.

Gibson (1979) states his basic relational proposition as follows:

“An affordance is neither an objective property nor a subjective property; or it is both if you like...It is equally a fact of the environment [artifact] and a fact of behavior [action]. It is both physical and psychical [social]... An affordance points both ways, to the environment [artifact] and to the observer.” (pp. 129-130)

Inspired by Gibson (1979), Zammuto et al. (2007) proposed that the affordance of the material properties of an object favours, shapes and invites (and at the same time constrains), a set of specific uses. These additional properties—affordances—emerge in relation to the activities of those using the objects. For example, a plastic chair may afford
to support a light person to sit upon but not an overweight individual. In this case, the properties of the chair remain the same in both contexts. That is, material affordances are relative to the users and their circumstances in which they are used (Hutchby, 2001).

Norman (1990) also applied the concept of affordance in the field of technology studies by suggesting that the affordances of an object are often designed into the object. For example, the curvature of a chair backrest which invites those who have back pain issues to sit. By incorporating the curvature into the design of the chair, the user (having back pain) could immediately perceive the affordance and at the same time the limitations by simply looking at it relative to their situation.

Warren (1984) also conducted a series of pioneering stair-climbing experiments seeking to understand affordance-based perceptions via body-scaled metrics. Specifically, he showed that actors perceive their environment in terms of intrinsic or body-scaled metrics, not in absolute or global dimensions. That is, judgment of whether one can climb a stair step is not determined by the height of the stair step but by its ratio to one's leg-length.

Generally, the set of Gibson-motivated affordances were focused on the physical or structural properties or features. However, there have been many debates on whether affordances should pay greater attention to include social dimensions (Balogun & Johnson, 2004; Gibson, 2000). Other researchers in social sciences, technology, and organisational studies have argued that there is a need to explore affordances and take into account the relational constraints that affect human interaction (Leonardi, 2011; Orlikowski & Scott, 2008; Zammuto et al., 2007).
3.2.1 Views of affordances

This subsection presents the views of the affordances of technology. Three different views of affordances are presented in this section, namely: affordance as a bundle of features, design and relational affordances.

3.2.1.1 Affordance as bundle of material features

One school of thought on affordances is that it should be considered as a *bundle of material features* (Turvey, 1992). This type of affordance can be seen in the research of Turvey (1992), which builds on the early Gibsonian work (Gibson, 1979). It offers a definition of affordance as a property of an object in relation to the environment. This implies that affordance is a property of an object that manifests itself under specific circumstances. For example, one property of a spoon is to be used for eating. However, the spoon also could be used for other purposes, and its property to serve as a bottle opener could be manifested in the absence of a proper bottle opener. This means that affordance of an object is dependent on the specific circumstances. Similarly, Arthur (2009) views technology as an object in the world defined by the functionality it provides. Thus, a bundle of material features means possibilities for actions that are not yet actualized, or that features are opportunities for actions.

There are two main problems with the concept of affordance as a bundle of material features. According to Faraj and Azad (2012), these problems are: 1) *conflation* of product categories and technology in use, and 2) *feature centricity*.

*Conflation* is the process of merging similar representations of the same physical entity into a single form. According to Faraj and Azad (2012) the conflation of product category and technology-in-use refers to the often ad hoc superposition of vendor defined categories as representing the technology being used. Faraj and Azad (2012) showed a
scenario of conflation using an email that did not work which was blamed by the user on the laptop. According to Faraj and Azad (2012), a secretary complained that her email was not working. When she was asked what the problem was, she pointed to the laptop as the cause of the problem. However, after a closer inspection of the problem, it was found that the laptop was not to be blamed, but it was a connection issue with the router because the laptop was not connected to the router. In this scenario, the email was not functioning not because of the laptop but to other related technologies (router disconnection) within the system. This reflects that the user saw the email as one with the rest of the system that runs it (laptop and connections) rather than a delimited bundle of functionalities (Zammuto, 2007).

We can observe in the example that the notion of email as a specific entity is largely not in alignment with email-in-use. The problem did not occur with the core email technology but from related technologies: the router being disconnected. However, from a user standpoint, the email technology, broadly defined, did not work: the Internet Service Provider (ISP) and physical connectivity problems become entangled in the mind of the user’s inability to perform his emailing activity. This implies empirical studies of technology adoption should look at users’ perspectives on affordances of technology beyond its obvious features and functionalities.

The second problem, according to Faraj and Azad (2012), is feature centricity, which is characterized as the process of emphasizing technology-in-practice based on the use of the same software in number of ways and perceiving the software as providing a distinctive bundle of capabilities. For example, he considered the use of word processing software, perceived by different users in different ways. For an office worker, word processing software can be used for typing; for an academic, it serves as a tool for writing papers that allows
bibliographic referencing; and for a brochure designer, it can be a tool for text placement and smooth lettering. Faraj and Azad (2012) argued that:

“If this (feature centricity) accurately represents the manner in which users appropriate and use technologies, then it is not clear at all if a ‘word processor’ can be represented as a core feature set universally. Should it be a software application including peripherals [i.e., hardware such as printer and PC]? Should it be the bundle associated with the academic writers’ perceived needed capabilities of a word processor? Alternatively, should it be the software feature collection that is associated with brochure design?” (p. 10)

Given this scenario, this list could expand depending on how other users may perceive the technology-in-use. What is problematic in this case, is that researchers may not be able to focus on what is important based on the users’ perspectives in relation to technology-in-use (Faraj & Azad, 2012). For example, Gutek, Bikson, & Mankin (1984) claimed that most systems are really sets of loosely bundled capabilities and can be implemented in many different ways. Furthermore, DeSanctis and Poole (1994) postulate that computer “systems vary so much in the presentation of their features that information based on features alone makes it virtually impossible to compare systems or versions of systems” (p. 333).

Considering the above issues, it is difficult for Information Systems (IS) researchers to decide on the features and the level of detail that are to be investigated. According to DeSanctis and Poole (1994), the problem is the “repeating decomposition problem: there are features within features... So how far must the analysis go to bring consistent, meaningful results” (p. 124). In an example from Griffith (1999) as cited in Faraj and Azad (2012), “…the personal digital assistant may take input from a stylus, the stylus may be plastic or metal, the plastic may be hard or soft, ad infinitum” (p. 11). Even with the criticism on the issue of
repeated decomposition, no alternatives to the use of features as an essential element in theoretical formulations were forwarded (Faraj & Azad, 2012; Markus and Silver, 2008).

3.2.1.2 Design Affordance

This view of affordance has been popularized by (Norman, 2011) who used the term affordance to nudge technology designers toward intuitive designing (Norman, 1988, 2007, 2011). Norman argued that design choices serve as a more direct communication between the designer and the user. He formulated that affordances need to be perceived to be useful and should exist or else the technology will be worthless. Norman (1990) also suggests that affordances are intrinsic properties of artifacts and that the role of design is to make affordances easily perceptible to would-be users. For example, knobs are for turning, slots are for inserting things into and balls are for throwing or bouncing. Just by looking at it, the user knows what to do with the object. No picture, label or instruction is required for the user to determine what the object can do. Thus, the use and possibility of interaction with the objects is based on a user’s mental representation of what the object is for.

For Norman, affordance is in the object, and the goal of an affordance is to signal to a user what the object can do, and how to do it. To achieve this goal, designers typically consider a group of users and make the affordance of the technology easy for them to perceive. To Norman, users are important because they identify the affordance of an object, but play little role in the creation of that affordance, because in most case the creation of such an affordance lies in the hand of the designer. As an example of this, we can look at the design of the website Pinoy Rice Knowledge Bank. The use of the local dialects in the website is a design affordance that allows its users to consider using the website often because they can easily understand the content using their dialect.
The issue with this type of thinking about affordances occurs when the technology leaves the hands of the designers. For example, when a technology is implemented, the technology is left on the hands of the users; the users will then look at the affordance of technology based on their context, goals and skills. If the technology affordance does not match the users’ goals then the users may not to use the technology, or if the technology requires complex skilful manipulation users may opt not use the technology. Given these factors, design considerations must not only be limited to the technology in use (object), but should include the circumstances of the users, that is, users’ skill in using the technology, age, and capacity.

In summary, Norman’s and Gibson’s views of affordance are different, and their main points are summarized in Table 3.1

<table>
<thead>
<tr>
<th>Gibson’s Affordances</th>
<th>Norman’s Affordances</th>
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<tbody>
<tr>
<td>Possibility of action— no need for visual information on how the object works.</td>
<td>Action possibility and the way that that action possibility is conveyed or made visible.</td>
</tr>
<tr>
<td>Interested in how people perceive the environment (manipulation is not the focus)</td>
<td>Manipulating or designing the environment so that utility can be perceived easily</td>
</tr>
<tr>
<td>Affordance exists or it does not exist</td>
<td>Make actions difficult or easy</td>
</tr>
</tbody>
</table>

3.2.1.3 Relational Affordance

With this, Hutchby (2001) pursues a middle ground between Norman’s and Gibson’s concepts of affordance. Hutchby emphasizes the relational characteristic of affordance. Hutchby views affordance as both *features of technology* (artefact that has a material
presence) in the sense of enabling and constraining action with the technology, and relational (that is affordance differs from one person to another or context-to-context).

In Hutchby’s (2001) view, affordances are therefore not exclusive to people (design view) or technological objects (features view) but are created because of the relationship between people and the materiality of an object when they come into contact. For example, for a student, a spreadsheet may afford computation of a given formula or solve some statistical, algebraic and trigonometric equations, but this affordance of spreadsheet could not be available to students who do not understand writing equations in the spreadsheet. With this scenario, affordances are both the bundle of features (in the sense of enabling to compute), but at the same time constraining (due to the lack of skill in writing equations). In this scenario, the affordance of the spreadsheet may be seen as limited by those students who do not know how to write the equations but will be perceived beneficial by those students who know how to do this. In this case, the affordance is relational, it becomes dependent on the context of the individual and differs from one person to another.

From the example, this means that humans and technologies cannot be treated and studied separately. This implies that if we look at the affordance of specific technology, we cannot look at it not on as singular entity (for example, looking only at the features or how the technology is designed). Rather, we should look at affordance as a combination of the features, design and the individuals who will be using the technology, or as products of sociomaterial entanglement. As Introna (2009) states:

“It would not be incorrect to say that our existence has now become so entangled with the things surrounding us [if it even makes sense to use the notion of ‘surround’] that it is no longer possible to say, in any definitive way, where we end and they begin, and vice versa...We are the beings that
we are through our entanglements with things – we are thoroughly hybrid beings, cyborgs through and through.” (p. 26)

For this reason, Leonardi (2011) argued that people attempt to reconcile their own goals with the materiality of a technology and they actively construct perceptual affordances and constraints. Leonardi explored this argument through the process of *imbrication* between the human and technology. Taylor (2001), Ciborra (2006) and Sassen (2006) characterize imbrication as the interweaving of human and material agencies. Leonardi (2011) compared imbrication to the arrangement of the roof tiles arranged in distinct elements in overlapping pattern so that they function interdependently. That is, the interlocking of tiles to waterproof a roof using the tegula and the imbrex. The tegula was a plain flat tile laid on the roof and the imbrex was a semi-cylindrical tile laid over the joints between the tegulae. The interlocking pattern of tegulae and imbrices divided the roof into an equal number of channels. The image is of an interlocking sequence that produces a visible pattern. He further argued that the roof could not be composed solely of tegulae nor of imbrices—the differences between the tiles in terms of shape, weight, and position prove essential for providing the conditions for interdependence that form a solid structure.

Similarly, for human and material agencies, though both have capabilities for action, they differ with respect to intention. Thus, like the tegula and the imbrex, they have distinct contours yet form an integrated structure through their imbrication. Taylor, Groleau, Heaton, and Van Every (2007) suggest that this integrated structure (tegulae and imbrex) is an organizational structure. “Applied to organizational analysis we consider [imbrication] to be the way that interagency relationships are interwoven to form...infrastructure” (p.399). With these arguments, according to Leonardi (2011), whether users perceive that
a technology affords or constrains users’ goals, technology users make choices about how they will imbricate material agencies. Acting on the perceived affordances of a technology can then lead users to realize new intentions that could be achieved through the material features of the technology. The different ways in which human and material agencies are imbricated results in distinct outputs—either a new routine, or a new technology.

From these views on imbrication, capacities for action are seen to be enacted in practice, and the focus is on constitutive entanglements (e.g., configurations\(^3\) - Suchman, 2005 and assemblages\(^4\) of humans and technologies - Orlikowski and Scott, 2008). To illustrate this point, a summary of Leonardi’s (2001) explanation of the model is presented in the succeeding paragraphs.

![Image: Figure 3.1 Imbrication of Human and Material agencies producing routines and technologies (Leonardi, 2011)]

In Leonardi’s model, M1 is material agency, H1 is human agency, M2 is new material agency, and H2 is new human agency. In Figure 3.2, routine is depicted as a circle made up of M1 and H1. As the material and the human imbricate, a routine is constituted, however, in the process of imbrication, the human may realize shortcomings of the material resulting in a perception of constraints\(^5\). Given this scenario, constraints exist between the space M1

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\(^3\)Configurations-is an exploration that include extended networks of social and material production, and recognizing the agencies, and attendant responsibilities, involved in the inevitable cuts through which bounded sociomaterial entities are made.

\(^4\)Assemblages-referring to the constitutive entanglement of human and technologies that are inextricably related. Orlikowski forwarded that “there is no social that is not also material, and no material that is not also social”.

\(^5\)Note that constraint, as it is used here, is not the property of the technology. Rather, a technology that was once everything users wanted or needed is now perceived by them as a constraint to achieving their new goal. This perception of constraint arises because (1) their goal has shifted and (2) they cannot figure out how to achieve their goal with the features of the existing technology (Leonardi, 2011).
and H1. As the constraints are perceived, the tendency of the material developer is to modify the existing technology to respond to the goals of its users, thus bringing changes to the material at a certain level. This new material will now have new material agency (M2) which contains the new features required by H1. Thus, the box in the model containing H1 and M2 represents the new technology, with new features by virtue of M2. With the technology now having new features M2, in the process of human engagement with technology, humans may create new human agency H2.

Thus, Figure 3.2 illustrates that the perception of constraints produces a sequence of imbrication that changes technologies while the perception of affordances produces a sequence of imbrication that changes routines. Further, a new agency (human or material) does not just imbricate with an existing agency; rather, it is interwoven with an entire history of imbrications that came before it. History is an important part of the imbrication process, as it defines how people make choices about how they imbricate with technology. The accumulated choices that the people have, affect the type of imbrication they will make with the technology in so much as they make perceptions of affordances and constraints.

By mapping the changes of technology and routines over time, we may be able to gain insights into the dynamics and processes of sociomaterial entwinement (Leonardi, 2011). The implication of accepting a relational view of affordance is to abandon the talk of generic user or to think of technology as bundles of features. User intent, abilities, social context, as well as the specifics of the situation matters. There is also a need to abandon the view that affordances are about technology or an object but about actions in the world that involve technology. Thus, in this study, the theoretical focus shifts away from the actor or the object or the interaction with the object, but what becomes important is how the specific action unfolds during the interaction.
To map the process of sociomaterial entwinement, it is helpful to look at the prior conditions of imbrication. This will be discussed in the next subsection.

3.2.2 Conditions of sociomaterial entwinement

In order to explore the conditions of sociomaterial entwinement, it will be useful to trace first how individual affordance shifts to organizational affordance. In this subsection, first, I will trace how individual affordance shifts to shared affordance and second, I will present conditions for sociomaterial entwinement found in the literature.

3.2.2.1 The shift from individual to shared affordance

Orlikowski and Iacono (2001) argued that information technologies are not made of a single entity but are composed of many features that can be used, in some cases, independent of one another and in many different ways. Kane and Labianca (2011) suggested that different individuals who make up a social group might choose to use different features of technology than those chosen by their peers. These differences in use can have significant implications to the outcomes on how the organization works. Leonardi (2013) suggested that to understand the mechanism in which technologies affect changes in an organization requires a focus on how members of the organization actually use the features of technology and how users of the technology converge on a shared adoption of the technology’s affordances, such that the affordances that the technology provides are jointly realized.

In organizations, it is common that individuals perceive affordance of an artefact differently depending on their duties. However, in most cases, workers in the organization share experiences and, in some cases, some ask advice of each other. From Blau’s (1955) classic study of federal business auditors to Perlow’s (1997) examination of software engineers—research has shown that most people’s work could not be accomplished if they
did not regularly turn to colleagues for advice. Thus, engineers and other professionals form informal advice networks, these are networks of communication wherein a person seeking advice about work related issues could go. Informal advice networks are consistently shown to be important engines of productivity and social support, because they enable the movement of pertinent information among employees (Cross, Borgatti, & Parker, 2001; Gibbons, 2004). In most cases, there are individuals who become proficient in putting the affordance of an artefact in action. This in turn allows them to gain power and influence over other members of the organization because of their ability to complete tasks that other members of the organization cannot (Kane & Labianca, 2011). As other members of the organization become aware of the benefits of the affordance of an artefact, they will aim to utilize this affordance in relation to their work goals. Those individuals who developed operational expertise quickly are sought by their colleagues for advice about how to use the artefact. In the process, individual perception of the affordances of the artefact diminishes or may change, and a collective perception of affordances of the artefact emerge. This means that the affordances of the artefact are shared by the workers thus, their status shifts from being individual affordances to shared affordances.

Leonardi (2013) defined individualized affordance as an affordance that someone enacts when using a technology’s features, but that affordance is not common to his or her workgroup. It will benefit the person who enacted it, but may not be available to everyone else in the group. Shared affordance, on the other hand, is defined by Leonardi (2013) as an affordance that is shared by all members of a group represents differential feature use that is necessary for completing non-interdependent tasks that when pooled achieve a group-level goal. When affordance is shared, the affordance of a technology becomes multiple and is dependent on what individuals want to achieve, and are not interdependent of each other.
Each individual can become expert in an area of interest that they can then share with the rest of the members of the group, eventually leading to achieving the group’s goal.

Schultze and Orlikowski (2004) showed how such changes in informal consultation patterns were shaped slowly in response to formal alterations to work roles that managers made to take advantage of a new technology’s capabilities and shortcomings. In addition, Leonardi (2007), showed how the decision to use features of a technology that were not used previously, gave employees access to new information about other people’s expertise. This new information led them to consult people they had not consulted before (e.g., users who only use a specific website to look for information, but when the user asks a co-worker, the user realizes that Google is a very powerful search engine). Although these studies discuss how technologies change advice networks, they are silent about the conditions in which these changes are likely to occur, which leads towards sociomaterial entwinement.

For these reasons, it is not surprising that many researchers have explored how and when (Kane & Alavi, 2008) informal advice networks affect the adoption and use of new information technologies. However, when considering the ways that newly implemented information technologies might be implicated in the shifting dynamics (i.e. from individual to shared affordance) research has been highly skewed toward a focus on how changes occur, and has often overlooked when such changes are likely (Leonardi, 2013).

3.2.2.2 Conditions of technology use

To address the issue on “when” changes in the perspectives of affordance will likely occur, this study explored Venkatesh, Morris, Davis, and Davis (2003) conditions of technology adoption. Venkatesh, Morris, Davis, and Davis (2003) formulated the ‘unified
theory of acceptance and use of technology’ (UTAUT) model. They identified four determinants of user acceptance and use of technology. These determinants are as follows:

1. **Performance expectancy** - defined as the degree to which an individual believes that using the technology will help individuals attain gains in job performance. Venkatesh et al. (2003) propose that performance expectancy captures the constructs of perceived usefulness, extrinsic motivation, job fit, relative advantage and outcome expectations. Perceived usefulness has been strongly related to usage intentions in various studies, Davis, Bagozzi, and Warshaw (1989) define it as “a person’s expectation that using the technology will result in improved job performance” (p.1112).

2. **Effort Expectancy** - defined as the degree of ease associated with the use of the system (i.e. ease and complexity). Ease of use is defined by Moore and Bensabat (1991) and Davis et al. (1989) as the degree to which an individual believes that using a particular system would be free of physical and mental effort. On the other hand, complexity relates to the degree to which a technology is perceived as relatively difficult to understand and use (Thompson & Higgins, 1991).

3. **Social Influence** - defined as the degree to which an individual perceives that important others believe he or she should use the new system. Subjective norms were found to influence adoption. Ajzen (1991) and Mathieson (1991) defined subjective norm as the perceived social pressure to perform or not to perform a behaviour. These social pressures could come from important others such as family and friends.

4. **Facilitating Condition** – defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system.
The facilitating condition construct has been examined by Thompson and Higgins (1991) and was described as the objective factors present that make an act easy to perform. For example, in research into information technologies, Thompson and Higgins (1991) found that training users, and then assisting them when they encounter difficulties, is an example of a facilitating condition that can influence technology utilisation.

Sargent (2012), added two determinants to UTAUT model to address the issue of organizational context namely: influence of top management support and resistance to change.

Sargent (2012) argued that, senior managers could influence the implementation and use of new technologies, referring to Young and Jordan (2008) who describe that top management support involves managers devoting time to the technology in proportion to its costs and potential, that influencing individuals involves reviewing plans, monitoring results and the management of problems involved with integrating the technology within the management processes of the business. Sargent (2012) further argued that, resistance to change has a negative influence on individuals’ intentions to use ICT. He based his argument on Oreg (2003), who claims that an individual’s dispositional inclination to resist change can predict reactions to specify change. It is a natural part of the organizational change process and individual resistance occurs because change involves going from the known to the unknown (Bovey & Hede, 2001).

It can be observed however, that what Venkatesh et al. (2003) and Sargent (2012) proposed are conditions that are leaning toward the social aspect of the sociomaterial divide. Their exploration shows that the conditions of sociomaterial entwinement are focused on the individual, while the material is treated as a separate entity waiting to be utilized. This model
is like DOI, TEL and WPL that focuses on either technology or the social aspects of adoption. However, these conditions identified by the authors can serve as a starting point that empirical studies could utilize for identifying the shift form individual affordances to shared affordances and making the analysis of data grounded in the assumptions of sociomateriality.

3.2.3 Synthesis

This literature review on affordances of technology has presented three views of affordance, which could be used to explore the process of sociomaterial entwinement. However, not all conceptualizations of affordance can be considered useful in studying how the social and material are entwined. For example, when affordance is considered as a bundle of features, it emphasizes a component’s view of affordances, which locates the affordance squarely in the material side of the actor/environment divide, and necessarily entails the presence of a matching concept from the actor. So too using the concept of technological features in sociomaterial research may result in conflation of technology and feature centricity.

The design perspective generally focuses on technology-in-use. This view of affordance emphasizes the interaction possibilities with the objects based on user representations of what the object can perform (Norman, 2007). The focus of design is on the user, thus making this view of affordance more socially inclined, toward Gibson’s view of affordance. This is so because designers work with a typical user or a class of users in mind when developing a technology design, including decisions on how they will make the majority of users ‘effortlessly’ aware of technology usability. This is achieved by hiding the complexity of a technology through good design principles. While a design can invite users, an issue with
this perspective is the point at which the technology leaves the designer’s hands. The technology is then subject to the whim of the user in relation to their culture, goals and skills.

Hutchby (2001) was able to reconcile these shortcomings by looking at affordance from a relational perspective. He argues affordances are both a bundle of features (i.e. technology having material presence) that enables and constrains actions and that which differs from person to person, context to context or person to context (relational). Using this relationship, Leonardi (2011) devised the concept of imbrication, to observe sociomaterial embodiment. He claimed that affordance and constraints produce a sequence of imbrication that results in new routines and new technologies emerging. He claimed however, that while sociomaterial embodiment can be observed in the process of imbrication, the conditions as to when and how the changes or imbrication will occur needs to be explored. He proposed, that these conditions can be examined by looking at how individuals use technologies in their organization and focusing on how individual affordance shifts to group affordance.

Venkatesh’s (2003) UTAUT model, which identifies the determinants of user acceptance, could be used as a springboard to identify these conditions. In his model, he acknowledged four determinants for technology use namely: performance expectancy, effort expectancy, social influence, and facilitating conditions. Sargent (2012) added two determinants to the model namely: top management support and resistance to change. However, these models are inclined towards the social aspects of the sociomaterial divide, which does not reflect an entwined nature of sociomaterial condition.

The above discussion indicates that there is still much to learn about embodying sociomateriality using the affordance perspective lens. This study investigates sociomaterial entwinement of farmers in selected FITS centres in the Philippines using the concept of
affordance, specifically by answering the research question “How do technology and individuals entwine?”

This research explores the following sub-questions:

1. How do farmers perceive intervention affordance before and during adoption?
2. What are the conditions that lead towards sociomaterial entwinement of farmers and technology?
3. How do perspectives of affordance and perception of constraints produce new practices and new technologies?

3.3 Sensemaking

In this subsection, I will present a body of literature about individual and group sensemaking processes in relation to the second research question of this study. I will divide this subsection into five major components. First, a brief history of sensemaking will be presented. Second, a number of schools of thought on sensemaking presented by various scholars will be discussed. Third, the stages of sensemaking as proposed by Weick will be discussed, followed by the different forms of sensemaking forwarded by different scholars used in different contexts. Fourth, studies on how culture could impede and trigger sensemaking will be reviewed. Fifth, work on the embodiment of sociomateriality in the sensemaking in different empirical studies will be outlined and a final a summary of this section and identification of gaps in the literature will be given.

3.3.1 Perspectives on sensemaking

Researchers have adopted different perspectives on sensemaking depending on how they have approached its use. These differences have depended on researcher assumptions
about what sensemaking involves. For example, researchers may look to whether sensemaking takes place within or between individuals.

For example, Starbuck and Milliken (1988) considered sensemaking as being composed of many “distinct aspects comprehending, understanding, explaining, attributing, extrapolating, and predicting” (p. 51). Hill and Levenhagen (1995) described sensemaking in terms of how people “develop a ‘vision’ or mental model of how the environment works” (p. 1057). These researchers have considered sensemaking as a process that took place within individuals.

In contrast, other perspectives consider sensemaking to be a social process that occurs between individuals, as meaning is negotiated, contested, and mutually co-constructed. For example, the study by Elsbach, Barr, and Hargadon (2005) explicitly links sensemaking with situated cognition and describes how the cognitive process of sensemaking connects existing schemas and organizational contexts. Likewise, Weick (1995) considers sensemaking as a social process. Weick et al. (2005) elaborate that sensemaking unfolds “in a social context of other actors” (p. 409), while Maitlis (2005) describes organizational sensemaking as a process in which an organization’s members interpret their environment in and through interactions with each other, “constructing accounts that allow them to comprehend the world and act collectively” (p. 64). Table 3.2 shows the various perspectives of sensemaking, which will be used in this research.

These perspectives on sensemaking as a process are useful in this research, in looking at the social dynamics and individual interpretive actions. What is common to these perspectives is that sensemaking is generally a process (Balogun & Johnson, 2004; Cornelissen, 2012; Maitlis & Christianson, 2014; Starbuck & Milliken, 1988). For Weick (2005), sensemaking is something that unfolds as a sequence that is triggered when individuals or
groups face issues or practices (triggers) that are new and confusing. Regardless of the differences of sensemaking perspectives, sensemaking is regarded as social, because even when individuals make sense on their own, they are embedded in a sociomaterial context. Their thoughts, feelings, and behaviours are influenced by the actual, imagined, or implied presence of others (Allport, 1985, p. 3, cited in Weick, 1995). Sensemaking focuses on the action that people take to make sense of a situation, which in turn are enacted in the environment that they seek to understand. This process is ongoing as individuals make temporary understanding of the issues and practices that are enacted and modified.

Table 3.2 Perspectives on sensemaking used in the study

<table>
<thead>
<tr>
<th>Author</th>
<th>Perspective</th>
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<tbody>
<tr>
<td>Starbuck and Milliken (1988)</td>
<td>Sensemaking is a process of comprehending, understanding, explaining, attributing, extrapolating, and predicting. It is characterized by placing stimuli into human frameworks.</td>
</tr>
<tr>
<td>Hill and Levenhagen (1995)</td>
<td>Sensemaking is a mental model of how environment works and ability to communicate this mental model with others and gain support.</td>
</tr>
<tr>
<td>Balogun and Johnson (2005)</td>
<td>Sensemaking is a conversational process that involves formal and informal communication, as well as verbal and non-verbal exchange. For example, during verbal exchange people participate in exchanging stories, sharing past experiences, seeking information; and during non-verbal exchange they observe each other behaviours and practices.</td>
</tr>
<tr>
<td>Maitlis (2005)</td>
<td>Sensemaking is an on-going undertaking to create order and make retrospective sense of experiences. This allows people to deal with uncertainties by creating rational accounts that enable action.</td>
</tr>
<tr>
<td>Weick et al. (2005)</td>
<td>Sensemaking is an individual’s or group’s reaction to events issues, and actions that are somehow surprising or confusing. Individuals attempt to interpret and explain these events through production and activation of narratives</td>
</tr>
<tr>
<td>Klein, Moon, and Hoffman (2006)</td>
<td>Sensemaking is a continuous effort to understand connections among people, places, events, and material objects.</td>
</tr>
<tr>
<td>Cornelissen (2012)</td>
<td>Sensemaking is a process of meaning making, as people interpret events and issues within and outside the organization that are affecting them.</td>
</tr>
<tr>
<td>Maitlis and Christianson (2014)</td>
<td>Sensemaking is a process, prompted by violated expectations, that involves attending to and bracketing cues in the environment, creating intersubjective meaning through cycles of interpretation and action, and thereby enacting a more ordered environment from which further cues can be drawn</td>
</tr>
</tbody>
</table>
3.3.2 Stages of sensemaking process

Weick (1979) described the process of sensemaking in four integrated feedback stages as shown in Fig. 3.3, namely: ecological change, enactment, selection, and retention.

Weick (1979) refers to *ecological change* as change in the environment external to an organization, which disturbs the flow of information to the members. For Whiteman and Cooper (2011), ecological materiality recognizes that the natural environment consists of material and physical elements; for example, rocks, rain, water, trees, soil, etc. Whiteman and Cooper (2011) argues that people receive cues from their environment and changes that disrupt their existing practice, thus, triggering sensemaking.

![Figure 3.2 Sensemaking Processes, adapted from Weick, 1979](image)

Ecological changes in the organizational environment create discontinuities or variations that engage the attention of organizational members, prompting sensemaking cycles of enactment, selection, and retention (Whiteman & Cooper, 2011).
The reciprocal exchanges between action and the environment during sensemaking are known as *enactment*, or “the process in which organization members create a stream of events that they pay attention to” (Orton, 2000, p. 231). Enactment is one of the stages that differentiates sensemaking from interpretation (Maitlis, 2014) and is premised on the idea that people play a key role in creating the environment in which they find themselves (Orton, 2000; Weick, 1979, 1988, 1995; Weick et al., 2005). For example, entrepreneurs organize themselves to dictate market prices or in some cases influence the passing of laws and policies to prevent a specific crime reoccurring. Weick (1988) observes that people who act in organizations often produce structures, constraints, and opportunities that were not there before they took action. During the enactment stage, people undergo a micro-process called retrospection (Weick, 1995). According to Weick (1995), retrospection is a process where people reconsider current practices against new ones.

The information resulting from the process of enactment clarifies emerging issues for the *selection* stage, where individuals interpret the rationale for the observed and enacted changes. During the selection process, individuals and groups try to sort through the multiple images of realities generated by previous enactment activities. They attempt to reach a common understanding that seems to portray the situation in the most plausible manner (Ancona, 2012). The process is contestable, as it is subject to the influence of different stakeholders’ interests and multiple interpretations existing in organizational life (Brown, 2003). During the selection stage, people try to answer the question: “*What was going on here?*” (Weick, 1979, p. 175). By asking this question, they attempt to reduce the equivocality of the enacted information.

The product of the enactment and selection stages is the *retention* stage (Weick & Roberts, 1993). Weick and Roberts (1993) claimed that for the retention process to take place,
shared meanings must fit into the prevailing norms of interpretation, otherwise they cannot filter through the cognitive framework and be stored in the collective mind of the organization.

During this stage, actors conduct *small experiments*. While action is key to sensemaking, it is often wiser to begin with and learn from small experiments, before broadening the action to drive change (Ancona, 2012). In addition, this stage involves acting and thinking, meaning people simultaneously interpret their knowledge using trusted frameworks; yet also mistrust those frameworks by testing new frameworks and new interpretations (Weick et al., 2005).

These stages of sensemaking could occur when users are affected by cues triggered by their environment. Many factors may cause people not to undertake the complex sensemaking process being described. These factors are identified and discussed in the next subsection.

### 3.3.3 Causes of minimal sensemaking

The stages of sensemaking as presented by Weick (1979) do not always occur in organizations, as some environmental cues may cause minimal sensemaking; thus members in the organization may not engage in complex sensemaking stages (Nag, Corley, & Gioia, 2007). In this subsection, the forms of sensemaking processes that may cause minimal sensemaking are presented.

According to Balogun and Johnson (2004), minimal sensemaking can occur when goals are mismatched. In his study on organizational structuring and middle managers’ sensemaking, he found that middle managers underwent a complex sensemaking process when a new goal that matched their existing goal was introduced to them. However, for those managers where the new goal did not match their goal, it was found that they were not likely
to undergo a complex sensemaking process. Likewise, Maitlis, Vogus, and Lawrence (2013) in their study of sensemaking and emotions in organizations, found that minimal sensemaking would more likely be associated with less severe impediments to less critical goals. This is because intense emotional reactions to negative events may be overwhelming and thus not lead to complex sensemaking. This means, that sensemaking cannot occur in individuals, if the event had negative impact on important personal goals.

In addition, minimal sensemaking may also occur when individuals or group members are unable to put a value on issues or change. Sonenshein (2010) for example argues that leaders may try to impose changes on employees, but employees may be less supportive of the change as they construct their own meanings or perceive that the change may not be significant enough to change their practices. This is similar to the resistance-to-change narrative in organizational studies; employees construct a change as leading to a significantly worse organization because they bemoan the loss of something they value and thus resist the new way of life brought by the change (Sonenshein, 2010). For example, in the study of Sonenshein (2010), when an organization changes goals, some employees may resist the change because they did not put any value on the new goals of the organization, wanting to maintain the status quo. He found that employees who are satisfied with the organization practices tend to preserve the status quo and find less value to the changes proposed by their managers.

In addition, Hoffman and Ocasio (2001) also identified that a lack of accountability could result in minimal sensemaking. In his study on how external events are attended to within the industrial sector, he found that a lack of accountability led to less likely enacted attention. His study on the Cuyahoga River Fire in the United States showed that the effects of media shape attention and accountability. While the Cuyahoga River fire could have been
attributed to chemical industry activities, no chemical companies were named within the local press and no articles were written at the national level. Instead, the fire was enacted as a problem for the city, not the industry, and the city (Cleveland) was held accountable for the event. Public attention was directed towards Cleveland's pollution problems. While the reputation of the city was at stake, the chemical industry’s reputation was unaffected by the fire. From this example, that the failure to hold a company accountable is one reason why company did not receive media attention and Cleveland’s accountability was not sufficient to attract interest from the national media.

Furthermore, Maitlis and Sonenshein (2010) added that lack of skills contributes to minimal sensemaking. They argued that possession of skills is vital in shaping the meaning of situations and the lack of skills on the part of individual can impede sensemaking. These skills could vary in political, emotional, physical, and mental skills of an individual. For example, Gioia and Chittipeddi (1991) study in a public university showed that educational managers equipped with management skills can easily influence lower level employees; however, those who do not have management skills are not likely to influence employee sensemaking.

Restricted sensemaking is another cause of minimal sensemaking according to Maitlis and Christianson (2014). Restricted sensemaking results from leaders promoting overarching accounts of issues they encounter, which stakeholders tend to accept with relatively few attempts to provide alternative understandings. This occurs when leaders drive and control organizational processes. For example, Monin, Noorderhaven, Vaara, and Kroon (2013) analysis of a carefully managed merger and acquisition is an example of restricted sensemaking. In this study, leaders were silencing alternatives to mergers or in some instances marginalizing particular ideas from others. Leaders engaged continuously in
sensegiving⁶ about justice in the newly formed organization. Members responded in different ways; some accepting leader constructions, while others distanced themselves from the issue, expressing doubt. Even from those who actively opposed leader sensegiving however, resistance was rarely strong.

Lastly, *guided sensemaking* can also result in minimal sensemaking. *Guided* sensemaking occurs when leaders are very active in constructing and promoting understandings and explanations of events, and stakeholders are actively engaged in attempting to shape beliefs about certain elements of the issues (Maitlis & Christianson, 2014). Wiesenfeld, Wurthmann, and Hambrick (2008) termed guided sensemaking as *constituent-minded sensemaking*, which they describe as “the process by which an arbiter renders an assignment of blame, guided not only by the arbiter’s professional standards and rational analysis but also by his or her own biases and the anticipation of his or her constituents’ biases” (p. 135). In the study of Weisenfeld, et.al. (2008) for example, arbiters serve both as a source of judgement and the audience for judgements rendered by other arbiters. In this process, the judgements of arbiters’ are transmitted to, and influence one another’s sensemaking. In doing this, individuals’ sensemaking is minimized because most of the information necessary to understand an event or an issue is given, thus, inhibiting sensemaking.

### 3.3.4 Culture and sensemaking

This section will discuss how culture can impede or trigger the sensemaking process.

The culture of an organization as defined by Schein (2011) is all the beliefs, feelings, behaviours, and symbols that are characteristic of that organization. More specifically,

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⁶ Sensegiving is intentionally trying to change how other people think. The intent of sensegiving is seen as providing a viable interpretation of a new reality and to influence targets to adopt it as their own (Gioia & Chittipeddi, 1991).
organizational culture is defined as shared philosophies, ideologies, beliefs, feelings, assumptions, expectations, attitudes, norms, and values. Similarly, Hofstede (1980) defines culture as the “collective mental programming of the people in an environment” (p. 43) manifested through the patterns of thinking, feeling and potential acts that people carry within themselves (Hofstede, 1997). Moreover, Hofstede posits that culture is evident in ordinary life occurrences such as expressing feelings (i.e. greetings) or even while eating. Culture can also be viewed from three different but interrelated aspects such as mental, behavioural and material (Bodley, 2011). The mental aspect is concerned with the mental rules that people follow, such as patterns of thinking, behavioural aspect reflects on understanding the life behaviours of people in a society, and the material aspect is concerned with understanding how people produce products.

For Weick (1995), “organizational cultures are retrospective, summarizing patterns in past decisions and actions, they are embodied in actions of judging, creating, justifying, affirming, and sanctioning and that these definitions provide continuity, identity, and a consistent way of ordering the world” (p.382). Culture is therefore a sensemaking device insofar as it cues existing discursive practices that serve as organizing principles through which actors enact reality. Weick’s (1995) subsequent work on organizational sensemaking articulated a theory for how objects in one’s environment are instilled with significance, meaning and content are made sense of, in the process of enacting a particular social reality.

According to Maitlis and Christianson (2014), culture can either impede or trigger sensemaking processes. Specifically, Dunbar and Garud (2009) suggest that even when discrepant cues significantly disrupt identity or goals, they may still not trigger sensemaking if group norms or the organizational culture mitigate against it. In their study of the National Aeronautics and Space Administration (NASA) Columbia shuttle flight, NASA had documented
the potential dangers of foam shedding, but its cause remained unclear. Despite this, foam shedding was reclassified over time from an in-flight anomaly to an *accepted risk* that was not a safety ‘off-flight’ issue. This deviant normalization of the event (i.e. people notice but quickly normalize unusual cues) became assimilated into an existing interpretation that resulted in a disaster for the Columbia mission. The reclassification of this incident to *accepted risk* became normal, and something expected, thus impeding sensemaking. Sensemaking in this example becomes integrated in the event as part of the system, as peoples’ routine and culture reduce mindfulness (Levinthal, 2006; Weick et al., 2005) which encourages accommodation.

Culture can also trigger sensemaking over an organizational crisis (Christianson, Farkas, Sutcliffe, & Weick, 2009), threats to organizational identity (Elsbach & Kramer, 1996) or planned organizational change (Balogun & Johnson, 2004). However, for these events to trigger sensemaking, Hoffman and Ocasio (2001) noted that the actors in the organization must first notice the event.

Christianson et al. (2009) examined an example of sensemaking triggered by organizational crisis. They studied the collapse of the roof at the Baltimore and Ohio Railroad Museum, in Baltimore, USA, which crushed many valuable artefacts and endangered those that remained. This event disrupted plans for a major fair to celebrate American railroading and also challenged organizational members’ understandings of what, if anything, the museum could be in the future. In this case, sensemaking was triggered regarding whether the roof collapse should be understood as an institution-ending disaster, or a temporary setback that could spawn further action and enable renewal.

In addition, Elsbach and Kramer (1996) looked at organizational identity that triggers sensemaking. They found that members of disappointingly ranked schools were prompted to engage in sensemaking about core identity attributes of their school, and its standing relative
to others. They worked to uphold aspects of the schools’ identity that the rankings overlooked. As Weick (1995) observed, “Sensemaking is triggered by a failure to confirm one’s self” (p. 23). Individuals construct their identity in ways that meet human needs for self-enhancement, self-efficacy, and self-consistency (Erez & Earley, 1993). From this example, sensemaking is triggered when one of these factors is threatened, and people act to restore their identity.

Lastly, on planned organizational change, the work of Balogun and Johnson (2004, 2005), examined a privatized utility company in United Kingdom undergoing a strategic change initiative. This examination included organizational change goals such as new working practices; specific change interventions, such as total quality training and process redesign. All of these were at odds with managers’ existing understandings of their organization, causing them to adapt to the organization’s new future and its implications for its members. This study suggests that changes in organizational structure, roles, and responsibilities create ambiguities for members of the organization, thus triggering sensemaking.

In summary, culture can influence the complexity of sensemaking that an individual or organization may undertake. The literature suggests that sensemaking starts when people or organizations experience an interruption (e.g., events, issues, crisis, planned or unplanned interventions) that is of value to them. People and organizations may differ in their sensemaking, and when sensemaking is triggered, both may experience the complex stages of sensemaking: enactment, selection, and retention. In some instances, minimal sensemaking may happen when peoples’ goals are mismatched, values are not perceived, there is a lack of skills, or sensemaking is restricted and guided. Therefore, depending on their situation and the circumstances of an event, they may undertake different forms of minimal
sensemaking. Culture may inhibit or minimize sensemaking however, in some instances it can trigger complex sensemaking processes.

3.3.5 Embodiment of sociomateriality in sensemaking

According to Maitlis (2014), studies on the embodiment of sociomateriality are quite rare, but he added that in recent years more scholars have focused on the embodied nature of sensemaking in sociomateriality. Some work arises out of critiques of sensemaking as a “rational [and] intellectual process” (Cunliffe & Coupland, 2012, p. 65) that ignores its embedded and embodied nature as well as observations. Likewise, Orlikowski and Scott (2008) state that in organizational studies, “attention has tended to focus on the processes of sensemaking and interaction with little recognition of the deeply constitutive entwinement of humans and organizations with materiality” (p. 466). Table 3.3 summarises the main ideas from empirical studies of sociomaterial embodiment in the sensemaking process.

Cunliffe and Coupland (2012) argue that the embodied narrative sensemaking can be best captured through lived experience. This means that people make sense of themselves and their lives through their experiences and by sensing their surroundings through their daily interactions. In their study during the British and Irish Lions rugby tour, they analysed the sensemaking process observed in a documentary film, that allowed them to examine the players’ bodily gestures, facial expressions and the positioning of the different team members in relation to each other during the game. They found that the main actor in the team sensemaking process “is not necessarily an information-processing activity but draws on an intuitive and informed feeling in his body” (p. 77). This finding shows that sensemaking is not purely in the mind or within language but can also be expressed through bodily movements.

Whiteman and Cooper’s (2011) research combine an emphasis on the felt sense (or felt senses, through different modalities) and materiality in the sensemaking process. Their
work analysed the extraction of material cues from the natural physically harsh environment. They referred to this type of sensemaking as ecological sensemaking. They define ecological sensemaking as “the process used to make sense of material landscapes and ecological processes” (p. 889). Focusing on the significance of ecological materiality, they demonstrate how concentrating on environmental materials such as black ice and vegetation, as well as other environmental conditions (e.g., wind, inclination of the ground) shape actors’ interpretation of, and actions in ambiguous and dangerous situations. The authors suggest that the ecological embeddedness of the actors (i.e. how actors are physically and culturally rooted in the land) determines how easily they are accustomed to changes in the ecological conditions. These actors can better make sense of their changing situation since they can access a wider range of cues.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Topic</th>
<th>Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cunliffe (2012)</td>
<td>embodied narrative sensemaking</td>
<td>people make sense of themselves and their lives through felt bodily experiences and through a “sensing” of their surroundings in the course of ongoing, everyday interactions</td>
</tr>
<tr>
<td>Whiteman and Cooper (2011)</td>
<td>ecological sensemaking</td>
<td>emphasis on the felt sense (or felt senses, through different modalities) and the part of materiality in the sensemaking process</td>
</tr>
<tr>
<td>Stigliani (2012)</td>
<td>collective sensemaking</td>
<td>further insights into materiality and sensemaking in product design and the transition from individual to group level sensemaking</td>
</tr>
<tr>
<td>Anand, 2008; Glynn, 2008; Oliver and Montgomery, 2008; Markus &amp; Silver, 2008</td>
<td>roles of place and space in sensemaking</td>
<td>field-configuring events that highlights the importance of settings such as tradeshows, conferences, and technology contests for collective sensemaking</td>
</tr>
<tr>
<td>Kellogg (2009)</td>
<td>institutional change</td>
<td>relational spaces—areas of isolation, interaction, and inclusion that allow middle-manager reformers and subordinate employees to develop a cross-position collective for change</td>
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</tbody>
</table>
Stigliani and Ravasi (2012) offered an additional perspective on sociomateriality and sensemaking by studying three design teams’ interactions in a U.S. consulting firm. They found that the combination of material and conversational practices resulted in collective sensemaking. In this study, they showed how material artefacts (magazine images, cards, sketches, maps, etc.) that members used played a role in the sensemaking process serving as cues. The material artefacts became permanently available and served as sources for team members’ emerging connections. In addition, because of the stability of these material artefacts, members did not need to rely on memory in order to re-use ideas expressed earlier in the process. The materials are always there, accessible and concrete, so that members can rearrange and recombine as they require. In their study, the authors showed the critical role of material objects in the sensemaking process and as an enabler in the transition from individual to group level sensemaking.

Furthermore, Kellogg (2009) highlights the importance of free spaces that enable interaction among supporters of change and defenders of status quo. Specifically, he elaborates how change in institutionalized practice inside an organization can be accomplished in response to regulation in the face of resistance from defenders of the status quo. He found that even when top managers support a new program to change an institutionalized practice, middle managers whose interests run counter to the new program are likely to resist it and to attempt to persuade their subordinates to refrain from adopting it. He demonstrated that middle managers sympathetic to reform and their subordinates can successfully change practice in such a situation by interacting with one another in spaces of isolation, interaction, and inclusion to build new task allocations, role expectations, and justifications for these new tasks and roles. This relational mobilization can enable reformers to sustain a cross-position challenge in the face of defender resistance and to pressure
defenders to change practice. In this way, relational spaces and relational mobilization enable the micro-institutional change that new regulation is designed to promote. In their research, the authors show the significance of material spaces in the sensemaking process that settle disagreements within an organization.

Similarly, Glynn (2008) studied role of place in sensemaking, her study offered insights when she studied the Atlanta Olympics as a field-configuring event that illuminates how patterns of structuration and symbolization arise in response to an event, and shape a community field. She found that mega-events like the Olympics introduced new actors, new relationships, and new ideologies to the civic communities in the host city, Atlanta also hinged to the history of the place in which they are held. She additionally found that existing institutional arrangements within cities established the bases for the relational and symbolic systems for the event. Thus, city traditions tended to perpetuate the ‘character of place’ even when punctuated by significant events. The host city’s character also changed, either intentionally or unintentionally, through the legacies of the event. Her study showed how places and their history may influence an event and how too, an event can influence the place where it is held.

These empirical studies mentioned above examine embodiment and sociomateriality in sensemaking, and the links of sensemaking processes to institutions, micro, and macro-social structures. Although sensemaking had been use by scholars in organizational studies and other fields, there are still areas that scholars claim need to be explored, such as:

1. The exploring fine-grained processes of sensemaking to understand better organizational and individual sensemaking processes over time and across context.
2. Links between sensemaking and routines to trace sources of change in organizations.
3. Examining the relationship between sensemaking and team processes, including coordinating, decision making and strategizing.

3.3.6 Synthesis

Differing perspectives on sensemaking were found in the literature, such as, embodied narrative sensemaking and ecological sensemaking among others. Common to these perspectives is that most scholars considered sensemaking as a process, which according to Daft & Weick (1984), follows a sequence that is triggered by interruptions in an organization’s or individual’s routines, that those involved consider important enough to draw their attention. By looking at this process, this research is able to understand how individuals and organizations negotiate with a given technology, leading to change in practices and routines. Another agreement among scholars is that they consider sensemaking as social, even if the sensemakers are embedded in a sociomaterial context. Lastly, scholars agreed that sensemaking is focused on practices that people undertake. Using these arguments, it is then possible to explore how sociomateriality can be embodied in sensemaking processes by focusing on the practices of individuals and organizations.

In order to follow the sensemaking process, Weick (1969) developed the sensemaking stages, namely: ecological changes, enactment, selection and retention. Ecological changes are characterized by interruptions in a person’s or an organization’s routines deemed worthy of attention. This is followed by the enactment stage, where actors reciprocate actions to the observed changes, characterized by retrospection. Then there would selection stage, where people interpret issues and arrive at a common understanding, which portrays the changes in most plausible way. To sum up, the retention stage is the product of the enactment and selection stages, characterized by fitting shared understandings into the existing norms of an organization.
Various causes of minimal sensemaking were also found in the literature. These causes generally described conditions that trigger sensemaking and those that impede or minimize the sensemaking processes. The literature showed that sensemaking is minimized in organizations or individuals when goals of individuals mismatch the goals of planned or unplanned changes. This can also occur when individuals or organizations are unable to feel value or worth attached to the changes they encounter. Lack of accountability was also found in the literature to contribute to minimal sensemaking. The causes of minimal sensemaking that are likely to hinder complex sensemaking are restricted and guided sensemaking. Restricted sensemaking occurs when leaders impose changes on an organisation’s members, such as new policies and rules and when leaders hide alternative information from members that marginalizes the ideas of others. Likewise, guided sensemaking occurs when leaders become too active in shaping the beliefs of their subordinates, imposing their views on the issue or cues.

In addition, the literature presented arguments stating that culture could trigger or impede sensemaking among individuals and organizations. Culture triggers sensemaking when an event becomes a threat to an individual or organization’s identity, however such an event must first be noticed and given recognition. In contrast, there are also studies which show that culture can impede sensemaking. This happens when the individual or organizational norms mitigate an event, as in the case of the NASA Columbia shuttle flight. By understanding the causes of minimal sensemaking, this study may contribute ideas toward strategizing implementation design of technological intervention. It may possibly add to the understanding of how empowering farmers to make sense of technology for themselves can deliver interventions sustainably, rather than by imposition, which may result in restrictions to adoption.
An emergent focus in the sensemaking literature is on its embodied nature. The review showed that studies in this area are rare, specifically in sociomateriality and sensemaking. The focus of the embodiment of sociomateriality in sensemaking studies is associated with those that incorporate senses and physical material cues and artefacts, or both. Studies in this stream range from bodily gestures and ecological environment, to the role of spaces and places.

Through this review, sensemaking has been found useful in examining how expected users of technology may negotiate their way into being entwined with technology. Furthermore, in exploring the sensemaking process of the would-be users of technology, we may be able to examine the relationship strength between an individual and technology, thus, determining the strength of sociomaterial entwinement. Lastly, by using sensemaking in this research, we may be able to provide an understanding on how people make sense of interruptions to their routines in the context of informal education.

Drawing on this review of the literature, the sensemaking perspective and other empirical studies could aid in exploring the research question of this study in the context of farmers’ interaction with technology in selected FITS centres in the Philippines, which is: **how do individuals make sense during the process of an intervention adoption?** Specifically, the following sub-questions will be examined:

1. What are the types and forms of sensemaking processes farmers undertake?
2. How sociomateriality is embodied in the sensemaking processes of farmers in relation to technology adoption?

The theoretical perspectives of affordance, sensemaking and learning, reviewed above, assume a constitutive entwinement of the human and the material. These three perspectives therefore could be integrated. In doing so, we can examine the learning path
that the farmers undertake and study in detail the learning process involved. This micro
processes can be explored by analysing how farmers make sense of the intervention’s
affordance and how they configure and reconfigure the technology ad simultaneously change
their practice. In addition, the combination of these three perspectives allows us to examine
how shared affordance emerge in organizations, how this type of affordance is continually
enacted to create sustained change of practice.

3.4 Learning in a sociomaterial context

The following presents literature on learning in sociomaterial contexts, pointedly, on
micro-processes involved in learning that lead to sociomaterial entwinement. The focus of
this review is on what actions people perform at this stage of learning and what the learning
processes are, which help shape sociomaterial practice. This section will start by presenting a
general introduction of how learning may be explored using a sociomaterial lens. The
examination of these two perspectives allows this research to build on a sociomaterial
perspective in relation to its objectives, purpose, and intentions as to how it can contribute
to studies in sociomateriality. That is, to understand how organizations and
technologies come to be as they are and why people think they had to be that way. The
second, third and fourth subsections discuss empirical studies on stages of learning. Notably,
section 3.3.2 discusses the first stage of learning termed figuring adapted from Mazmanian,
Cohn, and Dourish (2014). Section 3.3.3 explores the literature on configuring which is
adapted from the ideas of Boudreau and Robey (2005) and Engeström (2004). Section 3.3.4
discusses literature on reconfiguring which is taken from the ideas of Mazmanian, et al. (2014)
and Engeström (2004). It can be observed here that, the stages of learning were not taken
from a single theory, as studies that examine learning stages using a sociomaterial lens are
very scarce. As a result of this, a combination of learning perspectives was used to come up with the learning stages for this research namely: figuring, configuring and reconfiguring.

3.4.1 Perspectives on sociomateriality

Many organizations increasingly depend upon Information and Communication Technologies (ICT) to support information and knowledge transfer. ICT offers multiple opportunities for information and knowledge sharing in organizations, especially within geographically dispersed organizations. For example, groupware tools could facilitate communication between people by providing support for distributed electronic interaction (Orlikowski, 2000).

In the context of adult and informal education, sociomaterial analyses of technology have only recently begun to appear. These approaches have become reasonably popular in related fields, such as higher education, organizational learning and practice, workplace learning, and e-learning/mobile learning (Fenwick & Edwards, 2013). Gaining popularity in the study of information systems in organization is the focus on the material’s dynamic entwinement with human activity in everyday practices. Orlikowski (2010) called this constitutive entanglement of social and material. The notion of constitutive entanglement presumes that technology, as well as humans (refers also to the social aspect of human life), are constitutive of organizational life. The material and the social are considered to be inextricably related, as Orlikowski (2007) put it, “there is no social that is not also material, and no material that is not also social” (p. 1437). To Orlikowski (2007), social refers to symbols and meanings, desires and fears, and cultural discourses. Material refers to all the everyday stuff of our lives that is both organic and inorganic, technological and natural: flesh and blood;
forms and checklists; diagnostic machines and databases; furniture and passcodes; snowstorms and dead cell zones, and so forth (Orlikowski, 2007).

By using this understanding of relationships, the notion that social and material interact as separate entities is precluded. Instead, they are considered as heterogeneous elements of nature, technologies, humanity and other material objects (Barad, 2007) joined together by their relationship.

Similarly, the constructionist approach regards knowledge translation as a situated and ongoing process through which translation agents with their own reason for performing action (Gherardi & Nicolini, 2000) passes knowledge from actors to actors. In this view, knowledge is constituted and translated through practices and activities. This approach considers knowledge and knowing as being inextricably tied to the material and social circumstances in which they are acquired (Gherardi & Nicolini, 2000). From this argument, the understanding of knowledge transfer can be enhanced if it is examined using the perspective of constitutive entanglement (Orlikowski, 2007).

In addition, Sørensen (2008), argues that there is a “blindness toward the question of how educational practice is affected by material” (p. 2). She suggests that its concern is to treat materials as mere instruments to advance educational performance. In her study of the materiality of learning she shows how everyday educational activity and knowing are critically shaped, and not by the material. She argues that materiality is not consolidated within artefacts, but is distributed, such that social as well as physical processes can be understood as material. For her, it is this relational materiality that is often overlooked in educational research where the learning human subject is often taken as the initial object of study. This means that when looking at learning, the focus should not be on the individual alone, but on how the individual’s learning is shaped by the environment.
In addition, Fenwick (2015) argued that context is critical; learning cannot be considered effectively if the sole focus is upon individual cognitive processing. The content and process of learning change dramatically as it pulses through particular situations and discourses, as well as the tools available, technologies, social relations and environmental dynamics. She claimed that:

“Researchers have pressed for much more recognition of the ways that materials actively configure practice and knowing. Educators working from sociomaterial approaches are encouraging learners to attend to these quotidian material details that stitch together their practice, knowledge and environments – not just to attune very closely to the connections, but also to tinker and improvise, to interrupt, and to seize emerging possibilities.” (In press)

To recap the central idea underpinning the arguments above, learning and knowing in sociomaterial perspectives are enactments, not simply mental activity or received knowledge. Sociomaterial perspectives focus not on the individual learning of a subject but the larger sociomaterial collective. By using this sociomaterial perspective, learning means participating sensibly in different contexts. This makes the focus of learning on tracking an individual’s effects on the emerging sociomaterial situation, and on alternative practices. This therefore suggests a turn from learning as preparation and acquisition of competency to learning as attunement, response, and interruption – this implies that learning is practice.

Furthermore, to account for learning with technology, there is a need to focus on the materiality of technology and technology affordances as different (Fenwick, 2015). Sørensen (2008) argues “that as learning technology researchers we have to pay attention to the affordances of materiality even though in an ideal case we will forget that dualism” (p.92). As
Norman (1991) claimed, to articulate the role of information technology in learning is to show the modifications in assemblages by leveraging different affordances of the material and the social.

Likewise, the philosophical stance that Orlikowski and Scott (2008) advocate is based on Barad’s (1996) *agential realism*. Phenomena “do not merely mark the epistemological inseparability of observer and observed, or the results of measurements; rather, phenomena are the ontological inseparability/entanglement of intra-acting agencies. That is, phenomena are ontologically primitive relations, that is, relations without pre-existing relata” (p. 139). It is important to note Barad’s use of the term *intra-acting* as opposed to *interacting*. To *interact* implies that two pre-existing subjects engage in or encounter one another. To *intra-act*, on the other hand, implies an ongoing becoming, an “agential separability, that is, the condition of exteriority-within-phenomena” (p.140).

Although sociomateriality has been found by some scholars to be a sensible option in studying Information Technology, some critics argue that the application of sociomateriality using agential realism in the study of Information Systems (IS) is quite difficult in practice (Mutch, 2013). Added to, Mutch (2013) argues, that the sociomaterial approach of Orlikowski (2008) tends toward a stress on the human side of the ‘intra-actions’ that are supposed to constitute sociomaterial entanglements. Mutch adds that this produces accounts that are not specific about technology, because they fall short in identifying which combinations of the social and the material are performing subjects in particular situations and how. By doing so, it becomes difficult for the analysis to take into account other factors, for example, power. In the study by Wagner, Newell, and Piccoli (2010) on the discussion of impacts of the enterprise system (ES), they stress an example of a human-centred perspective to underplay the materiality involved. They cite one respondent as saying:
“I hope you understand that it is not [the ES] itself that is the issue. It is the lack of understanding and regard for the people brings in the money and the people doing the work that is so frustrating.” (Wagner et al., 2010, p. 285)

From this transcript, they found that it appears not to be a tale of sociomaterial entanglement but one of, say, less successful organizational communication. Wagner et al. (2010) claimed that they found it quite challenging to keep the material in the storyline without falling from one side to the other; either leaving the material realm unexamined, or emphasizing the agency of the material to the detriment of understanding the entangled practice.

Faulkner and Runde (2012) have also experienced similar problems with agential realism, suggesting that the thesis of interpenetration of the material and the social makes the operationalization of empirical constructs difficult. Leonardi (2013a) has taken this argument one-step further when he argues that there is much to be gained from a perspective like agential realism, which collapses the distinction between the material and the social on the one hand, and technology and organizing on the other. Leonardi (2013a) also suggests that this philosophical stance presents empirical problems because actors in the world do not perceive the material and the social or the technological and the organizational as interpenetrated entities. Instead, they can point to a hammer or a piece of software and say this is material but they would likely have a hard time fathoming that a hammer was in any way social.

From these arguments, Mutch (2013), proposed an alternative theoretical foundation of sociomateriality, which is critical realism. Critical realism proposes that materiality can exist as a concept separate from sociomateriality, which implies that there are some materials that are not simultaneously social (Leonardi, 2013).
According to Leonardi (2013a), the agential realist position would seem to deny this separation while the critical realist position would not. In the context of human-created artefacts such as information technologies the view that materiality is not necessarily social may be somewhat problematic. As Leonardi (2013a) said:

“Of course, all information technologies were created by people and are the result of social processes. But once those technologies have left the developers’ hands and are implemented in particular organizational contexts, users experience a set of features that do certain things and do not do other things.”

(p.69)

Leonardi (2013a) also added that the things that technology can or cannot do gain importance as people relate them to the goals that they would like to achieve using the technology. In between the goals and materiality are perceptions of affordance, utility, and constraints. These perceptions of the technology are tied to its materiality, pre-existent of its use. Based on this review, the difference between agential and critical realism is in the conceptualization of interpenetration. As it concerns the social and the material, agential realism would argue that there is no ontological distinction between the two, hence the hybrid sociomaterial. By contrast, critical realism would argue that the social and the material are indeed separate entities to appear inseparable over time. The core difference in the theoretical foundations offered by agential realism and critical realism is that the former treats the sociomaterial as something that pre-exists people's perception, while the latter argues that the ‘social’ and the ‘material’ are independent entities that become ‘sociomaterial’ as they enter into a relationship with one another through human action.

What these two approaches offer to this research therefore, are aspects to consider when studying the learning process and the artefacts involved. They promote methods by
which to recognise and trace the diverse negotiations and accommodations whose effects constitute components in learning such as the farmer, technicians, learning activities and spaces and knowledge representations such as texts. Finally, the sociomaterial offers a way to understand learning related to technology in informal settings by looking at the relationship between users, artefacts and how the relationship unfolds.

3.4.2 Figuring stage

In this research, I refer to *figuring* as a stage where users of the technology engage in viewing affordances of technology that have opportunities for action. For example, if a young child is shown a laptop, they may see an interpretation of this technology as a tool for watching videos or playing games. If the same is shown to a student, they may figure it as a tool for typing assignments and surfing the internet. If shown to an academic, the laptop is considered as a tool to create an academic work through multiple data sources appropriately. According to Mazmanian, Cohn and Dourish (2014), figuring is not limited to humans, but technology also ‘figures’. For example, a computer running algorithms to calculate trajectories of a spacecraft is ‘figuring’. These processes of figuring are happening in relation to, but also in excess of, the machine’s final output, its representational images. Mazmanian et al. (2014) argues that this is also happening in light of but independent from, the software engineers and navigation team who wrote the code and engage with the algorithms. This implies that people may figure their worlds, but the various routines, machines and objects present are actively figuring as well.

When new technologies are introduced to individuals, their beliefs and practices are usually interrupted. For individuals to cope with these interruptions, they may engage in a phase referred to as *articulation* (Weick, 1995; Weick et al., 2005). Articulation according to Weick, refers to verbal expressions of tentative interpretations. In this phase, individuals rely
on various conversational practices to help them *verbally articulate* tentative understandings. This phase involves articulating technological features (e.g., for farmers, the desired feature of a rice variety) and metaphors (e.g., demi rice – referring to a variety of rice that appears to be black, called black rice). In the process of verbalizing new ideas, individuals also engage in practice that involves the production or manipulation of material artefacts to support concept formation in a nonverbal way. This practice supports the infusion of abstract categories with new meanings by *linking* them to material cues (Stigliani & Ravasi, 2012). Furthermore, linking embodies the visible and tangible form (e.g., photographs and other objects) to construct new mental models and infuse them with meaning. For example, in a study by Stigliani and Ravasi (2012) of employees in a design consultancy firm, he found that designers used *pictures* to produce understandings of fundamental elements of the task, and collectively created boards gathering pictures to express desired design attributes in form of formal features (e.g., image boards). At times, they collected artefacts related to a particular user in special *user rooms* to help members grasp particular systems of users' meanings. This implies that when individuals are confronted with abstract concepts or unfamiliar objects, they may support verbalization by assembling visual images either mentally or physically.

In addition to articulation, Stigliani and Ravasi (2012) referred to the figuring stage as a stage of *elaborating*. *Elaborating* refers to the tracing of connections of mental structures by linking the various elements of the task environment. Although conceptually distinct, articulating and elaborating are intertwined, as the attempt to link emerging understandings of elements of a task occasionally triggered the need for individuals or groups to revise their interpretations over the course of multiple iterations of a process. According to Stigliani and Ravasi (2012), elaborating occurred mostly during group meetings, as members engaged in *interactive talk*; verbal exchanges of tentative understandings and discussions of possible
linkages between them. Similar to articulation, the conversation among individuals is assisted by objects that members engaged with to support the sharing, integration, refinement, preservation, and recovery of emerging structures.

For Stigliani and Ravasi (2012), during an elaborating phase, individuals engaged in various material practices that relied on the visualization of tentative linkages among emerging mental structures, which they called visual referencing. Visual referencing allows users of technology to draw connections between early ideas and integrate them to more complex mental representations. For example, matrixes, diagrams, graphs, etc. can serve as visual representations of data that can be more easily understood. By having visual representations of abstract ideas, individuals or groups can have a common reference to relate to and engage with at the same time, resulting in a material embodiment that enables sharing. For example, Oliver and Roos (2007) found that the use of Lego bricks in organizational development programs could be considered as a form of material assemblage aimed at collectively constructing new understandings of organizational strategy. Similarly, Kaplan’s (2011) study of PowerPoint presentations showed how slides-in-the-making serve as a form of material memory (in which to ‘park’ individual ideas as the process unfolds) and visual integration (to facilitate the exchange and merging of ideas) in strategy-making teams. In a different setting, Knorr-Cetina’s (1999) research on laboratory work in various fields of the natural sciences suggested how various forms of visual representation produced in the course of experimental research supported collective interaction in the production of new scientific knowledge (Knorr-Cetina, 1999).

The above practices, linking and visual referencing, allow the manipulation of experiences and ideas to be embodied in a tangible form, helping to sort things out (i.e. organizing these experiences and ideas based on patterns of difference and similarity). In
doing this, these practices provide a group’s participants with the possibility to see their thoughts and ideas right in front of them. To be able to physically move objects around, facilitate the discovery of commonalities, emergence of themes, and their assembly into broader groups or categories, the participants were informed through their sensemaking that allow them later to label and identify the characteristics of the objects based on the meanings they to it.

Another similar concept of figuring is incremental exploration, which refers to the construction of new knowledge by investigation within a given activity (Spinosa, Flores, & Dreyfus, 1997). For example, in a family where the members possess a strong work ethic than sense of personal security, they perform a range of activities to eventually conclude, that in one activity, practice of having strong personal ethic is more important than sense of personal security which therefore demands more time, effort, and resources.

In the context of technology intervention, normal routines are being interrupted. As peoples’ routines are interrupted, it paves the way for reconceptualising their existing beliefs and practices, and the production of temporary interpretations of new beliefs and practices. When people rethink their existing routines and practices, the literature suggests that they undergo a process of figuring, wherein, they try to picture, verbally articulate and link new ideas with previous ones. Individuals also engage in elaborating by tracing events, perceptions and practices back and engaging in visual referencing of the interruption. These theories from the literature can therefore, serve as a guide in tracing how farmers in this research learn, in turn leading to sociomaterial entwinement.

3.4.3 Configuring stage

Boudreau and Robey (2005) note that “a human agency position suggests that humans are relatively free to enact technologies in multiple ways…” (p. 3-4). This implies that
technology is subject to changes at the decision of human agents. Giddens (1984) defines agency as the capacity for action. At first glance, it may seem that such a definition extends agency to humans and technologies alike. However, Giddens makes an important qualification by suggesting “action involves motivation, rationalization, and reflexive monitoring” (p. 5). These mental processes are linked to human intention because people have goals that inspire them. People can rationalize their goals as acceptable given a set of circumstances and they can continuously monitor their environment to determine whether the goal is being achieved. Given Giddens’ explicit claim of agency on humans, technologies, beliefs (i.e. understanding of the environment), and ideas (e.g., new practices or technologies) can therefore be subjected to human manipulation. Humans therefore decide how they will entwine with technology. By having control of the agency of an object, humans can configure material agency and how it will be entwined with their goals.

The literature shows similar ideas of configuring based on the conditions above. It has been called ‘tuning’ (Norman, 1982), ‘customary disclosing’ (Spinosa, Flores, & Dreyfus, 1997), and ‘adjustable exploitation’ (Engeström, 2004). According to Norman (1982) tuning is characterized by adding information to an existing body of knowledge produced because of experimentation. To Norman (1982), tuning is the adjustment of knowledge to a specific task usually through practice. Adjustment is needed because the existing schemata for particular ideas or practices are too general, or because they are mismatched with the particular use that is required of them. For example, Norman (1982) discussed learning Morse code. To Norman, the initial learning of Morse code is the process of accretion. Learning to recognize sequences or full words represents restructuring. The gradual increase in translation or transmission speed indicates the process of tuning.
Another similar concept of configuring is proposed by Spinosa et al. (1997). They claimed that a *customary disclosure* space is an organised set of practices that allows the world reveal ways that are familiar to individuals’ styles of perceiving the world. Spinosa et al. (1997) illustrate the concept of a customary disclosive space by comparing seasoned New York driver to a driver from the American mid-West. In their account, the New York driver is attuned to their environment in such a way that “every other car on the road and every driver is a challenge to be surmounted. In New York, drivers feel themselves to be in a race, and all obstacles in the way of winning show up as irritating” (Spinosa, Flores & Dreyfuss, 1997, p. 21). On the other hand, “mid-western drivers...see no reason for any tension in driving. What counts in driving is what they notice happening along the side of the road...Other cars are not noticed unless their drivers request an act of kindness, which drivers are happy to perform” (Spinosa, Flores & Dreyfuss, 1997, p.21).

In addition, the concept of Stigliani and Ravasi (2012) on elaboration is also similar to the configuring stage. Elaboration occurs mostly during group meetings, as members engage in interactive talk—verbal exchanges of tentative understandings and discussions of possible linkages between them. Similar to articulation in the figuring stage, the conversation at this stage is assisted by the material artefacts that members engaged with, to support the sharing, integration, refinement, preservation and recovery of emerging structures. This phase of learning, according to Stigliani, is characterized by *group sketching* that stimulates the integration of early individual ideas into more refined interpretations resulting from collective interaction. For example, in their study a Boston consultancy firm, employees were asked to formulate product design based on consumer analysis for brand building. During the workshop, sketching sessions ended with the walls of the meeting room covered with individual sketches and other types of free-hand drawings, combined, and displayed to
present more elaborate versions of ideas participants initially intended to convey. In this study, participants considered group sketching crucial in the gradual integration of early individual ideas and in the collective refinement of the result, a process they referred to as *building on each other's ideas*. Participants perceived the increasing sophistication of the artefact as reflecting the gradual incorporation of different individual ideas and observed how the physical presence of material artefacts facilitated the exchange of feedback among them.

On a higher level in the elaboration phase, participants in the research of Stigliani and Ravasi (2012) entered into a practice they referred to as *story building*. Story building was found to be important because it reassured individuals about the appropriateness, reasonableness, and coherence of emerging concepts. For example, in the same study, story building consisted of collective preparation of a set of slides that would be used to present the ‘big idea’ to the clients. During this activity, clients and participants are engaged in interactive talk that allows the participants to reassess their ideas based on the feedback from their clients. By reassessment, participants were able to configure their understanding of the problem at hand and physically configure artefacts to support emerging interpretations. By doing this, the participants were reassured of the plausibility of their emerging interpretations.

Lastly, Engeström (2004) proposed a similar concept he called *adjustable exploitation*, which he defined as gradual acquisition and internalization of the existing knowledge and skills embedded in the given activity. This type of learning is manifest in apprenticeship type settings; for example, on the job training or experimentation focusing on the emerging ideas and beliefs. According to Spinosa et al. (1997), emerging ideas and beliefs can be disharmonious with the current practices of an individual as they may not coordinate well. The best way to explore them may therefore be through involvement in experimentation.
In summary, configuring is a stage of learning where individuals make adjustments so they are able to create harmony with their existing and new ideas. Similar to empirical studies reviewed in the figuring stage, these empirical studies paved the way for the identification of micro-process involved in the learning process. By understanding this learning stage, we can understand what the individuals do with technology when it is introduced to them.

3.4.4 Reconfiguring stage

Reconfiguring represents a process in which new sociomaterial assemblages are produced and reproduced (Mazmanian et al., 2014). To Engeström (2004), it is a radical exploration, meaning the creation of new knowledge, while for Spinosa et al. (1997) it is a process where new practices reframe the whole perception of the way of life.

Mazmanian et al. (2014) argue that sociomaterial reconfiguring can emerge from innumerable sources including organizational mandate, material breakdown, or micro social relations. Further, they call attention to the ongoing reconfigurations that shape what is called into being as reality, possibilities for action, and scope of knowledge. In their study of dynamic reconfiguration in planetary exploration, three empirical examples of ethnographic engagement by the National Aeronautics Space Administration (NASA) were used; data from missions orbiting an outer planet in the solar system to examine various configurations and sociomaterial relations between the aircraft and the engineers. They found that the representations (e.g., numerical figures, mathematical figures, graphical figures, algorithmic figures) illustrated the variety of reconfigurations in play at any one moment of sociomaterial engagement. For example, if an anomaly in the aircraft occurs, it may reveal an unpredictable and ongoing process of reconfiguration in which figures, models, representations, and imaginings are interpreted in open-ended and shifting ways. This example highlights reconfiguration as an organizational process that incorporates an anomaly into an
understanding of work practice. The engineers on the ground enact practices that have emerged over the life of the mission, practices that allow them to assess, label, and create a legitimated account of the uncertainties emerging through communication with a remote and semi-autonomous machine. This process calls upon knowledge of the spacecraft across time and space bringing together diverse perspectives from design, engineering, and operations to reimagine, or imagine again, the craft and its behaviour (Mazmanian et.al, 2014).

For Engeström (2004), radical exploration or reconfiguration starts when experimentation is no longer aimed only at making a well-bounded new technology work in the framework of a given, pre-existing activity. Radical exploration is learning what is not yet there. It is creation of new knowledge and new practices for a newly emerging activity, that is, learning embedded in and constitutive of qualitative transformation of the entire activity system. Such a transformation may be triggered by the introduction of a new technology, but it is not reducible to it. Engeström (2004) used an example of how humans previously used animals to transport materials and goods and to produce power, but today the majority of people (in the western world) use cars or other motor-driven vehicles.

Reconfiguring is about creating change or making a difference to human life. Thus, it is a way of no longer managing a practice, but controlling it and with this, control may be seen as a change of ‘style’ for the human. For example, instead of managing sexual desires, people today use birth control pills, etc. (Spinosa et. al., 1997).

In addition, Leonardi (2011) considered reconfiguration as a product influenced by past patterns of imbrication routines and technologies through which organizing is accomplished. The example of this process is from an auto works’ engineering workforce located in the Midwestern United States, which investigated activities of engineers occurring around a technology, built to automate computer simulations for crashworthiness. He found
that, when both routines and technologies are flexible, human and material agencies are in a process of continual imbrication, such that the organizational structures they constitute are always in flux.

From the above theories, it can be argued that people may engage in reconfiguration depending on their commitment to new beliefs and ideas. However, commitment is dependent on what meanings are attached by individuals to those new beliefs and ideas. These meanings are referred to some scholars as frames (Bateson, 1972), enactments (Weick, 1979), schemata (Poole, Gioia, & Gray, 1989), and cognitive maps (Porac, Thomas, & Baden-Fuller, 1989). Meaning, motivation, and subsequent involvement and action during any experience of work activity lead individuals to not only develop a sense of what is going on, but also a sense of how to engage (Drazin, Glynn, & Kazanjian, 1999). If people engage in reconfiguring, it results in desired outcomes they will respond by engaging with the new beliefs and ideas (Kahn, 1990), otherwise, they may limit or refrain from engaging in these actions.

Exploring these theories on reconfiguration allows for the explanation of why new technologies and practices emerge and how they emerge as part of the process of learning and relearning.

3.4.5. Synthesis

There are two prominent perspectives in sociomateriality, namely: agential realism and critical realism. According to Leonardi (2013), the choice of perspective to use in research may depend on the purpose of the research and contextual circumstance. Since the specific focus of this research is toward the understanding of how people and material entwine, thus providing understanding on how individuals or organizations learn, the assumptions used in
this research are based in critical realism. Critical realism has the capability to look at the process of entwinement where the social and material had existed independently.

In order to obtain an initial understanding of how individuals learn, various explanations of learning from different studies were interpreted in the light of sociomaterial assumptions. Based on this review, three main stages of learning from sociomaterial perspectives were identified, namely: figuring, configuring and reconfiguring. First, the figuring stage is characterized mostly by mental activity where individual views objects to have possibilities for action. Second, the configuring stage is characterized by the manipulation of new ideas, beliefs, and practices towards alignment of human goals with technology affordance, determining how they will be entwined with technology. The last stage of learning is the reconfiguring stage, which is characterized by practices in which new sociomaterial assemblages are produced and reproduced repeatedly. This stage of reconfiguration is characterized as a process of reframing new ideas, beliefs and practices (Spinosa et al., 1997). Reconfiguring can take place resulting from organizational mandates, material breakdown, or changes in social relations (Mazmanian et al., 2014). Mazmanian, et al (2014), put forward the idea that reconfiguration is an organizational process which call upon various perspectives and contexts of members to come-up with new understandings or meanings.

After examining these learning stages in the literature, areas related to specific individual or organizational micro-learning practices need to be explored to provide further understanding of how individuals and groups learn in the context of informal education in a developing country. Resultantly, this research will focus on identifying micro learning processes undertaken by individuals or groups through the different stages of learning embodied in sociomateriality, in the context of informal education.
3.5 Theoretical Framework

The theoretical framework of this study is anchored in three theoretical perspectives, namely: sociomateriality (Leonardi, 2011, 2012, 2013, 2013; Orlikowski, 2000), sensemaking (Weick, 1995) and learning process (Boudreau & Robey, 2005; Engeström, 2004; Engestrom & Ahonen, 2001; Mazmanian, 2014). This study integrates these three theoretical perspectives to trace the learning path farmers undertake that lead to entwinement of farmers with technology. Simultaneously, this combination allows to investigate the microprocesses of learning by looking at individual sensemaking that leads to the perception of affordances being continually re-enacted and sustained.

Prior to the individual’s learning to embrace technologies, individuals are performing their usual routine or practice. When technology is introduced to individuals, there could be two possible outcomes: a) individuals may engage with the technology or b) they may ignore the technology (Leonardi, 2012). If individuals ignore the technology, then, they continue with their routine (nothing is changed in their practice), on the other hand, if individuals choose to engage with technology, learning starts.

In the first stage of learning (figuring), individuals engage in perceiving affordances of the technology; the learning of the individual at this stage can be explored by understanding their sensemaking process. The sensemaking processes of individuals may shed light to the microprocesses involved in the emergence of new practice and routine, the microprocesses in their entwinement with the technology and reasons for adoption or rejection of the technology. If after sometime, individuals reject the technology (i.e. perceived technology affordances as mismatching goals), they may go back to their earlier routines; however, if
individuals (during their sensemaking) find the affordance of the technology to be helpful in achieving their goals, learning continues.

As learning continues (configuring), individuals position themselves relative to their personal (e.g., work), cultural (e.g., the way they work) and organizational (e.g., support from organization) circumstances (Boudreau & Robey, 2005). This means that individuals may suggest changes in the technology based on their goals (e.g., change in the functionality of a software from using codes to create a program to drag and drop) or put constraints to technology, for example, some individuals in a certain firm complained in using the report system as it was configured in a way that their reports are not being treated as private (Leonardi, 2015). Promoting changes, however, may require a critical number of individuals to rationalize, for example, Krook (2015) found that increase in the number of individuals could influence change, thus, changes to technology affordance could be a result of the perception of a shared affordance (Leonardi, 2013) among individuals. According to Leonardi (2013), shared affordance is a technology affordance that is shared by all members of the group. It is an affordance representing difference in the use of the technology features which is necessary for completing tasks, that when pooled together will achieve the group level goals. In this study, the individuals are quite independent from each other when it comes to production of an output (e.g., individual organic farming), but members interact and depend on each other when it comes to information for the achievement of their goals (e.g., how to produce economically viable organic farming products). The emergence of shared affordance could lead therefore to changes in the features of technology and also change in individual routines. As individuals interact, they continuously enact shared affordances; thus, learning goes on.
As individuals learn further, new sociomaterial assemblages are produced and reproduced (Mazmanian, 2014), new knowledge (Engeström, 2004; Engestrom & Ahonen, 2001), practices and routines are change (Leonardi, 2013; Orlikowski, 2007) and the cycle starts again. This theoretical frame is illustrated in the figure below.

Figure 3.3 shows the connection of the three perspective which shall be initially use in tracing the learning path and understanding the entwinement of socio and material. This study would try to add to this framework, how are affordances perceived, the micro-processes of sensemaking and understanding of continues enactment.
Figure 3.3 Theoretical framework
This synthesis of the literature provides the lens for exploring the following questions:

**How do individuals learn in their interaction with intervention in a sociomaterial context?**

To further the investigation, this study explores the following sub-questions:

1. What are the micro-learning processes that individuals undertake in the various stages of learning?
2. What are the sociomaterial artefacts used by individuals in the process of learning?

These questions are answered by studying farmers’ learning process and understanding technology adoption in the context of two selected FITS centres in the Philippines.
Chapter 4. Research Methodology

4.1 Ethnographic research method

For this study, I chose the interpretivist paradigm, as this view of reality and knowledge enables me to examine the phenomenon from the perspective of actors, specifically in their authentic contexts (Kaplan & Maxwell, 2005). This is because the aims of this research were to investigate perspectives, sensemaking, and learning processes of farmers and farmer groups that occur naturally, as part of their daily practices rather than under controlled conditions. The understanding of such phenomena requires exploration of how meanings are formed and influenced by the local context within which people share their understandings to achieve common goals (Myers & Newman, 2007; Myers, 1997).

In adopting the interpretivist view that reality is a social construction (Walsham & Sahay, 2006), and that social processes and practices are socially constructed (Cecez-Kecmanovic, 2010) as well as mediated by beliefs (Guba & Lincoln, 1982), I decided to use ethnography as a method for collecting the data necessary to understand these phenomena (Willis, 2007).

The ontological orientation of ethnography enables us to study socio-cultural contexts, within this method, individuals and their practices, behaviours and beliefs are examined within the cultural and social context in which they take place (Boyle, 1994). In ethnographic study, the understanding of a cultural system can come from both an ‘emic’ and ‘etic’ perspective (Yin, 2010). An emic perspective attempts to understand components of a context from the perspective of the group being studied. The etic approach analyses a context with research paradigms brought by the researcher from outside of that system (Pelto & Pelto, 1978 as cited in Whitehead, 2002). In ethnography, emic and etic complement each
other, because the characteristics of a context may be dichotomous (e.g., ideal vs. real, implicit vs. explicit).

The epistemological attributes of ethnography are greatly dependent on fieldwork (Spradley, 1980). Fieldwork allows the researcher to observe and examine all aspects of a particular context, especially those that could not be addressed through surveys or interviews. Epistemologically, the ethnographer believes that the way to gain a native’s view is to spend time in that world; as Spradley (1980) stated:

...[it is] participating in activities, asking questions, eating strange foods, learning a new language, watching ceremonies, taking field notes, washing clothes, writing letters home, tracing out genealogies, observing play, interviewing informants, and hundreds of other things (p. 3).

Another epistemological attribute of ethnography is that it is a process of discovery (Rosenberger, 2014; Whitehead, 2002). According to Whitehead (2002), this attribute allows the achievement of emic validity in a study by gaining as much information as possible through the collection of secondary information (e.g., documents, publications) from the participants and their social and physical environments.

This study aimed to provide a detailed, in-depth exploration of farmers’ learning and technology use in everyday life and farming practice. To achieve this I used three ethnographic data collection techniques: observation, interviews, and document gathering. This allowed me produce three kinds of evidence: quotations, descriptions from field notes and documents excerpts. This combination of data sources and evidence allowed me to create an in-depth understanding on the process of technology adoption among farmers and produce a narrative that is grounded in their authentic practices and context.
4.2 Case study strategy

Case study research is a research strategy that is inductive and exploratory, and involves thick descriptive data. Willis (2007) suggests that case studies are “about real people and real situations ... [they commonly] rely on inductive reasoning ... [and] illuminate the reader’s understanding of the phenomenon under study (p. 239)”. As a strategy, a case study is used when the researcher deliberately aims to cover a range of contextual conditions that might be highly pertinent to the phenomenon under examination. It is used to contribute to the knowledge of individual, group, organizational, social, political, and related phenomena (Yin, 2009).

Used within an interpretivist framework, “researchers do not seek to find universals in their case studies. They seek, instead, a full, rich understanding of the context they are studying” (Willis, 2007, p. 40). As Abercrombie, Hill, and Turner (2000) claimed:

...sociologists who use techniques of qualitative research such as ethnography or participant observation, which are time consuming and cannot easily be delegated to research assistants, almost invariably choose the case-study strategy ... Case studies may provide data of a richness and detail that are difficult to obtain from more representative research designs... (p. 123).

In addition, “shortages of resources are cited as common motivations for choosing a case study strategy as a primary method of investigation” (Abercrombie et al., 2000, p. 41).

4.3 The ethnographic case study

I situated this research as an ethnographic case study as it is the best methodological combination for understanding processes while discovering “context characteristics that shed light” (Merriam & Simpson, 2000, p. 33) on an issue. The FITS centre is a bounded system
with a “finite quality” (Merriam & Simpson, 2002, p. 128) in terms of time, space, and components. Concentrating on this single entity allowed me to examine perspectives and processes in a particular context, giving way to a rich description in the hope that it might “illuminate the reader’s understanding” in addition to bringing about “the discovery of new meaning and confirm what is known” (Merriam & Simpson, 2002).

Based on the above arguments, an ethnographic case study was considered most appropriate as this methodology attempts to describe and interpret the perspectives and practices of farmers, not only as individuals but also as a community. For the purpose of this study, perspectives and processes were viewed as embodied in practices and language, as well as the “knowledge people have acquired that in turn structures their worldview and their behaviour” (Merriam & Simpson, 2002, p. 236). The intent of this study was to interpret “a situation that incorporates the participants’ symbolic meanings and ongoing patterns of social interactions” (Merriam & Simpson, 2002, p. 108).

4.4 Research setting and participants

Convenience sampling is one of the three broad approaches for selecting participants, namely: convenience, judgement, and theoretical (Marshall, 1996). I employed convenience sampling to select the most accessible research participants. I invited participants based on the judgement that they would be able to help me explore the phenomena in this study, and having worked with several of them, I had a previously established connection. This in turn also provided me with convenient access. As Tracy (2012) proposed, one of the most convenient places to start fieldwork is right where you are, that is, your own workplace, or within your own cultural or social group.
The main participants in this study were farmers and key FITS personnels:

1. Municipal Agricultural Officer (MAO)
2. Instructional designer (ID)
3. FITS staff
4. Cybercom staff
5. Farmer scientist
6. Farmers

This choice of the participants enabled me to explore the processes undertaken towards intervention adoption from multiple perspectives that involved not only farmers but also other key members.

After the approval of the ethics committee (Appendix B), information was disseminated to the potential participants through a printed advertisement and through email. Forty-six (46) participants were finally selected, coming from two municipalities (12 villages) with their ages ranging from 30 to 65 years. Participants were 20 males and 26 females, comprising 1 Municipal Agricultural Officer (MAO), 2 FITS managers (one FITS manager is also a MAO), 1 instructional designer, 5 FITS and village cybercom staff, 1 farmer scientist, 3 community and farmer leaders and 32 farmers who were engaged with agricultural technology and ICT at various degrees.

I then sent letters to the participants, requesting them to participate in my study. These letters were in English, because all the participants can understand the language. (Most of them had attended school where the medium of instruction is English.) If the participants asked for clarification, I explained the details of the study in the local language.
4.5 Data sources and collection procedures

As Creswell (2007) suggested, there are four basic data categories that can be gathered in qualitative research namely: “observations; interviews (ranging from structured to open-ended); documents (ranging from private to public); and audio-visual materials (e.g., materials such as photographs, compact disks, and videotapes)” (p. 120). All of these data categories were used in this study. These multiple data sources are also known as the “data corpus” (Braun & Clarke, 2006, p. 79), used during the analysis to fully understand the practices and perceptions of participants.

The main data source came from observations on farmers’ practices and semi-structured interviews. All interviews were digitally recorded, and coded in NVivo 11 for ease of retrieval. The secondary data sources were documents obtained from the FITS centres, farmers’ record books, IRRI and PhilRice websites, and a FITS centre’s Facebook page. The use of multiple data sources is a common characteristic of case study research and in this study were employed in a process of triangulation to address issues related to credibility and trustworthiness (Eisenhardt, 1989; Yin, 2009). The data sources are described in Table 4.1.

4.5.1 Participant observation

Participant observation is a qualitative method with roots in traditional ethnographic research. Its objective is to assist researchers learning the perspectives held by study populations (Creswell, 2007; Yin, 2010). In this research, I assumed that the farmers would have multiple perspectives on FITS interventions. Since I was interested in knowing both the diverse perspectives and understanding the interplay among them, I observed and

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\(^7\)NVivo is a software that is commonly used in qualitative research to store and analyse qualitative data rigorously. [see http://www.qsrinternational.com/products_nvivo.aspx]
participated in their daily activities. Specifically, I joined the farmers in most of their daily routines: went together to farm at 4 am to observe their practices and attended together their informal meetings with their peers. Alongside, I asked them to explain to me why they were doing what they were doing and to clarify some issues that I was not familiar with.

Participant observation always took place in community settings, in locations I believed to have some relevance to the research questions. By conducting observations, I approached the participants in their environment rather than the participants coming to me. By doing this, I learned what their life as a farmer was like in their context.

During the observations, I made notes about what I saw and recorded accounts in my journal. Informal conversations and interaction with the participants were also recorded in the field notes. Field notes are a condensed account of interviews and informal conversations during fieldwork. These notes were written as memos, to record additional information after each interview and allow for a written record of important points that participants had raised during the interview. Although video recording was carried out during the observations, I opted to maintain a journal to ensure those significant practices and experiences observed and shared by the participants were easily retrieved.

These observation notes and journal entries were also recorded as memos in NVivo as part of the process of analysing and interpreting the data. Lastly, an observation protocol was developed to guide the researcher on the specific areas and aspects of the FITS and farmers’ activities (Appendix C).

Relevant documents were identified, located, examined, analysed, and interpreted for their meaning. I kept field notes, a journal and video recorded some of the observations of
farmers’ practices. Table 4.1 summarized the list of documents collected during the study from farmers and FITS centres.
<table>
<thead>
<tr>
<th>Document Type</th>
<th>FITS centre</th>
<th>QTY</th>
<th>Farmers</th>
<th>QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Printed Documents</strong></td>
<td>Technology Flyers Proposals</td>
<td>30</td>
<td>Meeting Minutes</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Municipal Ordinances</td>
<td>10</td>
<td>Financial ledgers</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>FITS memorandums</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FITS centre visitors Log Books</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Village Cybercom users Log Books</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Meeting minutes</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Picture Images</strong></td>
<td>Picture of Fits centre and computers</td>
<td>2</td>
<td>Farmers’ meeting</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Images of village cybercom Farmers’ training</td>
<td>6</td>
<td>Farmers’ farm visits</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Farmers’ festival Farmers’ information drive</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FITS centre’s awards</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Video and Audio recordings</strong></td>
<td>Provincial Festival focusing on Provincial Governors’ and the Provincial Agriculturists Speeches. Town Mayors’ Speech to village women Information drive opening of additional village to implement organic farming method Training on ICT use</td>
<td>1 hour of video recording</td>
<td>Farmers’ meetings focusing on farming issues with NGO facilitator</td>
<td>10 hours of video recording</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 hour of video recording</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 hour of video recording</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 hour of video recording</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Software promoted by FITS centre (e.g., NMRice)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Websites</strong></td>
<td>Websites recommended by FITS centres to farmers</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Social Networking site</strong></td>
<td>FITS centre Facebook page (FITS centre A only)</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.1 *Documents gathered in the study*
4.5.2 Semi-structured interviews

The interview is a data collection technique in qualitative research (Myers & Newman, 2007). It is described as a social interaction between the researcher and the research participant (Jacob & Furgerson, 2012).

I used semi-structured interviews with farmers and leaders to gather information regarding personal demographics, practices, and perspectives of intervention’s affordance introduced by the FITS centre. To elicit the necessary information needed for this study, I aligned the questions in the interview schedule to my research questions. I initially developed broad guiding questions for each research question. Then, I created a set of specific sub-questions that aimed to engage the participants in further discussions on the topic. These questions were piloted and revised before the field study (see section 4.5.3 for details).

An interview protocol was developed to maintain consistency when conducting the interview (Appendix D&E). According to Jacob and Furgerson (2012), an interview protocol is not just a list of questions but also includes a procedural guide for directing the interview process. The protocol is part of the incomplete script, which serves as a guide, and modification may be necessary as the interviews progress. The semi-structured interviews were audio-visually recorded, transcribed verbatim and then stored in NVivo software for ease of management, quick retrieval and analysis.

In addition, translation of the questionnaire from English to the local dialect (Cebuano) was also completed so farmers could understand the questions (Appendix D & E). This translation was certified accurate by an independent assessor in accordance with The University of Sydney Ethics Committee’s requirements (Appendix F).
Documents were uploaded to NVivo software and some were used for data triangulation to establish credibility. In summary, Table 4.2 shows the details of the data gathered from participants.

<table>
<thead>
<tr>
<th>Document Type</th>
<th>Informant Group</th>
<th>Total number of words</th>
<th>Total number of pages/informant group (single space)</th>
<th>Average number of hours of observation/interview per informant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interview transcripts</td>
<td>37- farmers</td>
<td>222,000</td>
<td>888</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>1 - ID</td>
<td>6,000</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2- FITS manager</td>
<td>12,000</td>
<td>96</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>1-Farmer</td>
<td>6,000</td>
<td>24</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>Scientist</td>
<td>24,000</td>
<td>96</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>4 FITS staff</td>
<td>24,000</td>
<td>96</td>
<td>1</td>
</tr>
<tr>
<td>Journal entries (observations and memos)</td>
<td>5- Farmers</td>
<td>50,000</td>
<td>225</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>2- MAO</td>
<td>20,000</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>2- FITS staff</td>
<td>14,000</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td><strong>354,000</strong></td>
<td><strong>1,529</strong></td>
<td></td>
</tr>
</tbody>
</table>

4.5.3 Pilot interview

Prior to conducting the actual interviews with farmers and other participants, the constructed interview protocol was piloted. The purpose of the pilot interview was to examine the questions and the protocol formulated in terms of content, structure and effectiveness, and whether the questions could be fully understood by the participants to obtain the information needed. Initially, I formulated general questions covering perspectives of affordance, sensemaking and learning processes.

I initially tested the questionnaire with two people whose backgrounds were similar to the participants in the research. The first participant was a farmer in my municipality (not included in main study) with rice farming experience and who had used ICT to gather information on farming practices. He was chosen due to his experience in integrating agricultural information he acquired for farming through ICT use, such as NMRice. The second
participant was a FITS centre staff member in one of the FITS centres. He was also not included as a participant in the main study. He was chosen because he was involved in the implementation of FITS interventions and was aware of the implementation issues and common problems of farmers in adopting FITS interventions. These two pilot participants were chosen for the elicitation of feedback and to assess if the questions I formulated were appropriate in terms of language use, order, content, and difficulty. Changes were made in consultation with my supervisor when I noticed that some questions might not have been entirely appropriate. For example, when questions where found not to elicit the appropriate response regarding the research questions, these were rephrased or modified. Probing was also used to elicit further responses from the participants in this research.

The outcomes of this pilot interview resulted in modification of the questions. For example, the pilot question “What do you know about the FITS centre?” to elicit perspectives of affordances of FITS interventions, was changed to “How do you perceive the FITS interventions such as ICT services and AT?”. Similarly, my initial question “How do you find the learning process on how to use the technology?” did not allow me to get enough details about the learning process. Therefore, I improved it by creating more sub-questions.

4.6 Data Analysis

4.6.1 Data management

I organized the data into computer files and folders, separating data from the two FITS centres. With the help of NVivo 11, I was able to organize these data for easy retrieval and analysis. In order to understand the sociomaterial process I systematically analysed all my collected data.
With vast qualitative data ranging from transcripts to video recordings, it was essential to use a management tool that helped organize, store and retrieve data with ease. In my study, NVivo helped me to efficiently handle the storage and retrieval of the files including the literature used in this research. I also used features such as transcription from source files, coding of audio/video sources, memos, visualisations, and advanced queries, to aid me in the analysis of my data. Samples of the NVivo environment capturing the data used in this study is shown in Figure 4.1.

Data analysis followed procedure suggested by Tracy (2013) and included the following stages: 1) coding of data; 2) identifying categories for the codes; 3) looking at relationships and creating final explanations.
In stage 1, I initially created open codes based on my data (Appendix G & H) generating 75 codes, I refer to this step as first level coding as described by Tracy (2013). I identified first level codes by asking myself what is present in the data. I specifically asked myself some basic questions as to who is talking (farmers, FITS staff) and what are they talking about. In coding, I extracted text segments of various lengths, (i.e. from single word to a whole text) and assigned them into codes after interpreting their meaning (e.g., when the word “meeting” is found I coded it as group learning as it involves exchange of ideas, information and practices among farmers or “can send SMS”, “receive feedback”, “get subsidies” are coded as affordance).

In stage 2, I reviewed the codes that were generated. I found that some codes had similar semantic meanings (e.g., visual referencing, farm visit, storytelling which refer to “learning”). I re-read all the codes and interpreted them based on their semantic meanings and grouped into more general categories or themes. I created descriptions of the general categories so that the codes identified earlier could be systematically grouped without losing precision. I looked for similarities and differences between the categories until distinct patterns were evident (Bogdan & Biklen, 2006; Merriam, 1998). At the end of this process a set of common ideas and elements emerged (e.g., “conditions for adoption” have four sub-themes, namely: design, habitual practice, power and facilitating conditions). I then organized the codes into three broad themes according to my research questions: affordance perspectives, sensemaking process, and learning process. I then created sub-themes under each of these major themes (e.g., “under learning process” as main category, sub-themes were figuring, configuring and reconfiguring) (see Appendixes J, K & L). Having specific groups of codes, I proceeded to the next stage of coding.
In stage 3, I continued the analysis by focusing on relationships. Since this study investigates the process of entwinement, relationships provide valuable insights into actions and change (Tracy, 2013). Specifically, I focused my analysis on generating explanations of contextualized activity. I did this by looking at the process of entwinement historically, that is, linking what occurred prior to entwinement and what happened after that event. For example, using affordance as a lens in the entwinement process, I looked at how farmers perceived the affordance of the technology prior to entwinement (e.g., as a bundle of features) and during their entwinement (e.g., as to how the technology was designed) and at the end (e.g., as means to achieve their goals). I extended this analysis by linking specific responses of the participants to my observations and field notes collected during immersion in the community overtime.

4.6.3 Describing, interpreting and representing

Patton (1987) defines descriptive reporting as a foundation upon which qualitative research is built. He compared reporting of the data to storytelling; thus, inviting reader to see through the researcher’s eyes what they had seen. This is done by a straightforward description of the context and events. Narratives are presented using direct quotations from the data that support the theme, and offered as commentary on how the theme relates to the research questions (Creswell, 2007).

Reports based on an ethnographic case study include pure descriptions of the experiences of people in the research context (Yin, 2010). The role of the description is to let the readers know what occurred in the environment under study. For example, what it was like to be in the setting from the participants’ points of view, and what particular events or activities in the setting were like (Genzuk, 2003).
In this study, the data that I described and presented were those accounts of the participants related to my research questions. In some cases, I described and used specific experiences of the participants and I have written these descriptions in narrative form to provide a holistic picture of what happened in the participants’ activities. Finally, the data are represented in a narrative as enriched tables and figures.

At a deeper level of analysis, the researcher makes inferences, develops models, or generates theory. Miles and Huberman (1994) describe this process as moving up from the empirical trenches to a more conceptual overview of the landscape. The role of interpretation is to attach meanings and significance to the data, explaining descriptive patterns, and looking for relationships and linkages among descriptive dimensions (Genzuk, 2003; Yin, 2010).

In this study, interpretation was conducted by creating themes related to views of participants and organizing the patterns emerging from the data. During the process of interpretation, I reflected on the participants’ stories, their contexts, the consistency of their narratives in relation their practice, their ideas and beliefs. In the process of reflection, I always revisited the purposes and aims of the study, to ensure that my interpretations were consistent with these intentions.

4.6.4 Triangulation

“As in other areas of qualitative research, triangulation in ethnography is a way of promoting quality research… Good ethnographies are characterized by flexible and hybrid use of different ways of collecting data and by prolonged engagement in the field. Triangulation can help reveal different perspectives on one issue in research, such as knowledge about and practices with specific issues. Thus, triangulation is a way to promote quality of qualitative research
“in ethnography and more generally a productive approach to managing quality in qualitative research.” (Flick, 2007, p. 89)

In this study, I mainly aimed to achieve credible outcomes by triangulating data sources. Data triangulation by data source is a process which involves approaching several sets of data from different times, different places, or different people, in the same methodological frame (Denzin, 1978). In my research, I used participants associated with two independent FITS centres (one successful and less successful in technology adoption) so I could elicit perspectives on technology prior to and during adoption. I also ensured that I had representative participants from five different villages possessing cybercom within FITS centre A, so I could conduct comparisons of farmers’ perspectives within the same FITS centre.

Using data triangulation allowed improvement in credibility for observations and participants’ stories. For example, observation data can be a direct way of learning participants’ practices in a particular context, and can be validated and enriched by examining the interview responses of the participants. This could provide additional descriptions of observed practices. On the other hand, while interview data is an efficient and credible way of understanding someone’s perspectives and practices, observations could provide physical representations of those understandings and ideas.

Data triangulation within data sources could also account for the historical nature of participants’ responses. In this research, two respondent story types are possible. For example, participants in FITS A who were intervention adopters are likely to tell of prior perspectives of the intervention (i.e., before adoption). To substantiate these stories from farmers in FITS A, I could use responses of farmers in FITS B, who were just in the process of
adopting the intervention. In doing this, I would be able to compare the differences and similarities in their views through their responses.

In addition, this study also utilized triangulation of theory given the scope of the literature and lenses presented in this study. Using theoretical triangulation allowed me to substantiate responses of the participants with what other empirical studies had found. Specifically, I compared with empirical studies on affordance, sensemaking and learning process that used sociomateriality as their theoretical lens.

4.7 Research trustworthiness

4.7.1 Credibility

There is a long historical differing of opinion on credibility in the social sciences (Healy & Perry, 2000; Ritchie & Lewis, 2003). Researchers in the social sciences deal with humans and human behaviour, where the duality of subject and object are difficult to maintain. The human experience appears to be bound by its cultural context, and as such, doubt emerges that a neutral view can exist and be used to describe events, processes, and situations associated with the worlds of human and social behaviour (Aguinaldo, 2004). Thus, whenever a researcher adopts qualitative approaches, these questions about the data, findings, and conclusions needs to be addressed (Maxwell, 2005).

According to Merriam (2009), the qualitative investigator is concerned with the extent to which the findings of one study can be applied to other situations. That is, how congruent are the findings with reality. Lincoln and Guba (1998) argue that ensuring credibility is one of most important aspects in establishing trustworthiness.

This research made the following provisions to attain credibility and trustworthiness in findings based on Shenton’s (2004) arguments:
A well-established method was adopted in this qualitative study. Yin (2009) forwarded the importance of incorporating correct operational measures for the concepts being studied. Thus, the specific methods employed in data gathering and data analysis should have been derived from those successfully utilized in previous comparable researches.

**Familiarity with the culture of participating organisations.** Lincoln and Guba (1985) and Erlandson (1993) are among the many who recommend prolonged engagement between the researcher and the participants in order to gain an adequate understanding of an organisation and to establish a relationship of trust between the parties. A danger emerges, however, when the researcher may become so immersed in the organization under scrutiny that their professional judgements are influenced. This is not considered an issue in this study as I had been working with the FITS as regional coordinator for more than 2 years (see section 4.7 for details). The danger of bias is also avoided, as my motivation is not towards promoting the FITS project but looking for reasons why some FITS centres were successful and other FITS centres were not. In addition, during the research I was not connected in any way with the FITS program.

**Triangulation** is also considered as a way improving credibility and trustworthiness of a qualitative research. How this was done has been described in section 4.6.4.

**Iterative questioning** involves use of probes to elicit detailed insight. In this study, the process involved returning to responses previously provided by participants and extracts related data through rephrased questions. I also used probes for me to get insights why the responses vary across instances, sources and contexts, thus allowing a holistic picture.

**Peer scrutiny of the research project.** Opportunities for scrutiny of the project by colleagues, peers and academics should be welcomed, as should feedback offered to the researcher at any presentations (e.g., at conferences) that are made
over the duration of the project. I made all my presentations at the University of Sydney, Faculty of Education and Social Work. This included my presentations in the Faculty’s Learning Technology Research Festival, Faculty’s Postgraduate Research Student Forum, Research Centre’s Doctoral Colloquium and various other research centre’s seminars. During these presentations, my peers, supervisors and other academics asked questions and challenged my initial assumptions and interpretations. This enabled me to refine the methods and develop stronger arguments and interpretations.

Sampling. Although this study does not claim generalisability of the findings, it aimed to ensure that farmers with different experiences from both FITS centres were similarly well represented. I selected participants who varied in their practices and crops being grown to ensure that my collected data reflect different farming practices, technology adoption experiences and different contexts.

One of the most highly respected ways to ensure credibility is to give thick description phenomenon under scrutiny. Creswell (2007) claimed that ethnography and case studies produce thick descriptive reports. In this type of study, detailed description can be an important provision for promoting credibility as it helps to convey the actual situations and contexts that surround the participants. Without this insight, it is difficult for the reader of the final account to determine the extent to which the overall findings “ring true” (Shenton, 2004, p. 69). In this study, detailed descriptions of the cases were presented using quotes, stories, tables and diagrams to present situations of the participants.

4.7.2 Transferability

Transferability is concerned with the extent to which findings of one study can be applied to other situations Merriam, 2009). This was also termed by Erlandson (1993) as generalizability. Erlandson (1993) claimed that, since qualitative studies are specific to a small
number of individuals and contexts, it is impossible for the findings to be applicable to other people and situations. An opposing view was offered by Stake (1995), who proposed that although each case is distinct, it is an example inside a wider group of people or contexts. Because of this, the possibility of transferability should not be rejected. Therefore, if other researchers would like to replicate elements of a particular qualitative research project, they must see to it that the situations are similar to that described in the study.

In this study, I described the context in Chapter 2, presented in detail my role as researcher in section 4.9 and provided thick descriptions of the farmers’ stories and the phenomena under investigation in Chapters 5, 6 and 7, so that other researchers may compare the instances and phenomena as described in their studies.

4.7.3 Dependability

Dependability refers to the “techniques to show that, if the work were repeated, in the same context, with the same methods and with the same participants, similar results would be obtained” (Shenton, 2004, p. 64). Shenton (2004) added:

“…to address the dependability issue more directly, the processes within the study should be reported in detail, thereby enabling a future researcher to repeat the work, if not necessarily to gain the same results.” (p. 71)

In this study, the research methods and research strategy were clearly justified in relation to the aims of this investigation, which includes how it was undertaken. I also presented in detail how the data were gathered and how I carried out the fieldwork. I also described in detail how I analysed my data. In doing this, future researchers may be able to replicate all, or elements of this research.
4.7.4 Confirmability

According to Patton (1987), confirmability relates to objectivity of the researcher. Shenton (2004) added that qualitative researchers must ensure that the findings of the study are the result of the experiences and ideas of the participants, rather than the characteristics and inclinations of the researcher.

Confirmability is achieved by reducing the effect of the investigator’s bias, which can be achieved through triangulation. Another way to achieve confirmability is for the researcher to admit his or her inclination or bias (Miles & Hubermann, 1994), and by doing so, the acknowledge the decisions made in adopting the methodology, the choice of the participants and other influences that could cause doubts regarding the conduct of the study. By doing this, the researcher may allow readers to determine the acceptability of the data and findings.

In this research, confirmability is addressed by presenting the findings of this study using direct quotes from the participants. I also presented in detail, the triangulation process used in this study in section 4.8.4. The rationale of the choice of the methodology and participants were also presented including my stance as a researcher.

4.8 Researcher’s role

One of the significant issues in conducting ethnographic research is the role of the researcher. In the previous sections (section 4.8.4 and 4.9.1), Flick (2007) and Guba et al. (1985) emphasized the importance of prolonged observation and familiarity with participants and context under examination in order to improve credibility and trustworthiness of the study. Lincoln and Guba (1985) however, warned of the danger of prolonged engagement and familiarity, as it may lead investigators to become so immersed in the organization that their judgements may be influenced.
During this study, I explained the purpose of my research using the local dialect so that the participants would be able to understand well the aims and provide me with the correct and precise information. In cases where participants did not agree to participate, they were not included, and in cases, where participants did not want to be quoted, their statements were rephrased. This is explained further in the succeeding paragraphs.

My prolonged engagement and observation (4 months of fieldwork and 2.5 years serving as regional techno-gabay coordinator of the FITS centre) yielded enough insight to allow me to construct thick descriptions, bringing strong credibility and trustworthiness to this study (Erlandson, Harris, Skipper & Allen, 1993). In addition, the effect of my long engagement with the participants in this research allowed me to immediately recognize experiences, practices, and perspectives (Anderson, 2007) spoken of by my participants. It also enabled me to have a connection with the farmers’ stories during the interviews and observations. This relationship allowed an understanding of their caution when responding and fear of appearing critical of others. They understood they were at the bottom of the FITS hierarchy, and thus seemed reluctant to make any direct, negative statements about the FITS centres. In some cases, however, some farmers requested to go ‘off the record’, to further explain their negative thoughts and opinions, which allowed me to understand the broader context.

Going off record often occurred when participants criticized their organization, people within the organization, or the local policies. Participants would request to go off record to avoid future reprisals from the organization or people they criticized.

Although this delimits the study, as these responses cannot be presented, it gave me an understanding as to why participants acted or perceived events in a certain way, and in turn, why they behaved in a particular way when presented with an intervention. To address
this issue, I asked the participants if they would allow me to reflect their comments as my observations. When the participants agreed, I reported these off the record conversation as my personal observations.

Hebert and Beardsley (2002) further recommend that in ethnographic studies, it is essential to have an insider within the organization, especially if the researcher is new and unfamiliar with the organization. Having someone inside the organization allows for the development of trust between the researcher and the participants, which may result in conversations that are more open. I did not require an insider to the community acting as a key informant, deemed necessary in many ethnographic case studies. One advantage I possessed was my reciprocal relationship with the FITS centre, which was first established through my position as a TGP regional coordinator. I believe this gave me a distinct advantage in collecting and analysing the data of the participants’ perspectives and practices. I was already part of the FITS centre community of practice at the inception of this study. Lincoln’s (1995) idea of reciprocity between the researcher and participants was essential because of the “person-centred nature of interpretive work” and the “kind of intense sharing” that marked our relationships with a “deep sense of trust, caring, and mutuality” (pp. 283-284). In this study, reciprocity occurs in terms of respect of opinion and trust. Engaging with the farmers for two and a half years allowed for a mutual understanding of, and respect for their practices and culture. During their participation in the study, they were also aware that my presence in their lives came from an intention to offer assistance. This realisation precluded any difficulty in the development of trust between us. They knew that I would respect their opinions, although I may have certain degree of doubt (reflective or productive) of their responses because of the relationship.
The danger of this relationship is that the researcher may not be able to create any ‘distance’ from the participants, which may affect their responses. In addition, the researcher may present his/her own experiences rather than the participant’s experiences. Concerning this issue, Hammersley (1990) and Levinthal (2006) recommend researchers not conduct observations themselves but make inferences only from what participants do and say (i.e. directly quoting the participants) during interviews.

In this study, the above limitation was overcome by the choice of strategy in analysing the data. The combination of ethnography and case study allows me to focus on the aims of the study, thus making inferences based on the participants’ responses to my questions and reporting the findings using direct quotations.

Finally, during my attendance of seminars, training, festivals and information drives, I attempted to maintain a low profile. I dressed and behaved in a manner consistent with the activities and I followed the requirements for visitors. During these activities I was unobtrusive. I usually sat at the back, making sure that the audience would not be aware of my presence. I took notes during without talking to any of the participants, and only after the activities, did I have conversations with some of the participants for further clarification of their speeches or questions.

4.9 Ethical considerations

The University of Southeastern Philippines Extension Director and FITS centres (Appendix M, N & O) supported the study, and it was also approved by the Ethics Committee of the University of Sydney (appendix B).

In accordance with the ethics protocol of the University of Sydney, participants were invited for voluntary participation in this study (Appendix P). Prior permission was sought from each participant before arranging interview sessions to ensure that the process would
not disrupt their work or other activities. Individual participant written consent was sought together with confirmation of their voluntary participation (Appendix Q). These letters were in English, because all the participants can understand the language since most of them had attended school where the medium of instruction is English. In cases, were the participants need clarification, these letters are explained to them by the researcher in the local language.

I took steps to ensure the privacy of participants. I maintained separate files to store consent forms and transcripts, and personally transcribed, coded and removed individual or FITS centre identifiers from all interviews. With the exception of a few individuals who gave permission for me to include their pictures in publications of the research, no images have been presented in such a way as to allow identification of a participant. In those cases, where permission was given, I provided the participants with a copy of the pictures and gave them the opportunity in advance to approve or decline their use.

During data analysis, the confidentiality of participants’ information was regarded at all times and their identities remained anonymous. To ensure this, data were aggregated so that it could not be linked to any individuals. To ensure the confidentiality of the research participants, pseudonyms were used in the quoted transcripts when reporting findings. No attributions were written in any form to indicate the identity of the participants.

4.10 Chapter Synthesis

This chapter presented the research methodology and design employed in this study. An ethnographic case study was considered as the appropriate methodology for this research as it allowed me to overcome the lack time required for a longitudinal ethnographic study and to answer my research questions holistically, in a natural setting.
I have described the data collection procedure and analysis in detail, including the data sources and collection procedures, and presented the types and volume of the data collected in this study. In the data analysis, I presented the importance of data management, how I developed codes in order to identifying similarities and patterns of the data that led to the development of themes. I also presented how I conducted the triangulation of data sources to improve the trustworthiness of this study.

To achieve trustworthiness of this study, I showed how I overcame issues of credibility, transferability, dependability and confirmability. I have identified and addressed five provisions of credibility, addressed how transferability of this study could be improved, identified techniques for possible replication of this study and how bias was reduced to improve confirmability.

To improve further the credibility of this study, I presented my role as an investigator by describing my involvement of this study and how I overcame the dangers of being an insider in a prolonged period of engagement.

Finally, I presented the ethical considerations of this research, describing the importance of participant confidentiality and how I adhered to rules of The University of Sydney Ethics Committee.
Chapter 5. Farmers’ perspectives on design affordances and entwinement process

5.1 Introduction

This chapter presents the empirical data, findings, and interpretation of this qualitative case study. The data were collected from 46 in-depth interviews, field observation notes, and organisational documents. The responses of the participants in this research include both their personal reflective accounts, and what they observed when interacting with other people.

This chapter is structured to answer the first research question of this study, which is, “How do interventions and individuals entwine?”. First, I will explore how farmers perceive affordances of an intervention, specifically in ICT use. Second, I will present the conditions perceived by farmers that led towards sociomaterial entwinement of farmers and technology. Third, I will present farmers’ practices and experiences on how affordances and constraints produce new practices and new technologies. Lastly, I will present the Chapter Synthesis and implications of the findings in relation to the first research question and its sub-questions.

5.2 Farmers’ perceived affordances

This subsection will attempt to answer the first sub-question in this study that is, “How do farmers’ perceive intervention affordances before and during adoption?”. In order to answer this question, I conducted interviews with participating farmers and asked them the following sub-questions: (a) How did they perceive the FITS intervention when it was introduced to them?; (b) How did they perceive the intervention when the technology was given or offered to them for use?; (c) How did they perceive the intervention when they decided to use it? These three questions allowed me to elicit responses and stories from my
participants of their views of the intervention before, and then when they adopted it for use. Note that the term intervention in this study is referring to both ICT and AT as described in Chapter 1.

When I conducted my interviews and observations, I noticed that the farmers viewed affordances of the interventions differently at different times during their engagement with the FITS centre. At first, farmers perceived ICT affordances based on what the ICT could do. In most cases, farmers shared their perspectives of ICT affordance based on what they knew, observed, and what other people told them. This I observed was normal, as most of the respondents had not even touched a computer prior to the introduction of the FITS intervention. To entice farmers to use ICT, implementers emphasized the technical features of ICT intervention (i.e., the inherent properties of the intervention) for example, as a tool to acquire information in the World Wide Web.

As the conversation with the farmers moved from what they initially perceived, to the time when the ICT was made available for use, their perspectives of affordance had shifted from features to the ICT design. I noticed at this point, the farmers did not limit themselves to what the technology could do in general terms, but they were considering how the technology was designed. For example, some farmers were concerned that they may not understand the content of a particular website because it was written in English. In some cases, farmers had apprehensions because the media made available to them were limited (e.g., availability of printable materials and videos). In addition, farmers did not only consider the design features of the ICT but went beyond by considering for example, its accessibility, the presence of support groups or communities of practice, feedback, and contextualization.

When I talked to farmers about how they perceived the interventions at the time they were using it on their farms, they shared different views of affordances the interventions
presented. At this point, they had shared perspectives in relation to their goals in farming. As I was talking with the farmers, they shifted their views of affordances from affordances of ICT, to affordances of AT. This occurred when they were using ICT, and were able to find agricultural technologies (e.g., choice of rice variety) in the process. Farmers further told of constraints of the interventions, and how these perceptions of constraints, specifically of ICT, led to the emergence of modified or new technologies, affordances, and practices.

I will present narratives of these perspectives in the succeeding sub-sections.

5.2.1 Affordances as bundle of features

During the promotion of the FITS and its services to the farmers, implementers endorsed the program by telling farmers of its usefulness in obtaining information about farming. I asked one of the FITS managers how he informed the farmers of the FITS services, specifically the use of computers. She replied:

“We promoted the FITS services during farmer gatherings sir. We usually told them that if they had problems in their farming, such as, pests, diseases, fertilization and irrigation, they could get information using the computers in the FITS centre. They could also send SMS to particular mobile numbers and they would receive feedback on their problems. They could also attend video-conferencing, so they could ask experts directly.” (MAO, 12/12/2014, 4:25 PM)

When I asked farmers about their views of ICT at the time it was introduced, very common answers were the naming of basic ICT features. They were very quick to answer, and as one farmer shared:
“It is a place where we can search for solutions to our problems, because, that is what they told us when they [FITS staff] went to the villages to conduct the information drive before the cybercom was established.”

(Jimmy, farmer, 12/10/2014, 3:07 PM)*

This response is Jimmy’s independently-formed perspectives of what ICT can do, and it was influenced by the promotion strategy implemented by the FITS centre to promote ICT use. In another conversation, a farmer scientist highlighted a feature of ICT, mentioning access to various information sources and advice services on agricultural topics:

“Yes, this is a huge development in our community, especially now that we are ‘high-tech’. Before when we had problems about rice farming, we had to read a book, or ask our fellow farmers. There are times that your questions are not answered. Now, with the FITS centre, it helps a lot, because, if you have a question, you can just answer it through the internet and there are websites that are connected to agricultural topics, like Nutrient Manager for Rice (NMRICE), RICE DOCTOR, and Palay check.” (Lilia, farmer scientist, 3/10/2014, 11:00 AM)

This farmer scientist considered the internet as a tool to acquire information and access applications that she believed could aid her in her farming.

Another feature of ICT use that was conveyed by some farmers was the expanding of their informal advice network. They considered ICT use as tool to reach experts and receive advice from them. Anna sees ICT use as a direct line to experts at times when they are needed. She stated:

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* This pseudo name of the respondent, his work, date and time of the interview in that order.
“It [ICT use] will immediately give you answers to your questions, especially if you use the internet and you can contact experts directly like people from IRRI and PhilRice.” (Anna, farmer, 9/10/2014 12:02 PM)

She added:

“The cybercom of course have the internet. It is very easy for us to contact our relatives in other places. That is one of the advantages; aside from farming, there are also other benefits.” (Anna, farmer, 9/10/2014, 12:02 PM)

In this case, Anna considered ICT as a tool that allows to reach technical experts. She further shared that possibilities to access the internet enabled her to expand not only her formal connections (e.g., contact experts from IRRI and PhilRice) but also her social network (e.g., connect to relatives).

In summary, my findings indicate, that initially participants looked at ICT affordances as a bundle of features, mostly conveyed to them by the FITS staff. Farmers perceived ICT use as a tool to acquire information and expand their network. Based on their responses, the focus appears to be on what ICT can do. These affordances perceived by the farmers were usually their initial perceptions and possibilities which still needed to be actualized, or opportunities for action that needed to be verified. I further noticed that the features explained to me by the farmers were often features (getting information from the internet-IRRI and PhilRice, software like NMRICE, Rice Doctor, Palay Check) that they recognized as most beneficial to them and social network (relatives which known to her and knowing other relatives thru social network).
5.2.2 Design Affordances

In this subsection, I will present how farmers perceived the ICT design of the FITS centre interventions, specifically the design of recommended websites, software applications and the implementation design of the FITS centres. Farmers’ views of ICT use were not limited to the technical features of technology (e.g., as a general tool for accessing information) but also included various aspects of design such as accessibility, presence of communities of practice, feedback, and contextualization of ICT. I will discuss these perspectives related to design in detail below.

5.2.2.1 ICT Design features

Many farmers discussed affordances offered by the intervention by pointing out various design features. During my observations and interviews with farmers, I recorded four features of design that were very important to them: (a) accessibility, (b) communities of practice, (c) feedback, and (d) contextualization. Accessibility refers to the resources and tools present in technology design that make information accessible and understandable to farmers. Accessibility for farmers is not limited to inherent design of the ICT application (e.g., language used), but also included the geographic proximity of the facility and design of the learning space. Communities of practice refers to the opportunity for farmers to work with other farmers and share experiences. Feedback refers to the intrinsic design of technology to respond to farmers’ needs and problems, built into the technology or from external sources. Contextualization refers to resources and tools needed in relation to the farmers’ circumstances. I will discuss these views in detail below.

5.2.2.1.1 Farmers and accessibility

Based on the definition of accessibility above, one consideration of technology design I observed was the use of language. During this research, it was revealed that, most farmers
did not finish higher education. As such, most farmers could hardly understand the English language. As one farmer shared:

“It [information] is difficult for farmers to understand because most of the farmers here are elementary graduates and they do not understand the English language well. However, the site [Pinoy Rice Knowledge Bank] has a Cebuano translation so we can easily understand it when we read it.” (Ruben, farmer, 12/11/2014, 4:18 PM)

In one of the informal discussions with an instructional designer of the IRRI water management module, she explained that during the conceptualization stages of the module development, various stakeholders were consulted before the development of instructional materials. One of the considerations was the use of language, as not all users could understand English and scientific terms:

“Putting material online, which cannot be understood by its users, is considered a design flaw and a violation of our Quality Management Standards (QMS), we have to make sure that the terms we use are those that are easily understood by our users. It [language] should not be scientific, and we use simple English and if possible translate the finished product into the spoken dialect of the users.” (Ella, Instructional Designer, Mindanao Learning Space, 12/15/2014, 3:55 PM)
This particular feature could be seen in the Pinoy RKB website, where there is a selection of major Philippine dialects that a user may choose from (Figure 5.1).

![Dialect options](http://www.pinoyrkb.com/index.php) (Retrieved on November 5, 2013)

In this website I observed that five different languages/dialects included in the design: English, Tagalog, Cebuano, Iluko and Hiligaynon. The latter four are major dialects spoken by most farmers in the Philippines.

The farmers’ responses showed how inherent design of the technology may have encouraged them to use the website. Farmers were found to become interested in using the ICT service when they could understand the content easily. Like other farmers’ comments, Willy stated:

“The content is not difficult to understand, because it is written in our dialect…” (Willy, farmer, 10/14/2014, 10:19 AM)

Another accessibility design feature that farmers considered important was the proximity of the facility to their homes. I observed that in most cases, one of the reasons why farmers had second thoughts in using the ICT was they had to travel far to gain access. As Boyet complained:
“The farmers in my village were hesitant to use the FITS centre facility (computer and internet) because it is located in the town centre. They need to travel, pay for the fare and need to bring food with them. It is expensive and takes a lot of their time.” (Boyet, farmer, 27/11/2014 5:19 PM)

In order to address this issue, the FITS centre management initially introduced the mobile internet van that roamed between different villages on a given schedule, which was later followed by the establishment of a village cybercom in five village locations. As the MAO shared:

“Most of the complaints that we received from farmers were about the proximity of the FITS centre facility to their homes….so our Municipal Mayor donated a mobile internet van with five laptops in it and with internet connection that roams around the different villages. Luckily, IRRI together with the Department of Agriculture (DA) and the Department of Science and Technology established this village cybercom project. As a result, we were able to make the FITS services more accessible to farmers and other users.”

(MAO, 12/12/2014, 4:25 PM)

Although the FITS centre management addressed the proximity issue, some farmers that I interviewed were still hesitant to use ICT within their village. They mentioned that the placement of the facility within their village centre was not favourable, and they were ashamed to access it publicly. Tess explained this to me by saying:

“We are ashamed to go to cybercom, because you have to pass by the session hall on the way to the cybercom, and there are times that they are having
sessions, and to go there (cybercom), we have to pass through the session hall.” (Tess, Farmer, 03/12/2014, 2:20 PM)

In my engagement with farmers for more than 20 years, I have observed that they are generally shy and as much as possible do not wish to make others aware of their presence. In the Philippines, although farmers are recognized as the backbone of the economy, being a country that depends on agriculture, most farmers think otherwise due to their generally perceived low socio-economic standing. In this case, accessibility of information is not limited to the physical accessibility of the facility (location, design of the space and distance) but also on the design of the software to access the information (website or an application). For some farmers, the ease of information on the website is an essential feature.

5.2.2.1.2 Farmers and the emergence of a community of practice

Another design feature that emerged from the interviews was the presence of experts. Presence of experts is not limited to a physical presence, but also virtual interaction. An example of virtual interaction is the use of video conferencing. In this case, the farmers were able to see the experts in real time and could interact with them when they had questions. This “co-location” of farmers and experts allowed for timely feedback and substituted for the physical presence of experts in the field, as well as allowing farmers to get information directly from agricultural experts. FITS organized regular season-long video conferencing with farmers and experts, usually conducted at a time when farmers needed advice the most. As one farmer said:

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9 A session hall is a space where the village council conducts their regular meetings to discuss village issues and pass village policies and laws.
“...What we do is, we take a picture of the plant or disease, and then we show it to experts online during video conferencing. We show it to them (experts) and they give us feedback immediately.” (Pastor, farmer, 28/11/2014, 3:36 PM)

The former village chieftain added:

“We also make a schedule for online discussions with farmers and experts. ...Sometimes, it is good that we see them [experts] face to face even if they are just on the projector screen, just like on the television.”

(Nita, Farmer, former village leader, 14/11/2014, 1:00 PM)

It was shown in the conversation with the MAO that this virtual face to face interaction between farmers and experts allowed for the building of trust between them:

“By video conferencing, farmers can see who is talking, unlike when you just read something [agricultural information], you do not know if what you are reading is true. Unlike when you hear it from experts, you can see that the information is coming from him [an expert].” (MAO, 12/12/2014, 4:25 PM)

As farmer information awareness increased, I discovered it led to the emergence of small groups. These groups became a community of practice where they shared their experiences and practices. I observed that some groups conducted regular weekly meetings to discuss issues and concerns related to farming. They also conducted farm visits, so they could observe how their fellow farmers took care of their rice plants. As one farmer conveyed:

“Advocacy like this [organic farming] will not work if farmers will not organize. ... If we organize Sir, things become easier, because you
can ask other farmers if you have some problems. For example, if you forgot about how to open the computer, you can ask someone, or you forgot the name of website, or share the website you are using. It is the same as organic farming group, we learn individually, but we share everything during our regular meetings.” (Jimmy, farmer, 12/10/2014, 3:07 PM)

In one of the meetings I attended with a farmer group, I observed that if they anchored themselves in an informal organisational structure, they felt the support of their peers and became more confident in their practice. In this situation, they were able to draw advantages from the information they acquired through hearing of the experiences shared by other farmers in the group. This shift from individual learning to group learning shows that learning becomes more effective in groups. In further shows that in the context of informal education individual learning communities of practice naturally emerge when people become engaged in learning. By doing this, they reinforce their ideas and become more confident of what they should do in practice.

5.2.2.1.3 Farmers and feedback

Another important design feature that invited farmers to use/adopt the intervention was the timeliness of feedback. In various conversations with farmers, my analysis showed they were concerned with the promptness of feedback and timing. I noticed that this is important for farmers as each stage in rice production affects the yield of the crop. As a result, a slight delay in fertilization, watering and pest control will greatly affect yield. As one farmer said:
“It is very difficult if the feedback is late because we cannot tell the rice plants to wait or the insects to stop infesting our plants. The good thing with the system [referring to the design] is we just ask [referring to varieties to plant in a given season, pest, etc.] once and then we write it on paper before each planting season. So, we just look at it [notes] when it is the appropriate time to plant it [a variety].” (Lito, farmer, 13/12/2014, 5:54 PM)

Lito’s response showed that they were enticed to adopt the use of the intervention because of the service design; to give timely feedback, which they consider crucial in rice production. Findings also indicated that the feedback mechanism did not often lie within the intervention itself, but also included feedback from experts, technicians, and peers.

“The good thing with video conferencing is, we can show it [infested plants, insects] to them [experts], and they give us feedback immediately.” (Pastor, farmer, 28/11/2014, 3:36 PM)

5.2.2.1.4 Farmers and contextualization

I use the term contextualization to refer to farmers’ preference to use special ICT resources or materials that could be accessed through ICT (e.g., printed or video materials) in relation to their personal circumstances. These circumstances include their computer skills, education, and preferences for learning. I observed that farmers are willing to use ICT if different media are made accessible for them to choose from. As one farmer pointed out:

“Farmers are different from each other. There are farmers who learn from observing others, other farmers learn by doing it, others by reading from materials, and other by listening from experts or technicians. ... That is why
others learn through listening to the radio [school of the air], others by reading materials from the FITS or internet, others by watching video and other by attending meetings with experts.” (Boyet, farmer, 27/11/2014 5:19 PM)

Subsequently, the ideas contained in the above transcript were confirmed when I took field notes conversing with Nonong, as he compared written information to video:

“Comparing the one that is written, and video, I prefer the video Sir. Because you can actually see how they do it. Because if you just read, you still need to ‘figure out’ how it is done. The good thing with video is that, you do not need to read, because you already saw it. For me that [video] is the best.” (Nonong, 12/11/2014, 10:00 AM)

In addition, I also learned that some farmers preferred printed materials. As a result, they print materials from the internet so they can read them at home or during their free time. Given these findings, I examined the Pinoy RKB website to see if it was designed to address farmers’ learning preferences (Figure 5.2).
The website was indeed designed to address the issues of learning preferences through watching video, reading hard copies, listening, etc.

It was observed that various media were available for farmers to use in these learning modules, depending on their learning preferences. For example, an e-Book, video, audio file, printable materials, games, and mobile options were available. By providing these different resources, farmers were more likely to be enticed to use the ICT resource, because the design addressed their learning preferences.

5.2.3 Relational affordances

Relational affordances, as mentioned above, are emergent practices resulting from the sociomaterial entwinement of farmers and ICT. I noted that when farmers were presented with new information or services, new practices and beliefs emerged from this. Examples of emergent
practices were: use of the nutrient manager application, use of Palay check, use of organic farming, mixed method farming\(^{10}\) and bookkeeping.

The new information and services matched with their goals. Farmers saw ICT affordances not just as a bundle of general technical features or services and not just through their design characteristics, but as affordances that gradually enabled new practices and which were closely intertwined with other features of the changing context. For example, when I asked farmers what they could say about the FITS centre interventions, most of them answered that it helped not only with getting information but also with their livelihood (rice farming):

“\textit{It (computer and internet) helped me a lot, especially now that I am practicing organic farming Sir. I can search through the internet for the information I needed, for example, land preparation practices, the most appropriate variety to plant and identify pests and diseases.}”

\textit{(Jimmy, farmer, 12/10/2014, 3:07 PM)}

Probing their initial responses, I asked them how the use of ICT influenced them to change their practice. Jimmy said:

“\textit{Initially, it (computer and internet) provided me with the information. But it was a mix of ICT use, observations of what other farmers are doing, government programs and policies. For example, Sir, the municipal government passed an ordinance that we are not allowed to burn rice stalks or else we will be fined, the reason why I changed my practice.}” (Jimmy, farmer, 12/10/2014, 3:07 PM)

\(^{10}\text{Mixed method farming practice is a rice farming practice that combines the use of both organic and inorganic farming. In this practice, farmers reduce their inorganic inputs like industrial fertilizers and pesticides by using organic materials such as worm and animal droppings and self-made concoctions like fermented fruit juices or fermented snails.}\)
Another farmer also commented:

“It was not only the cybercom Sir, but I also thought about sustainability, because I noticed that the soil in the farm is too acidic and it started to harden, especially that part there (pointing to an area on his farm). If I continue doing my old practice (referring to inorganic farming), maybe I will be losing, because now I must fertilize and spray a lot just to reach my target production. I am also thinking about my family, because with the volume of chemicals that we are spraying, I might be poisoning ourselves slowly. That is why I considered changing my practice.” (Willy, farmer, 10/14/2014, 10:19 AM)

Another farmer added:

“Market price is also one of the reasons I changed my practice. It is not only the use of ICT Sir, because I also did some little experiments to make sure that the agricultural technology works. For example, testing the variety to plant, using different planting distances to determine which planting distance is appropriate to a particular variety because different varieties differ in plant size, height, and tilling capacity.” (Juan, farmer, 23/10/2014, 3:00 PM)

My findings indicate that, the change in farmers’ practice could not be solely attributed to ICT use, but due to various factors in the environment such as: (a) political, referring to the policies imposed by government or organizations, (b) social such as influence from family or peers, and (c) environmental such as market prices and sustainability practices.
Probing further, I asked the farmers about the role of the cybercom in relation to their current practice. Jimmy started by telling:

“The cybercom is always there Sir when we need it, we are given priority to use the facility and a staff are hired to assist us...I do not use it very often though, only when I have some questions, like about ‘bad fumes’...” (Jimmy, farmer, 12/10/2014, 3:07 PM)

Pastor added:

“...we use it (computer and internet) during seminars and when there is video conferencing with experts from PhilRice.” (Pastor, farmer, 28/11/2014, 3:36 PM)

In this context, the affordances of ICT and its design became secondary to the affordances of the information itself, accessed through ICT. Further findings related to the relationship between farmers and ICT. As the relationship grew, new affordances could emerge, in this case, the affordances of agricultural technology. As I explored this relationship between the farmers and ICT, I noticed that the materiality of ICT was reduced to a simple ‘tool’, just as farmers treated other farming tools, such as a plough, farm animal, thresher machine, and scythe. That is, its agency is only employed when required. Thus, the entwinement between ICT and farmers became embedded within the entwinement of farmers and agricultural technology.

In order to explore this finding, I looked further at the conditions related to how farmers entwined with the intervention. This is discussed in section 5.3.

5.2.3.1 Shift from individual to group affordances

In this study, the analysis suggests that, most of the farmers belonged to a formal group or organization. Farmers organized themselves for different reasons, for example,
establishing support groups for self-advocacy, to influence the market, to promote specific practices and influence decision makers. As one seed producer suggested:

“We organized ourselves for marketing purposes. ...we can sell our product in large volume, thus we can demand higher prices.” (Ruben, farmer, 12/11/2014, 4:18 PM)

While an organic farmer shared:

“Without an organization, it will be difficult to invite more farmers to use organic farming because some farmers will not believe this (organic farming) technology works. If there will be more farmers using it, we might be able to convince more.” (Pedro, farmer leader, 20/11/2014, 10:15 AM)

He added:

“... It is easy for us to share information and practices, for example Sir, if I have some problems on my rice farm, I can always ask my fellow members in the group during our meetings or when we meet in the streets...” (Pedro, farmer leader, 20/11/2014, 10:15 AM)

Farmers organized themselves with specific goals in mind. In these two sample cases, their goals were to influence market prices and invite more people to use an advocated practice such as organic farming and sharing of information.

In one of the organic farmer meetings I attended, I saw evidence of Pedro’s claims that farmers using the same practice offered support to each other by sharing their experiences, problems and practices. Farmers passed on information about what they observed on their farms, while the host of the meeting showed the effects of his practices on his farms to fellow farmers (Figure 5.3). This sharing of information occurred as a result of having a collective perception of affordance as mentioned earlier. I observed that farmers who are not members
of a group usually kept information to themselves as they considered other farmers as competitors.

I further discovered that other farmers used their membership of the group to confirm their practice, by observing how other farmers were working, thus, reassuring themselves that what they were doing was appropriate. As one farmer said:

“Even if we are advocating the same practice, there are things that we are not very confident about. We do not know everything ... That is why we still need advice from our fellow farmers who are doing well, to know their secrets, so as a group we can produce more...” (Pastor, farmer, 28/11/2014, 3:36 PM)

Another farmer confirmed Pastor’s statement saying:

“Our organization, with the help of the NGO, serves as support system; we help each other by sharing our experiences and even resources. By doing so we will be able improve our practices as advocates of organic farming, and at
From the conversations with Pastor and Wilyam, I noticed reasons for their shift from perspective of individual to group affordances. That is, from carrying out a specific practice alone, to a group effort where they supported each other. The two conversations quoted simply mentioned of the benefits of collective action (i.e. sharing of knowledge and learning from each other). However, my analysis showed that their perspectives of collective action also lead to their new perspective of affordance (e.g., as a support system, rather than just a tool). Similar statements were very common in farmers’ accounts of their informal learning suggesting that these practices emerged as a part of the FITS intervention.

I looked further into conversations with other farmers, and traced how individual affordances are embraced to achieve the group’s goal. My finding indicates that, the farmers had unique views of affordances depending on their skills. For example, Jimmy stated:

“I am using ICT to research bad soil fumes. I am more concerned about it because for me, no matter how much organic fertilizer we throw onto the rice fields, if we do not understand what is going on, our efforts will be useless.”

(Jimmy, farmer, 12/10/2014, 3:07 PM)

While Pedro shared:

“ICT use helped me in identifying insects and diseases, pests that are friendly and harmful. By doing this we will not be killing friendly insects because they are helpful, for example, spiders and frogs.” (Pedro, farmer leader, 20/11/2014, 10:15 AM)
These two affordances identified by farmers are different from each other (soil management and pest management. However, the common theme is promoting organic farming.

I observed that because of these differences, each group member was seen as unique and each had become viewed as ‘expert’\(^{11}\) in his/her areas of concern, usually consulted by other members of the group. This is considered unique because this skill is not common to all farmers (e.g., identifying bad fumes or knowing what is beneficial and non-beneficial insects). Through information and practice-sharing among members of the group, farmers’ individual views of affordances led to the achievement of organizational goals. Furthermore, in the process of shifting farmers’ affordances to group affordances, organizational routines were changed, influenced by the creation of new affordances and constraints related to an intervention. This will be discussed in the next section.

Based on these conversations with farmers, I consider collective affordances to be a specific kind of relational affordance. Group affordance as defined by Leonardi (2013) is an affordance “that is collectively created by members of a group, in the aggregate, which allows the group to do something that it could not otherwise accomplish. A collective affordance may be the result of pooled individualized affordances” (p. 752). These are relational in the sense that these affordances are perceived by the group of farmers with specialized or unique skills in relation to the goals of the group. Collective affordances are possibilities of action, perceived in a given intervention by the group of users.

\(^{11}\) Expert in this context does not refer to scientific expertise, but to a person whom other farmers go to for advice when they have specific problems.
5.3 Conditions for sociomaterial entwinement

The previous section suggested relational affordances could be explored by examining emergent farmer practices. I further noted that the changes in these practices were influenced by political, social and environmental conditions.

This subsection examines the conditions that influence changes in practice among farmers, and how these conditions facilitate entwinement of farmers with an intervention. I will specifically answer the sub-question, “What are the conditions that lead towards sociomaterial entwinement of farmers and technology?”

In summary, I identified the following conditions expressed by farmers which are: implementing conditions, practice/habitual conditions, power conditions and facilitating conditions. These conditions will be discussed in the succeeding subsections.

5.3.1 Implementing conditions

Implementing conditions, in this study, refer to the technological and implementation circumstances of the intervention by the FITS centre. For ICT, this includes the flexibility of the intervention, which refers to ease of software or application modification to fit to the needs of the users. In addition, it includes implementation of the intervention to address barriers such as geographical distance and the culture of users.

During the farmer interviews, I recognised that implementation conditions were not limited to the inherent features of the intervention, but included the ease with which the ICT features can be changed. For example, when I discussed the Nutrient Manager for Rice (NMRice) application introduced to farmers by the FITS centre, Jimmy explained the reason he stopped using it:
“Now, I stopped using NMRice v1.1, because it was designed for inorganic farming, which, I am not practicing. I am using the version 2.0 which they called mixed method Sir. They (IRRI) have introduced a new one (v 1.2) and Rice Crop Manager (RCM v 2.0) which is better, because it provides me with the fertilizer requirement when using the mixed method.” (Jimmy, farmer, 12/10/2014, 3:07 PM)

Jimmy revealed the reason why he shifted, stopped and then shifted again in his use of NMRice software. It was due to its lack of suitability for his farming practices. Although NMRice v1.1 was reliable, as it had been used by inorganic farmers for a long time, it was also considered a flexible technology, as the designers, although not working directly with the farmers, had been able to make modifications to the application to fit to the changing needs of its users. This was done by adding additional features to the application such as the calculation of fertilizer requirements when using the mixed method of farming. The flexibility of the NMRice application invited farmers to use the software as it aligned with their practice.

Another implementation condition observed was ease of access. By access, I refer to the geographic distance of the facility from farmers’ abodes and the situatedness of the facility within the village centre. In the course of my interviews with the farmers, most pointed out, that the first location of the facility was too far away from their homes, and that they needed to spend time and money just to get there. As one farmer remarked:

“Originally, the FITS centre was located in the municipal hall that is why most farmers did not go there, because it was far and they had to pay for their fare and spend their time. They needed to wear proper clothing because there are so many offices there and the place is too formal. We farmers are ashamed
to go there wearing our farming clothes.” (Wilyam, farmer, 15/12/2014. 3:35 PM)

The municipal FITS centre however, addressed this issue by establishing the cybercom villages in different communities to make the facility more geographically accessible to farmers.

“In order to make the computers and internet widely accessible to farmers, we arranged with the village leaders to establish village cybercoms, provided they would spend some money as a counterpart.” (MAO, FITS manager, 12/12/2014, 10:00 AM)

Making the technology accessible in terms of geographical distance increased the prospect of farmers’ ICT use. Putting the intervention nearer to farmers further addressed the issue of additional cost and time to access the facility.

An additional observation from Wilyam’s response above is the effect of culture on their engagement with an intervention. Farmers were hindered when going to the FITS centre because of its location in the town centre. My observations indicated that farmers tended to shy away from using the facilities in the FITS centre because they were not dressed appropriately. The necessity to ‘dress up’ was due to the facility’s location in the town centre, where other municipal government offices are also located.

These findings suggest that implementation conditions were an essential consideration that led to sociomaterial entwinement. In implementing an intervention, specifically in the context of farmers in a developing country, implementers should consider flexibility of the technology, geographic proximity and the culture of its users.
5.3.2 Habitual practice

Habitual practice conditions in this study refer to farmers’ traditional practices. Habitual practices are those passed on from generation to generation, to these farmers from their parents. Depending on the embeddedness of the habitual practice of farmers, this condition tends to hinder sociomaterial entwinement, which can be associated with farmers’ resistance to change.

During the period of this study, I learned that an accepted practice of different farmers or farmer groups governs the likelihood of farmers’ entwinement with technology. In this study, I encountered four farmer groups:

1. *Inorganic rice producers* – farmers who produce rice for consumption using inorganic inputs.


3. *Seed producers* – farmers who produce hybrid seed rice using inorganic inputs and are mostly directed and controlled by multi-national companies.


Among these four groups, the inorganic rice producers and seed producers were those found to be less likely to adopt the interventions. I further discovered that inorganic farmers had tendencies to ‘hold on’ to their practices, especially those who had been using a practice for a long time. As one inorganic farmer pointed out:

“I learned to farm rice from my father and my father learned from his parents. Our family has been using this practice for a long time and this practice is providing us with sufficient income.” (Lisa, farmer, 26/11/2014, 1:30 PM)
From this conversation with Lisa, it can be noted that the farming practice she was using was deeply embedded in her family’s past. For her, the affordances of new technologies were not sufficient to change her practice, as she found it too ‘risky’. She added:

“It is very risky as you can see Sir, rice farming is our main source of income, and I have to pay the rent of our farm, regardless if we produce or not.” (Lisa, farmer, 26/11/2014, 1:30 PM)

Similarly, seed producers are found to be a group unlikely to adopt new technologies. For example, one seed producer stated:

“The cybercom is just in front of my house. I know my brother is using it, since he advocates organic farming, but I found no use for it, because all the information I need for producing hybrid seeds is being provided by the technicians from our buyers, and we need to follow their recommendations or they will not buy our seeds.” (Ruben, farmer, 12/11/2014, 4:18 PM)

Because of the nature of Rubens’ farming (hybrid seed production), Ruben’s practice was restricted by the demands of his buyers. Because of this restriction, Ruben and other farmers within his group were less likely to change their practice. Farmers within his group had become dependent on the agricultural technology imposed by their buyers. In this case, adoption of the intervention introduced by the FITS centre was hindered.

In summary, there are two specific aspects related to why farmers may choose not to adopt an intervention. First, due to the embeddedness of family practice, and second, the presence of restrictions within existing practices.

5.3.3 Political conditions

In this research, Political conditions refer to the power of a group of farmers. Power does not necessarily mean formal power, as in hierarchical position, but can also emerge
from the bottom up. That is, farmer groups may influence management decisions and
technology designs. In my study, I observed that this influence occurred when the number
of farmers promoting change became significant enough to be noticed by community
leaders. As the MAO shared:

“The decision to come-up with the mobile internet van was because of the
farmers’ demands to make the facility accessible to them, since they live far from
the municipal hall where the FITS centre is located.” (MAO, 12/12/2014, 4:25
PM)

Note that in this case, the farmers were in direct contact with decision makers in the
municipality, but were not directly involved in the decision-making process. The decision to
improve the implementation came about because of farmer demands for a more accessible
facility in terms of geographic distance.

The case of NMRice however, was a different story. The farmers did not have direct
communication with the designers of the application. However, it was observed that over
time, the farmers were able to influence the modification of the software because of their
changing practices. In this case, there was no formal demand for change in the software, but
as the users of the NMRice became fewer due to new farming practices, the municipal
leaders were able to observe these changes and pass on their concerns to the designers, who
in turn modified the technology. When I asked the MAO why this modification occurred, she
stated:

“Maybe they [people from IRRI] noticed the need, because the government is
promoting organic farming and mixed methods, and farmers are shifting
practices. We also told them about this issue during one of our meetings.”
(MAO, 12/12/2014, 4:25 PM)
In these scenarios, power started from the bottom rather than the top of the organization. Even without any formal clamour for change, flexible technologies such as NMRice could change because of the demands of its users. In this case, the farmers using NMRice perceived constraints (such as the inappropriateness of NMRice v.1.0 when farmers started to use mixed method farming) on the software that resulted in its modification and creation of new affordances. I will discuss this in detail section 5.4.

5.3.4 Facilitating conditions

Facilitating conditions refer to the social structures and technical infrastructures created to support the use of the intervention. Considering the demographic characteristics, such as lack of computer skills, low educational attainment, age and so on, this shows that facilitation was essential to increase the likelihood of intervention success. However, in order to create these facilitating conditions, leadership support should be established. As the MAO pointed out:

“The success of the FITS centre and the village cybercom is dependent on the leadership, that is, from the Mayor of the municipality down to the village leaders. The leaders need to support the project by providing funds to maintain the operation of the facilities, such as, payment of electricity bills, internet subscription, and salary of the staff that will help farmers operate the computers. The village leadership must also provide the space for the computers so farmers do not need to go to the municipal hall to conduct their research.” (MAO, Town A, 12/12/2014, 4:25 PM)

This need for structural support presented by the MAO of the municipality shows the municipal and village government support in the establishment of the village cybercom. She pointed out that support should not only come from the municipal leadership, but also from
the village leaders who are in direct contact with the farmers. The involvement of the village leaders was important for sustaining the implementation of the village cybercom project, for it allows the villagers to feel a sense of ownership of the facility, and not as a free project provided by the government. The MAO added:

“The municipality and the village share the FITS village cybercom project expenses. We let the village share some amount so they can feel ownership of the project. If they will not spend, they might not take care of the facilities and if damaged, they (leaders) will think, the municipality will just replace it anyway.” (MAO, 12/12/2014, 4:25 PM)

Another facilitating condition was the presence of a cybercom staff member in all village cybercom projects. As pointed out by the MAO, the staff roles were generally to assist farmers in using the computers and to conduct computer training for users. As one farmer said:

“It does not matter if you do not know how to use the computer or the internet, because there is a staff member in the village cybercom that will assist you. The village is paying for the salary of the staff and they even conduct training for those who are interested in learning.” (Trinidad, farmer, 10/12/2014, 3:06 PM)

In addition, I witnessed that facilitation was not limited to helping users with the computers or browsing the internet, but also included the understanding of information or content farmers learned from using ICT. As Pastor explained:

“The support should not stop after farmers acquire the information Sir. As you can see, most of the farmers here did not finish higher education or earn
a degree, so we need assistance when we implement what we learn from the internet.” (Pastor, Farmer, 28/11/2014, 3:36 PM)

When I asked other farmers as to what support they needed in using the information, they pointed out it was needed from government and non-government organizations:

“We need technicians, from the government or non-government sector to assist us, for example, either guiding us how to conduct experimentation or providing us advice when we implement what we learn and if we have problems. For example, for pests and diseases, we can immediately talk to someone.” (Jimmy, farmer, 12/10/2014, 3:07 PM)

I also noted that facilitating conditions are not only limited to leadership support, provision of staff and funding, but also in facilitating the organizing of farmers. When I talked to husband and wife, Freddie and Sally, Freddie explained:

“Organizing the farmers is also beneficial, because we meet them every day, we can always share experiences, in that way we can support each other in the absence of experts.” (Freddie, farmer, 3/11/2014, 4:53 PM)

In this case, Sally and Freddie pointed out that part of the support necessary for effective use of technology was to organize farmers into groups, as the farmers could easily relate to each other due to the similarities in their work.

5.3.5 Land Ownership

Another condition that affects intervention adoption is land ownership. By land ownership, I refer to land ownership of the land where the farmers are working and their role as recipients of the benefits of intervention use in the long run. In my study, 42% of the farmer participants rented their rice farms. These farmers have to pay landowners every
cropping season regardless if they produce or not, whatever crop. This condition caused farmers to become hesitant toward changing their practices or adopt new technologies. As one farmer said:

“...I do not own the land, adopting new technology like mixed or organic farming is too risky, if I fail, I will not to be able to pay the rent.” (Flor, farmer, 4/11/2014, 9:30AM)

In contrast, Boyet, who owned his rice farm stated:

“...using new agricultural technologies introduced by FITS can help me improve the fertility of my farm.” (Boyet, farmer, 27/11/2014 5:19 PM)

Comparing these two farmers, the landowner-Boyet was more willing to adopt a new technology than to Flor who rented her land. He thought of improving the soil of his land using new AT while Flor was more concerned with paying the rent.

In addition, Trinidad’s concern was related to the land being taken back from them if the soil was improved. She shared her frustration as to who will benefit from the use of the new AT in the long run:

“We will not be benefitting from using organic farming Sir, because if the farm will be producing well in the future, the owners might take it back and we will lose our livelihood, they will cultivate it themselves because it is producing well.” (Trinidad, farmer, 10/12/ 2014, 3:06 PM)

I noted that in Trinidad’s case and in the case of other farmers who were in similar circumstances (renting their farms) lack of land ownership could hinder change in farmer practices, thus lessening the likelihood of sociomaterial entwinement.
5.3.6 External affordances

Based on interviews and the observations conducted among both the farmers and leaders of the community in the FITS centres, I realized that some farmers adopted the intervention because of the incentives that went with it. These incentives were not inherent features of the ICT, or of the agricultural technology, but were aspects added to invite farmers to adopt the technology. I will refer to this aspect as external affordances and define it as intentionally enacted affordances, to invite possible users to make use of the intervention. In this context, these affordances may take the form of government subsidies or incentives. On the other hand, internal affordances are referred to as affordances inherent to the intervention (e.g., functionalities) and its design.

Based on my observation, external affordances were affordances put in place within the intervention to promote or increase acceptability of a product or intervention. For example, if farmers use a specific agricultural technology, the government would provide them with free fertilizers, pesticides, and free technical assistance within a given period. By doing so, farmers were enticed to use an intervention, incentivised by the benefits attached to it. The MAO explained:

“Some projects of the Department of Agriculture (DA) give subsidies to farmers when they adopt its use. For example, with the use of the mixed farming method, DA provides free inorganic and organic inputs to farmers, just to show them that the agricultural technology works and invite more farmers to use the AT.” (MAO, 12/12/2014, 4:25 PM)

Mixed farming rice farmers were found, as a group, more likely to adopt interventions. This acceptance of new technologies was not because of the inherent affordances of the
technology, but because of the subsidies that went with its adoption. As one mixed farmer pointed out:

“It is a waste if I will not take the opportunity Sir, because if I will use the intervention [mixed farming], the municipality will be giving us free inputs [fertilizers and pesticides] …” (Tess, farmer. 3/12/2014, 2:20 PM)

In addition, another mixed farmer said:

“What the FITS centre did was, if there were subsidies [fertilizers and seeds] given by the municipality to the farmers, then those who were not using the technology were not given a subsidy. Those farmers who were not abiding with the ordinance, for example, non-burning of rice stalks, were blacklisted and were not given incentives…” (Jimmy, farmer, 12/10/2014, 3:07 PM)

I observed that this case of sociomaterial entwinement could be considered temporary, as some farmers might have gone back to their old practices once the subsidies were lifted. As Jimmy added:

“... the problem with a subsidy is, it is not permanent, so what will happen if the subsidies were stopped? Either the farmers will continue using the technology or they will go back to what they used to do.” (Jimmy, farmer, 12/10/2014, 3:07 PM)

Further to this case, I asked Jimmy, what he thought could be reasons why, as a farmer, he might continue to use or cease using the intervention. He responded:

“It depends on the production and cost Sir. If the new technology will give a better production, as a user I will continue using it, if the production will be comparable to what I used to do, I will probably stop using it. Besides, I think
with the use of inorganic inputs, I think farmers are being taught to be lazy, 

... While with mixed or organic farming, you need to work a lot, so if a farmer is lazy, then he will likely stop using a new technology when the benefit [subsidy] is lifted.” (Jimmy, farmer, 12/10/2014, 3:07 PM)

From this and other similar conversations with farmers, external affordances could be seen to serve as a motivation for the sociomaterial entwinement.

5.3.7 Synthesis

In this study, I discovered six conditions that increased or decreased the likelihood of sociomaterial entwinement namely: implementing conditions, habitual practice, political conditions, facilitating conditions, land ownership, and external affordances. The possibility of sociomaterial entwinement depended on the flexibility of an intervention to adapt to the changing needs of the farmers. Habitual practices of farmers had a tendency to decrease the chance of sociomaterial entwinement especially if such practice was deeply embedded in farmers’ past habits and routines. In addition, when farmer groups were restricted to the farming protocols imposed by buyers, they tended not to accept interventions. On the contrary, there were also individual farmers and farmer groups who were open to change, especially those farmers who became advocates for the interventions.

Another condition that also defined sociomaterial entwinement was a political condition. Leadership was found to be essential in increasing the likelihood of sociomaterial entwinement. However, this study also found that political conditions may not necessarily emanate from the top of the organization, but may also emanate from the bottom. A farmers and farmer groups may influence technological change and implementation design when a sufficient number who clamour for change, come together. The Facilitating condition was found to be crucial to sociomaterial entwinement, because, depending on the skills and
capabilities of farmers, a certain degree of support was required to incentivise farmers to use the intervention. However, for this condition to be sustainable, the recipients of the intervention must share responsibilities so they are able to feel ownership.

The two significant findings discovered as conditions for sociomaterial entwinement in this study are; land ownership and perception of external affordances. Ownership of the land the farmers were tilling was identified as one of the conditions for sociomaterial entwinement. Farmers who were tenants perceived that the long-term benefits of using the intervention would not necessarily come to them and may invite owners to take back their land. In addition, farmers also perceived that changing practice posed a risk to their production that could lead to non-payment of their rent. External affordances, when perceived by farmers, usually led to sociomaterial entwinement. However, this was found to be temporary if the experience was not economically practical to sustain the change in practice.

These conditions need not occur simultaneously for the sociomaterial entwinement to take place. Sometimes even one condition was sufficient for a farmer to be entwined with the intervention, but the strength of sociomaterial entwinement between farmers and an intervention was dependent on the degree of sociomaterial embeddedness. This degree of sociomaterial embeddedness is referred to as the degree of sociomaterial entwinement which will be discussed in detail in the embodiment of sociomateriality in sensemaking (section 6.3.1) in the next chapter.

5.4 Emergence of new affordances and perceptions of constraints

In section 5.3.3 under political condition, I have shown how a critical mass of farmers could influence change in an intervention. In this subsection, I will consider the human-technology ecosystem, specifically regarding emergent practices of the farmers’ FITS centre.
community. I will also explore perceived technological constraints of NMRICE that were imposed by its users, leading to the modification or creation of constraints, new affordances and practices among farmers. Specifically, I look at this question, “How do perspectives of affordances and perceptions of constraints produce new practices and new technologies?”.

In the context of this research, the emergent behaviour or emergent practices of the farmers with reference to their interaction with the FITS services were not limited to ICT use, but included farmers’ use of AT. In exploring this, I will not look independently at the features of ICT, or of the abilities of farmers, but on the emergent practices and explore how they came to be.

In order to discuss these findings, I will provide an illustration of how the process of entwinement of social and material came about, using the NMRice web service as an example. I will show how such entwinement led towards the emergence of new practice, sustaining or changing routines or technologies. By illustrating this process, the creation of constraints, affordances and practices can be shown, and at the same time, the suitability of relational affordances in theorizing the sociomaterial entwinement.

Returning to the example of the NMRice web service, I have traced how changes in both farmers’ practices and NMRice evolved. The evolution of farmers’ practices occurred when they attempted to reconcile their goals with the materiality of NMRice, where they actively perceived affordances and constraints. Depending on whether they perceived that NMRice afforded or constrained their goals, they made choices as to how they would entwine with its material agencies (e.g., would the farmers accept all or only part of the recommendation). The different ways in which farmers and NMRice agencies were entwined resulted in distinct outputs — either a new routine or a modified web service.
To illustrate this, I will use the example of the NMRice software and how it influenced the changes in farmers’ practices and NMRice application. Figure 5.4 shows the entwinement of human and material agencies, which produced changes in farmers’ practice and the NMRice web service.

5.4.1 Entwinement 1: Human-Material (perception of constraints and emergence of new technology)

For generations, farmers had been using inorganic fertilizers in growing rice. This practice had been passed from parents to their children. These practices included the amount and type of fertilizers to use, timing of applications, and other farming practices which are referred to in this research as traditional practices. Since most of the farmers did not attend formal education, and these practices had been handed down from their elders, the rationale behind these practices is not explicitly known to the farmers. As one farmer had explained:

“My practice before was based on what my parents taught me, which my grandparents taught them, so it is a practice being passed from one to another. I did not question it before, because we were producing and earning, and production was relatively good. I only finished high school Sir, so I do not really know about the percentages of the nutrients in a fertilizer.” (Pedro, Farmer leader, 20/11/2014, 10:15 AM)

In 2010, with the goal of improving rice production in the Philippines, IRRI developed software that could compute fertilizer requirements needed by farmers given their specific farming context. Farmers are required to enter data into the software such as rice establishment method, rice maturity (age), average yield in previous cropping, crop residue management, and soil fertility, among others. This software was called Nutrient Manager for Rice (NMRice V1.0) as shown in Figure 5.5.
Figure 5.4 The process of entwinement of farmers and NMRice web service agencies. Model adapted from Leonardi (2011)
Farmer groups at this time were very happy with the software for they were able to accurately apply the exact amount of fertilizer depending on their projected yield. Furthermore, farmers also knew the exact timing for fertilizer application.

Figure 5.5 NMRice V1.0 screenshot (http://webapps.irri.org/nm/nmtutorial/nmtutorial.php) Retrieved on 04 February 2014

However, in 2011, after the Philippine presidential election, the focus of government policy towards agriculture had shifted from inorganic to organic farming. This shift of priority has constrained the farmers and the use of the software, because local governments had to align their programs with the new government’s directions for agriculture. Due to local government encouragement, farmers also had to shift their practice, thus the demand for NMRice v1.0 lessened.

Since such an abrupt change of practice (from inorganic to organic farming) did not materialize, in 2012 the government introduced a mixed farming method, a combination of organic and inorganic farming practices. For example, farmers could use inorganic fertilizer inputs (commercially produced synthetic fertilizers) and at the same time use organically produced fertilizer, such as animal dung or decomposing rice straw. The introduction of this program resulted in the demand for software that calculated fertilizer requirements given
these conditions. As a result, the developers of NMRice had to make adjustments, and revised NMRice v1.0 to meet the demands of the farmers, finally bringing about the introduction of NMRice v1.11.

What we can see in Figure 5.4 is the start of entwinement between farmers and the NMRice web service. When the farmers initially engaged with NMRice they entwined their existing human agency (appropriate fertilizer application) with the existing material agency of NMRice (calculation of inorganic fertilizer requirements and timing of application using inorganic inputs). As time passed, farmers’ goals changed, which in turn produced a perception of constraints of NMRice v1.0. This change in perception eventually led to a change in NMRice functionality, thereby giving it a new material agency, which consequently resulted in new entwinement (material-human).

5.4.2 Entwinement 2: Material-Human (change in routine and emergence of new human agency)

In NMRice version 1.2, as shown in Figure 5.6, additional information for farmers was required to enhance its functionality to compute both organic and inorganic requirements of rice grown in a given farming condition. This information included data on the previous crop planted in the rice field as well as waste management - requiring farmers to answer a question on how the rice stalks were disposed of (e.g., were the rice stalks burnt after threshing or where they allowed to decompose in the field?). This question allowed the software to compute the nutrient requirement of the rice field given specific conditions. In 2012, a new version of NMRice was launched adding features that allowed mixed method rice farmers to use the software.
Figure 5.6 NMRice v1.2 with additional features and questions to compute fertilizer requirements under mixed rice farming practice (http://webapps.irri.org/ph/rcm/Retrieved on 04 February 2014)

The introduction of NMRice v1.2 brought about new routines among farmers and community leaders. For example, towns passed laws that imposed fines on farmers who were burning rice stalks in the field. In addition, subsidies such as fertilizers (organic and inorganic) were given to rice farmers abiding by the laws, while violators were blacklisted, fined and disqualified from claiming subsidies. Farmers who abided by the law on the other hand were routinely provided with subsidies and other benefits. Other farmers had also changed their ways, as one farmer commented:

“The investment in using mixed methods is smaller than that of inorganic farming. Prices of fertilizer have gone up, it is very expensive. While if I use mixed methods, the investment is less because I can produce the organic fertilizers myself in my backyard, I do not have to buy it.” (Pastor, farmer, 28/2/2014, 3:36 PM)
It was also revealed that farmers had organized themselves into groups to support each other through their advocacy. For example, groups such as seed growers using inorganic inputs, mixed farming advocates and organic farming groups. The second and the final examples are new groups that evolved from the entwinement of farmers and the intervention. These groups came about when they interacted with FITS intervention, as one farmer described:

“First Sir, let me talk about sustainability. Sustainability for us farmers is based on how long the land can provide us with the rice we produce. Rice production cannot be sustainable if we farmers will keep on using inorganic inputs, because as we observed, producing rice is becoming expensive every year. We need more fertilizer because our land is becoming barren and pests are becoming immune, we fertilize and spray a lot, and it is affecting our health.” (Lito, farmer, 13/12/2015, 5:54 PM)

From this statement, I observed that a new social agency emerged due to a new understanding (i.e. understanding of sustainability and pest and disease immunity). This new understanding was a result of the change instigated by the sociomaterial assemblage in entwinement 1, which then eventually led to the emergence of constraints in the earlier version of NMRice, thus, necessitating changes in its features.

As a consequence of entwinement 1, the entwinement of new human agency with the new material agency (human - material) as shown in Figure 5.6 to some extent brought about changes to NMRice. Farmers in this period began to use the newly changed features (e.g., capability to calculate fertilizers requirements for mixed farming method) of NMRice which produced new practices (e.g., forming or joining farmer groups) in farming. Consequently, farmers began to form groups to support each other depending on their advocacy, thus
creating new human agency (e.g., organic farming), which in turn led to entwinement 3. That is, human-material.

5.4.3 Entwinement 3: Human-Material (new material agency and new practices)

In 2013, a new version of NMRice was launched under the name Rice Crop Manager for Rice (RCMRice). It included new features such as recommending the timing of fertilizing for farmers using organic farming.

RCMRice did however face some challenges, specifically regarding its usability among organic farmers; its limitation was that it could only recommend the amount of Nitrogen, Potassium and Phosphorous (NPK) that could be applied in a particular growth stage of the rice plant. It did not actually specify the amount of organic fertilizers in terms of kilograms or bags that could be applied at a given time. This is because organic fertilizers produced by farmers vary in nutrient content and have not undergone nutrient analysis due to associated costs. A couple of farmers reflected on this issue:

“The problem with RCMRice is it will give you an output using NPK requirements. Our [the farmers] problem is that each farmer produces his own organic fertilizer using different organic matter. For example, I am using rice straw, banana stems and leftover food, while other farmers are using chicken dung, goat dung or cow dung. Therefore, if you compare the NPK composition of these composts, it will be different from one farmer to another. RCMRice does not have the functionality, maybe it is too complicated. So it is up to us [farmers] how much we use, there is no danger anyway as it is organic, but the problem is if what we apply fall short of the recommendation, we can only know if the rice plants are not healthy.” (Wilyam and Wife, 15/12/2014, 3:36PM)
RCMRice in this case has given rise to both affordances and a constrain affordance by providing timing of fertilizer application and a constraint by not providing the exact quantity (in terms of kilograms and number of bags) of organic fertilizer that can be applied on a given rice field.

This, however, resulted in new farmer practices. In the absence of appropriate information, farmers performed experimentation in their fields to test fertilizer effects on the different rice varieties. As one farmer explained:

“We [farmers] always conduct trials at two stages, first is a verification trial, then, we try it again in small areas, and from the test, we choose what is best and we mass propagate the variety that we choose, using the amount of organic fertilizer we use during the trial.” (Lito, farmer, 13/12/2015, 5:54 PM)

The emergence of this new practice was never previously observed among traditional farmers. It has come about as result of the combination of all aspects of entwinement such as: farmers and AT (as a result of new information), farmers and ICT (as a result of the lack of information causing uncertain AT), farmers, GOs and NGOs. As another farmer commented:

“This is how we educate ourselves, most farmers here did not finish a bachelor’s degree, some of us are just elementary, or high school graduates, and you can count on your fingers the number of farmers who have a college level education. We educate ourselves, doing it in the field with the help of government technicians and NGOs with their expertise and their gadgets. We learn continuously by meeting every Tuesday of the week, sharing our experiences and showing to our fellow farmers what we have done in our rice
fields using new agricultural technologies.” (Pedro, farmer leader, 20/11/2014, 9:00 AM)

This entwinement between human and material as demonstrated in entwinement 3 in Figure 5.6 shows a similar pattern to interweaving in entwinement 1. However, since farmers were specialized in various practices (e.g., seed production, mixed farming, and organic farming), this entwinement (human-material) resulted in new practices, proving that recommendations of fertilizer requirements and their timing could actually work in the field.

5.4.4 Synthesis

This discussion demonstrates how farmers interacted and worked with flexible technologies and dynamic technologies such as NMRice. It has shown how farmers could change their beliefs and how interventions such as NMRice were designed to be flexible; to cope with the changing goals of the farmers, which consequently sustained sociomaterial entwinement.

As illustrated in Figure 5.6, when an existing human agency (e.g., farmer’s practice as a mixed farming advocate) is entwined with material agency (e.g., NMRice capability to calculate inorganic fertilizer input and timing of fertilization), then technology changes (human-material). Moreover, when new material agency (e.g., NMRice v1.2, capability to calculate fertilizer requirement for mixed farming method) is entwined with new human agency (verify applicability) people are likely to change their routines (e.g., performing experimentation- material-human).

I have found that an intervention, specifically NMRice, was a good example of flexible ICT technology, in the sense that designers were able to reconfigure its material features so that new tasks could be performed. When farmers work with flexible technologies, they were able to have a choice. That is, they could retain traditional approaches (i.e., no entwinement
taking place), change their practice (i.e., when they choose to entwine via intervention - entwinement 2) or propose changes to the technology (i.e., when there is a perception of constraints - entwinement 1 and 3).

As illustrated in Figure 5.6, practices could be considered as components of the intervention (e.g., organizing is a result of the capability of NMRice to calculate mixed farming practice) while, technology could also be components of the practices (e.g., NMRice changes because of its perceived constraints by farmers). These relationships have resulted in changes to NMRice at given times linked to previous practices, which in turn linked to practices that came after. In this continuous sequence of entwinement, farmers drew on the infrastructure created by past entwinement to construct perspectives of affordances and constraints (e.g., NMRice v1.2 was created because NMRice v1.1 could not compute for mixed farming practices). In this case, farmers could create a space for opportunities and frustrations, on which people were motivated to act. Because of this space, farmers were compelled to create new entwinements (entwinement 2 and 3) that continued to produce new routines and shape technologies. Thus, the entwinement between human and material was ongoing and interdependent.

Finally, this subsection has shown that using the dynamics of relational affordances we can examine sociomaterial entwinement. By tracing emergent practices of farmers and evolution of the interventions, it was possible to trace how sociomaterial entwinements occurred and how it shaped technologies towards sustainability.

5.5 Chapter Synthesis

This chapter explored the question posed by this study: “How do interventions and individuals entwine?” This was achieved by utilizing different farmers’ views of affordances of a given intervention (sub-question a). This occurred due to the recognition of the
conditions of sociomaterial entwinement (sub-question b), and by tracing how farmers’ interactions with the interventions resulted in changes to the interventions (i.e., affordances and materiality), farmers’ practices, and the perceptions of constraints (sub-question c).

This chapter revealed three ways farmers saw the affordances of the interventions, namely: (a) as a bundle of features, when farmers perceived intervention affordances based on inherent features (e.g., as tool to obtain information), (b) based on the intervention design, when farmers considered design features of the intervention that make it suitable for their needs (e.g., use of understandable language in its content), and (c) relational - when farmers perceived the intervention’s affordances not as their own but in relation to their goals (e.g., as tool to increase production).

Findings in this research indicate that these perspectives of affordance were built on each other. The connection of the affordances is illustrated in Figure 5.7. This implies that farmers should first perceive what an intervention can do (general features of the intervention), and once identifying these features, they may shift the focus of their perspectives to the design of the intervention, by looking at how it is designed in relation to their capacities (e.g., education, skills, and learning styles). They may also look beyond the inherent design of the intervention considering other factors such as timeliness of feedback, geographical proximity of the facility and the opportunity to communicate with other people. When an intervention design meets farmers’ expectations, this may lead to another shift in perspectives of affordance, that being, relational affordances. This perception is crucial as it determines if the farmer will decide whether to entwine with the intervention. Findings indicated that farmers considered a number of conditions, which, depending on their situation, could affect entwinement. These conditions were: implementing conditions,
habitual practice, political conditions, facilitating conditions, land ownership and the perception of external affordances. As discussed earlier, one condition could be sufficient for farmers to decide to entwine with an intervention, but this entwinement could be weak and unsustainable (e.g., in the case of subsidies and incentives).

Figure 5.7 An illustration of the affordances as perceived by farmers

This chapter further illustrated the ongoing process of sociomaterial entwinement of farmers and the interventions that led to the emergence of new routines, new technology, new affordances, and constraints. Findings have indicated how farmer interaction with interventions, specifically with NMRice, could stimulate the enactment of new routines (e.g., shift from existing farming practice to a new one), changes to interventions – new technology (e.g., modification of NMRice 1.1 to NMRice 1.2), new affordances (e.g., the move from only calculating inorganic fertilizer inputs to calculating mixed farming fertilizer requirements) and constraints (e.g., ability to calculate fertilizer requirements for organic inputs). The process of entwinement of farmers and the interventions previously shown indicate that changes in practices at any given time are associated with the technology that came before and conversely, changes in technology are linked to changes in practice that may have preceded.
Chapter 6. Farmers’ sensemaking processes

6.1 Introduction

This chapter is structured to answer the second research question of this study: “How do individuals make sense that leads towards the adoption of an intervention?”

To answer this question, I will specifically look at:

1. The levels of sensemaking processes farmers undertake which lead to adoption and non-adoption of an intervention.
2. How sociomateriality is embodied in the sensemaking process of farmers in relation to the adoption of an intervention.

In this chapter, I first present the non-adopter’s sensemaking process, and then, the adopters’ sensemaking processes that I explored. Following this, I present adopters who underwent minimal sensemaking processes, by identifying influences that led to this outcome. Lastly, I explore how sociomateriality is embodied in sensemaking, specifically the degree of sociomaterial entwinement as revealed in their sensemaking practices.

6.2 Farmers’ levels of sensemaking

Based on my observation of the farmer groups, I learned that farmers make sense of the intervention and make decisions about adoption and non-adoption through engaging in sensemaking processes at different levels of complexity, namely: minimal sensemaking that leads to non-adoption, reflective sensemaking, and minimal sensemaking that leads to reflective and quick adoption.
6.2.1 Non-adopter’s sensemaking processes

After the analysis of the data, one of the patterns that emerged in the farmers’ responses was the complexity levels of sensemaking they engaged in. One of these is the minimal sensemaking of non-adopters.

In summary, there are seven reasons that farmers articulated why they chose not to adopt the intervention, thus resulting in minimal sensemaking. These reasons were: (1) Imposed restrictions, (2) Comparable production, (3) Lack of accountability or agency, (4) Circumstances (e.g., age, education and skills), (5) Lack of time, (6) Habitual practice, and (7) Land ownership.

I will elaborate on each of these reasons below, based on the participants’ narratives. I observed that farmers who were involved in seed production and some farmers who were involved in inorganic farming, were less likely to engage in sensemaking and entwine with the intervention. As one seed farmer said:

“The village cybercom is located in front of my house, but I am not using the computers and internet there, because the information I need in seed production is provided to us by the company [referring to the multinational company] technicians. We need to follow everything or else they will not buy our products.” (Ruben, farmer, 12/03/2014, 4:18 PM)

During the interview with Ruben, I noticed that his perceived affordances of the use of ICT as a tool to acquire information did not contribute to his goal. That is, to produce hybrid rice seeds in agreement with the protocol provided by the multinational company, which buys his products. These restrictions did not give him the freedom to choose how he would grow his rice.
In a similar situation, one of the inorganic farmers mentioned that he chose not to use the new AT because he did not see any difference in his production when he compared those farmers using new AT and his current practices. Ver pointed out:

“My practice now provides me with sufficient income, their (referring to farmers using the intervention) production and mine is comparable, so why should I change?”. (Ver, farmer, 8/11/2014, 12:00 PM)

I noticed in the conversation with Ver, that he did not perceive any value in being entwined with the new technologies in relation to his income. In this conversation, Ver indicated that the production levels of farmers using new technologies was not sufficient to convince him to change his practice and so did not prompt him to ask in detail what the new AT was all about. For Ver, his production level, and that which he observed from other farmers, was sufficient for him not to make any further sense of the intervention. In his case, Ver did not place any value on the intervention based on his observations.

Another point raised by some farmers as to why they did not use the intervention was their lack of accountability and agency for taking action. During one of my conversations with the farmers, we talked about how some government and non-government organizations claimed rice being produced inorganically was poisonous, or it had unhealthy effects on humans, gradually poisoning consumers and the producers as well. However, one of the farmers argued:

“There is nothing we can do about that issue [referring to slowly poisoning consumers and themselves because of the use inorganic inputs] Sir. We have been practicing this for a long time. If the government believes in it, then they must pass a law to stop those businesses producing inorganic inputs.”

(Nonong, farmer, 22/11/2014, 10:00 AM)
We can note that in this argument, although Nonong did not directly mention it in his statement, he was making the government accountable for the health effects of their practice and not the farmers themselves. The perception of lacking agency, not accepting accountability, and putting the blame on another entity led Nonong to minimal sensemaking and engagement with the intervention.

Some other farmers also shared that they did not use computers or the internet to obtain new agricultural information because of their age and education. Trinidad mentioned:

“I am too old to use computers and the internet Sir. I think that is just for younger people.” (Trinidad, farmer, 10/12/2014, 3:06 PM)

Trinidad was referring not only to her age and education but also to her skills and interest in using a computer. By saying that using the computer is for younger people, she was referring to children whom she observed using computers from time to time, either playing games, working on their assignments or using social media.

In addition, Trinidad further added that the reason she did not think much about using the intervention was she did not have the time to learn.

“... I have to do some work to earn a living. At times I make some roofing made of Nipa (species of palm), I take care of my flowers so I can sell them, and I work as a beautician.” (Trinidad, farmer, 10/12/2014, 3:06 PM)

Other farmers were also found to undergo minimal sensemaking because they were not ready to give up the practices they learned from their elders. In Chapter 5, section 5.3.2, habitual condition was shown to hinder sensemaking, because existing farming beliefs are deeply embedded in the farmers’ farming practices.
The last reason for non-adopter farmers engaging in minimal sensemaking was a lack of land ownership, discussed in Chapter 5, section 5.3.5. As Flor elaborated in her response in Chapter 5, section 5.3.5 (Land ownership):

“... I do not own the land. I have to make sure that I will be able to pay the rent every cropping season. Landowners usually take 40 sacks. Therefore, I am scared to change my practice. Second, they told us that if we change our practice, soil fertility would improve, but what if the landowners will take it back. It will not be us who will be benefitting.” (Flor, farmer, 4/11/2014, 9:30AM)

In this conversation, Flor it was clear that, she was concerned about the long-term benefits of adopting the intervention for fear that when the farm improved its production, and having no tenure over the lease, landowners could take back the farm at any time. My analysis suggests that, the reason why Flor would be less likely to undergo complex sensemaking.

6.2.2 Reflective adopters

The next group of farmers that I noted in this study were the reflective sensemakers. I considered these sensemakers as gradual adopters of the intervention. While exploring how these farmers make sense, my analysis showed micro-processes in each of the sensemaking stages, that the farmers underwent. These micro processes are found in Table 6.1.
Table 6.1 *Micro processes in the stages of sensemaking*

<table>
<thead>
<tr>
<th>Stages of sensemaking</th>
<th>Micro Processes</th>
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<td>Selection</td>
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<td>Cultural Change</td>
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<td>Retention</td>
<td>Verification</td>
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<td></td>
<td>Creation of learning spaces</td>
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In this subsection, I will describe these three stages of sensemaking and micro-processes contained in each stage by illustrating them with quotes from the narratives of the participants.

6.2.2.1 Enactment

Enactment\(^{12}\) in this study, could be defined as a stage where farmers encountered the intervention and reconsidered their existing farming practices in relation to new agricultural technology learned by embracing ICT. This involved a process of retrospection. That is, farmers examine and compare their existing practices with newly introduced practice. At this point, I noticed that farmers were *seeking out information* or *exploring*. This shows that exploration could only be limited by what a farmer wanted to know and varied from one farmer to another. As one farmer explained:

“Before I really did not know that there was such thing as beneficial insects, for they are all the same, so when I sprayed chemicals they all died and I did...”

\(^{12}\)Enactment is the application or change in the practices of individuals to better understand the likely use of technologies and its consequences in a certain condition (Orlikowski, 1992)
not care. But with Palay check, you can identify harmful and beneficial insects, so you do not have to spend too much.” (Pastor, farmer, 28/11/2014, 3:36 PM)

While another farmer shared:

“Before I adopted organic farming, I needed to know what varieties would be suited to my farm given the climatic conditions we have here Sir. You know Sir, we cannot just use any variety if we will be adopting organic farming, because some of the varieties now are designed for inorganic farming, for example hybrid rice.” (Pedro, farmer leader, 20/11/2014, 10:15 AM)

I further noted in conversations with other farmers that exploration was not limited to what Pastor and Pedro mentioned. Other farmers mentioned comparing mechanized against non-mechanized farming, comparing profit, expenditures, and production levels and even decisions on whether or not to become a member of an organization. I observed that farmers underwent this micro process to develop a sense of security (in most cases financial) in what they practiced as being financially viable.

I further witnessed that as farmers underwent the enactment stage, they became active in joining groups and being involved with group or village activities, specifically those activities that involved use of the interventions. As Nita conveyed:

“I have joined a farmer group using the FITS intervention, because it is scary if we will not observe farmers who are doing the same. ...They trialled the information they got and then implemented it in their farms.” (Nita, farmer, 14/11/2014, 1:00 PM)

In addition, Jimmy shared about the benefits of being a member of the organization:
“Advocacy like this (organic farming) will not work if farmers do not organize. … things become easier, because you can ask other farmers if you have some problems. For example, if you forgot about how to open the computer, you can ask someone, or you forgot the name of a website, or share the website you are using…” (Jimmy, farmer, 12/10/2014, 3:07 PM)

The analysis suggests that, in these and other conversations, being involved in a group allowed farmers to verify their practices and confirm their beliefs. Individual farmers were able to solicit ideas, share views, practices, and identify inconsistencies as they compared their practices with those of other farmers. Although farmers may have had different goals, sensemaking activity in such situations became collective, as they used the group to help them decide about the plausibility of the new agricultural technology.

6.2.2.2 Selection

The second stage of sensemaking that farmers underwent is the selection stage. In the farmers’ sensemaking practices, this could be described as a stage where farmers or farmer groups ‘sort-out’ various visualizations of realities they perceived during the enactment stage. Within this stage, two sensemaking micro processes were revealed, namely: emergence of new practice and change in culture.

Aiming to affirm the credibility the information that they learnt during enactment, farmers at this stage underwent a process of change in practice. This change in practice was either gradual or abrupt, depending on the farmers’ situations. Farmers who were less confident underwent a process of gradual change. That is, they overlay an existing farming practice with the new technology. This means that they did not totally abandon their old practice, but gradually made changes that led towards a new practice. For example, instead
of changing from inorganic to organic practice, farmers first used mixed method farming before adopting organic farming. As Sally concurs with Freddie when he pointed out:

“It is very difficult if we will just accept the new technology. ...if we do not have sufficient information yet. ...we decided to gradually change our practice by adopting the mixed method first. Then, depending on the production and cost, we may eventually change our practice.” (Freddie, farmers, 10/10/2014, 3:00 PM)

In addition, Pedro presented an analogy to changing practice:

“...it is like eating something you are not used to eating. You may have stomach problems because you are not used to consuming it. Farming is like that; you cannot just adopt anything because it [agricultural technology] might not be suitable for your land and weather conditions.” (Pedro, farmer leader, 20/11/2014 10:15 AM)

After the initial enactment, other farmers abandoned previous inorganic practices and totally replaced them with new practices. These farmers were those who had confidence in the organization that supported them, and the technicians who were helping them. For example, Pastor, who had great confidence in the technicians, explained:

“I just adopted the technology. I do not think they [technicians] would be telling us something that was not true. If they let us use the internet, what we could see there [information from the internet] must be true.” (Pastor, Farmer, 28/11/2014, 3:36 PM)

In some instances, these farmers simply saw immediate benefits and wanted to reduce their expenses. As Lito said:
“It is at this point that I realized that even if we do not spray chemicals, our crops are still healthy. I also found that I was spending Php 27,000 [$700 AUD] per hectare per cropping, but, when I compared it with my new practice using the new agricultural technology I learnt it was just Php 12,000 [$300 AUD]. (Lito, farmer, 13/12/2014, 5:54 PM)

I also found that the farmers not only changed practices in the selection process, but also changed their culture. By culture, I am referring to a belief that farming is a *livelihood*. That is, rice farming as a means of securing necessities such as food, clothing, shelter, and education for their children. I noticed that in most cases, farmers who changed their practices (abandoned their current practice), are also starting to employ basic bookkeeping activities. Figure 6.1 shows a sample of a farmer’s books of accounts.

![Farmers’ bookkeeping records](image)
As Lito said:

“Before, we farmed because it was our means of livelihood. …. but when we changed from inorganic to organic farming, we treated farming as a business.” (Lito, farmer, 13/12/2015, 5:54 PM)

This change from seeing farming as a livelihood to seeing farming as a business was an outcome of Lito’s sensemaking process. He looked beyond his culturally reinforced understanding of farming as a way to secure his family’s basic necessities. By engaging in sensemaking, he realized that farming was not only a livelihood, but also a business undertaking that required a more rigorous, informed and careful accounting approach.

6.2.2.3 Retention

The third stage of farmers’ sensemaking processes was the retention stage. The Retention stage was characterized by the adoption of methods that were proven successful, or practices that were reused when similar incidents occurred. This was further characterized as the product of both the enactment and selection stages, where the shared meanings in previous stages fit into the prevailing beliefs and interpretations of the individual farmer or farmer groups.

One of the micro processes within this stage was the conducting of small experiments. I identified that farmers conducted small experiments to assure themselves that what they would be practicing would help them reach the desired level of rice production. In addition, they also wanted to improve their practice, As Pedro explained:

“I did many trials… We cannot just depend on one, because we learned from the internet, that it is not a good practice to plant the same variety all the time... this is also what the NGO told us during our weekly meetings.”

(Pedro, farmer leader, 20/11/2014 10:15 AM)
I further found that small experiments were not only conducted once, but were conducted on a regular basis. As Lito pointed out:

“We [farmers] always conduct trials in two stages. First is a verification trial, then, we try it again in small areas, and from that test, we choose what is best and we mass propagate the variety that we choose, using the amount of organic fertilizer we used during the trial.” (Lito, farmer, 13/12/2015, 5:54 PM)

In the case of farmers like Lito, and other farmers performing similar experimentations, these farmers were found to be verifying the information they obtained from their initial experimentation. In doing this, they could determine the plausibility of the early results, thus assuring themselves that the technology worked. Farmers were not leaping to judgements on the new agricultural technology used based on inconclusive evidence. Instead, the farmers delayed the judgement of the interventions and engaged in extensive information searches and generated multiple interpretations of known evidence. In other words, these farmers did not put closure on their sensemaking process; instead, they postponed the judgement until they possessed as much information as possible by performing re-trials.

Another micro process within the retention stage is the creation of learning space. I noticed that this process emerged because of the initiative of the informal group network of farmers (section 5.2.2.1), government and non-government organizations. As farmers became comfortable with their practice, they became curious about what their fellow farmers were doing. From my observations, farmers were making use of their communities of practice
to create spaces so they could learn from each other (See section 5.4.3, p. 162). As Jimmy explained:

“We also created a University without Walls Sir (laughing), under the Mango tree, where farmers can come and share their experiences or listen to technicians.” (Jimmy, farmer, 12/10/2014, 3:07 PM)

I noted that in these two situations, due to their desire to learn, they informally created a space (e.g., University without Walls) to substitute a formal learning space such the village cybercom or the FITS centre. Farmers created the space for convenience and to make the learning atmosphere less formal.

Not only did farmers create informal spaces like the University without Walls or a regular meeting space as mentioned by Pedro, but they also nominated a farm that would serve as a demonstration farm for farmers who wanted to adopt the new agricultural technology. As Lilia shared:

“In each of the towns, there is a nominated farmer scientist, and they use their farm to display new agricultural technologies to other farmers. By doing this we are providing space for farmers to learn, meet, and share their experiences.” (Lilia, farmer scientist, 18/2/2014, 9:00 AM)

6.2.3 Quick adopters

This group of farmers is characterized by being intervention adopters after minimal sensemaking. Data in this research showed three influences why some farmer adopters underwent a minimal sensemaking processes. These factors are: (a) Sensemaking was restricted, (b) Sensemaking was guided, and (c) Sensemaking was driven by a cultural trait ‘gaya-gaya’ (imitating what others are doing) as described by Hawkins (2010).
In this subsection, first, I will introduce restricted sensemaking and present some farmer narratives. Second, I will describe guided sensemaking and present findings showing how it affected farmers’ sensemaking, and lastly, I will explain the sensemaking driven by the ‘gaya-gaya’ attitude of farmers and discuss why it caused minimal sensemaking.

6.2.3.1 Restricted sensemaking

During my four months of immersion with the farmers, I realized that some farmers who were entwined with the intervention did not undergo a complex sensemaking process. One of the important contributors to restricted sensemaking was the presence of external affordances of the intervention (see section 5.3.6, Chapter 5). External affordances impeded the sensemaking process of farmers because they were more interested in the benefits or rewards attached to intervention adoption.

6.2.3.2 Guided Sensemaking

Farmers also engaged in minimal sensemaking when the sensemaking activity was being guided. Guided sensemaking occurred when facilitators or mediators guided farmers on how things were to be done. For example, regarding farmers’ use of ICT in the two FITS centres, I observed highly mediated activity. Two technicians were assigned to each village cybercom to help farmers use the computers to learn agricultural technologies. Because of this, farmers did not have many concerns as to how they used the computer or internet, but more about the information they gathered. As one ICT staff said:

“There are two of us who are employed by the village to look after the cybercom and the farmers Sir. Our main duty is to assist farmers whenever they want to use the computer or internet or even help them search answers for their questions. By doing this, farmers will not worry anymore if they...
know or do not know how to use the computer because we are here to assist them.” (Matet, Cybercom Staff, 1/11/2014, 4:13 PM)

In terms of agricultural technology, analysis showed a similar situation. Village agricultural technicians were fielded by the municipal agriculture office to guide farmers on the new agricultural practices. As a result, farmers became dependent on the technicians’ instructions and conducted less sensemaking by themselves. As one farmer shared:

“It is not difficult to use the FITS initiated technologies Sir, because there are technicians who can help us. For example, during Palay check, there is always one technician assigned to the community on a given day to guide us and follow up on what we were doing. Then, at the village cybercom, there is staff that could help us in using the computer.” (Joseph, Farmer, 15/11/2014, 3:30 PM)

In my conversation with Joseph and other similar farmers who underwent minimal sensemaking, the common reason identified was that the intervention was a government program. I also found that government programs were usually controlled and highly managed by local technicians who were driving the adoption process. Lisa said:

“The FITS centre introduced the intervention to us, and they [technicians] are assisting us in implementing the intervention, because the government is promoting it. I believe it must be for our own good.” (Lisa, farmer, 26/11/2014/, 1:30 PM)

6.2.3.3 Gaya-gaya Culture

Lastly, one cultural trait specific Filipinos known as ‘gaya-gaya’ contributed to minimal sensemaking. Gaya-gaya is a trait characterized as imitating what other farmers are doing without thinking why they are doing so. Gaya-gaya was found to lessen sensemaking as
farmers simply imitated and went with the trend. Some farmers also imitated what other farmers were doing because they wanted to avail themselves of the benefits of high market prices and government subsidies, thus, minimizing their sensemaking process. As one farmer shared:

“Some farmers are just imitating because, their neighbours are doing it, and they realized that market price is high if you are producing organic rice.”

(Nita, Farmer, former village leader, 14/11/2014, 1:00 PM)

Another farmer added:

“It is difficult if I do not adopt the technology Sir, because I would be the only one who would not be getting the government subsidies while the rest of the farmers are getting it…. I do it by observing what my neighbours are doing. If they fertilize, I also do it, if they spray, I also spray, so the insects will not transfer to my farm (laughing).” (Jesus, farmer, 10/11/2014, 2:00 PM)

6.3 Embodiment of sociomateriality of sensemaking

Using the conversations, observations and other data in this research, I explored how sociomateriality could possibly be embodied in sensemaking by reading and reading the accounts of the participants regarding their engagement with the FITS interventions. To do this, I focused my attention on four selected farmers and examined the embodiment of sociomateriality during their sensemaking process.

During the exploration, the embodiment of sociomaterial entwinement could be identified by considering the looseness and tightness of the sociomaterial entwinement. I will refer to this in this study as the degree of embeddedness of sociomaterial entwinement. From here, I constructed a continuum containing the degree of embeddedness of
sociomaterial entwinement, which I labelled as: *entwined sociomaterial, mediated entwined sociomaterial, loosely entwined sociomaterial, and untwined sociomaterial.*

This exploration allowed me to answer the sub-question of this study, “*How is sociomateriality embodied in the sensemaking processes of farmers in relation to technology adoption?*”

6.3.1 Degree of sociomaterial entwinement

Using the data from this study, I developed descriptions of the degree of embeddedness by utilizing the characteristics of each degree, as shown in my observations and conversations with the farmers in their sensemaking process. From the analysis of the data, I was able to develop the following descriptions below:

1. *Entwined sociomaterial* – referring to entwinement in relation to the depth of understanding of the peculiarities of rice farming (e.g., farming - weather, planting seasons, fertilization, etc.) and ICT use (e.g., opening the computer, browsing the internet, using google search, etc.)

2. *Mediated entwined sociomaterial* – referring to entwinement with AT or ICT, that is mediated by other people (e.g., use and development of organic concoctions mediated by technicians or peers, use of NMRice software assisted by agricultural technicians).

3. *Loosely entwined sociomaterial* – entwinement wherein only some aspects of ICT use and agricultural technology are understood (i.e., farmers only know bits of information related to the intervention). This also includes entwinements due to the intervention’s external affordances. (e.g., government subsidies)

4. *Untwined sociomaterial* – refers to non-adopton or non-use of intervention.
Using these degrees, I recognized that farmers could be placed along a continuum that reflected the degree of their sociomaterial entwinement using their sensemaking practices. This is presented in detail in the succeeding sub-section.

6.3.2 Farmers’ practices and their degree of sociomaterial entwinement

As mentioned earlier in section 6.3.1, four farmers were chosen to represent the degree of sociomaterial embeddedness identified in this study. I purposely selected these farmers to illustrate a clear distinction between the different degrees of farmers’ sociomaterial entwinement.

The first farmer that I followed was Jimmy. Jimmy was considered to belong in the entwined sociomaterial continuum. He became tightly connected with the intervention specifically, with his advocacy (organic farming) and use of ICT to obtain information related to it. He regularly changed some specific practices depending on his observations in the rice fields and on his levels of production. Jimmy regularly conducted experiments to keep himself aware of the characteristics of other organic rice varieties in different seasons. Jimmy explained to me:

“I need to know their [rice variety] characteristics, because, if my production fails this season, I will have an option to choose from a selection in the next season, based on the rice variety characteristics.” (Jimmy, farmer, 12/10/2014, 3:07 PM)

I consider Jimmy as a reflective farmer, for he constantly reviewed his previous actions based on its outcomes. I noticed this, because he kept many concoctions in storage. He explained:

“I keep different types of concoction Sir, for example, Fermented fruit juice, snail concoction and vermi tea so I will have choices. If for example one will
“be less effective, then I can use another one.” (Jimmy, farmer, 12/10/2014, 3:07 PM)

Lito on the other hand, is a farmer who did not have extensive knowledge of the interventions, but advocated their use. He said:

“We just ask once and then we write it down on paper. So we just look at it when is the appropriate time to plant it [variety].” (Lito, farmer, 13/12/2014, 5:54 PM)

Lito is an example of a farmer whose entwinement with intervention is what I referred to as *mediated entwined sociomaterial*. He is a skilled farmer, but to compensate for his limited knowledge, he required mediation from experts (agricultural technicians and ICT staff) to guide him in performing the practices. At the selection stage in sensemaking, Lito was cautious about employing the interventions or changes in practice, so instead of abandoning his traditional practice immediately, he overlayed his traditional practice with a new practice. He pointed out:

“No, I did not change my practice immediately. It is a slow process Sir. I used a small area first, and even used the mixed method before I adopted organic farming.” (Lito, farmer, 13/12/2014, 5:54 PM)

Litos’ behaviour was understandable, because farming was his means of livelihood and his only source of income for his family.

Lisa was an example of a farmer who belonged to the *loosely entwined sociomaterial*. Lisa generally had good farming skills, but decided to be entwined with the intervention because of external affordances (e.g., subsidies). In the future, Lisa may become closer to *untwined sociomaterial* if she finds no value or benefits from her experience with the
intervention. On the other hand, her degree of entwinement could be strengthened and if she sees benefits in her entwinement.

However, at that point in time, Lisa did not perceive relational affordances of the intervention, and was more interested in the external benefits she received because of adopting the intervention.

“It is a government program Sir, so it must be good! In addition, they are giving out free fertilizers if a farmer adopts the intervention.” (Lisa, farmer, 26/11/2014, 1:30 PM)

Lisa was in fact entwined with the technology, because she observed that some of her neighbours using the new AT.

“I just go with the flow Sir (laughing). I noticed that some of my neighbours were using the mixed method, so I also used it.” (Lisa, farmer, 26/11/2014, 1:30 PM)

In the selection stage of the sensemaking process, I observed that Lisa attended the seminars and video conferences with experts not because of her willingness to learn, but as compliance to the requirements, in order to receive the benefits attached to adoption. She further confessed that at that moment, she had stopped attending training on new AT or ICT, but simply visited her neighbour to observe what they were doing.

Lastly, Ruben was an example of what I called the *untwined sociomaterial* farmer. He did not consider the use of ICT because he did not want to. He did not adopt the use of new AT, because he was producing rice seeds following restrictive protocols. Ruben’s goals were just not aligned with the FITS program, so he did not become entwined in anyway with the use of ICT, nor the use of the new AT introduced by the FITS centre. Reiterating Ruben’s statement in section 6.2.1 above, he said:
“The village cybercom is located in front of my house, but I am not using the computers and internet there, because the information I need in seed production is provided to us by the company (referring to the multinational company) technicians. We need to follow everything or else they will not buy our products.” (Ruben, farmer, 12/03/2014, 4:18 PM)

Table 6.2 presents a summary of the degree of sociomaterial entwinement of the four farmers in relation to their sensemaking practices.
<table>
<thead>
<tr>
<th>Farmer / Degree of sociomaterial entwinement</th>
<th>Farmer's Practices in Sensemaking Stages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jimmy – Entwined sociomaterial</td>
<td></td>
</tr>
<tr>
<td><strong>Practice:</strong></td>
<td><strong>Practice:</strong></td>
</tr>
<tr>
<td>AT: Actively identifies feasible rice varieties using specific rice farming conditions.</td>
<td>AT: Regularly making changes in practice depending on observations and production in the field.</td>
</tr>
<tr>
<td>ICT: Uses Google and other websites not only Pinoy RKB website.</td>
<td>ICT: Performs routine sensemaking of information acquired from the internet.</td>
</tr>
<tr>
<td>Sample quote: “My decision on what variety to plant is dependent on the season, soil type and productivity”</td>
<td>Sample quote: “I found it not advisable to use the same variety from time to time, because I noticed immunity diminishes.”</td>
</tr>
<tr>
<td>Lito – Mediated entwined sociomaterial</td>
<td></td>
</tr>
<tr>
<td><strong>Practice:</strong></td>
<td><strong>Practice:</strong></td>
</tr>
<tr>
<td>AT: Talks to technicians and fellow farmers regarding what possible rice variety to plant.</td>
<td>AT:Feels uncertainty of changes in practice.</td>
</tr>
<tr>
<td>ICT: Requires ICT staff to use computer and internet.</td>
<td>ICT:Lacks trust of the information acquired from the internet.</td>
</tr>
<tr>
<td>Sample quote: “I follow the technicians’ recommendations and what my fellow farmers are doing.”</td>
<td>Sample quote: “To make immediate changes to my practice is very risky, as you can see, my livelihood depended on farming, I need to change slowly.”</td>
</tr>
<tr>
<td>Lisa – Loose entwined sociomaterial</td>
<td></td>
</tr>
<tr>
<td><strong>Practice:</strong></td>
<td><strong>Practice:</strong></td>
</tr>
<tr>
<td>AT: Does not compare old and new practices.</td>
<td>AT:Imitates what other farmers are doing.</td>
</tr>
<tr>
<td>ICT: Unsure if he will be using ICT.</td>
<td>ICT:Uses ICT when required (e.g., attends video conferencing because it is required to receive subsidies).</td>
</tr>
<tr>
<td>Sample quote: “I follow what other farmers in my group are doing, if they use brown rice, I usually do the same.”</td>
<td>Sample quote: “Lately, I have not attended any training on new AT Sir…”</td>
</tr>
<tr>
<td>Ruben – Untwined Sociomaterial</td>
<td></td>
</tr>
<tr>
<td><strong>Practice:</strong></td>
<td><strong>Practice:</strong></td>
</tr>
<tr>
<td>AT: Use what is habitually practiced.</td>
<td>AT:No observed change in practice.</td>
</tr>
<tr>
<td>ICT: Does not use ICT.</td>
<td>ICT:Does not use ICT.</td>
</tr>
<tr>
<td>Sample quote: “I have a very strict production protocol to follow, if we do not follow this protocol our products will be rejected in the market.”</td>
<td>Sample quote: Not applicable.</td>
</tr>
</tbody>
</table>
6.4 Chapter Synthesis

This chapter revealed three levels of farmers’ sensemaking, namely: non-adopter sensemaking, reflective sensemaking and quick adopter sensemaking. Farmers who were non-adopters were found to undergo minimal sensemaking for various reasons: imposed restrictions, comparable production and lack of accountability or agency, farmers’ circumstances, lack of time, habitual practice, and lack of land ownership.

Reflective adopters on the other hand are sensemakers who underwent complex sensemaking processes and were characterized in going through the following stages of sensemaking: enactment, selection and retention. During the enactment stage, farmers were observed to seek out information and explore, comparing their traditional practices with the new ones. The selection process, characterized by the emergence of new practices and culture, follows this stage. Noteworthy in this stage was the overlaying of old practices or in some cases, abandonment. Farmers’ culture also changed in this stage, where their perception of farming as a livelihood shifted to farming as a business. The result of the enactment and selection stage was the retention stage, characterized by practices such as experimentation and creation of learning spaces. The former was to test the plausibility of tentative ideas about the interventions while the latter was to overcome limitations of accessibility, for example, due to shyness.

The third level of sensemaking was quick sensemaking. Farmers who belonged at this level were intervention adopters who underwent minimal sensemaking. Mediators guided the adopters at this level, facilitating adoption. In addition, farmers who were quick sensemakers were motivated by the external affordances of the interventions. Some farmers
in this level were also found to simply imitate (gaya-gaya) what other farmers were doing, thus limiting sensemaking processes.

Data analysis revealed that sociomateriality could be embodied in sensemaking. This was done by describing the embeddedness or degree of the sociomaterial entwinement of the farmers and the intervention. Four degrees of sociomaterial entwinement were found in study, namely: (a) entwined sociomaterial - referring to the depth of farmers’ understanding of the intervention and the practices, (b) mediated entwined sociomaterial – referring to the embeddedness that was mediated, (c) loosely entwined sociomaterial - referring to entwinement associated with little understanding of the intervention and as result of external affordances, and (d) untwined sociomaterial - referring to non-adoption or non-use of the intervention.

The degree of sociomaterial entwinement not only showed how sociomateriality was embedded in sensemaking but also helped determine the strength of the bond between farmers and the intervention which may have influenced the sustainability of this relationship.
Chapter 7 Farmers’ learning processes

7.1 Introduction

This chapter is structured to answer the third research question of this study, “How do individuals learn in their interaction with technology and how does their learning shape the emergence of new practices?”. To answer this question, I will specifically address the following:

1. Explore the stages in the farmers’ learning processes.
2. Identify micro learning processes of farmers using assumptions from a sociomaterial perspective.

First, I will present the stages of the farmers’ learning. Second, I will discuss specific learning stages, starting with the *figuring* stage, by identifying micro learning processes undertaken by the farmers. Third, I will describe the stage of *configuring*, and identify the micro learning processes during this stage of learning. Finally, I will discuss how farmers *reconfigure* their learning, resulting from figuring and configuring, and prompting the emergence of new practices and understanding.

This chapter extends the previous chapter on sensemaking, by integrating learning into the sensemaking process. While in the previous chapter I explored sensemaking processes that led towards intervention adoption, the focus of the discussion in this chapter is on the farmers’ learning processes, specifically on how they reflected on the plausibility of their understanding of the interventions and how the interventions worked. In addition, this chapter will focus on the processes involved in the farmers’ critical examination of the interventions, by identifying the micro learning processes, which emerged. Further, this
chapter explores the implications of the farmers’ learning processes that led to change in farming practices and new technologies (e.g., ICT and AT).

7.2 Stages of farmers’ learning processes

7.2.1 Figuring

*Figuring* in this research refers to the pre-entanglement stage of the sociomaterial environment. The figuring stage is an instance of the codes where farmers underwent mental and verbal micro learning processes without involving material objects. At this stage, farmers were not manipulating artefacts, but were generally reflecting through construction of mental representations of ideas through verbal interaction. Data showed that the micro learning processes these farmers underwent were: *linking interventions with the new ideas*, *observing*, and *comparing*.

7.2.1.1 Linking interventions

In this initial stage of learning, linking interventions refers to linking abstract ideas with material cues. I noticed that in this initial stage, when farmers were presented with an intervention, they were struggling with the abstract promises of the intervention in relation to their experiences. As Jimmy explained:

“…I was hesitant at first, because I thought it was difficult. If you think about it in relation to rice farming, how can you have a good yield if you do not apply fertilizers? Even if we apply fertilizers, there are times that yields are not good. How much more if you just use compost? At first, I thought it was a crazy idea.” (Jimmy, farmer, 12/10/2014, 3:07 PM)

From this conversation, it can be observed that when the interventions for organic farming were introduced to Jimmy, he was hesitant and reflected on the new organic
technology in relation to his experiences in farming, and especially rice yields. Through this process, Jimmy was linking an abstract idea [organic farming] to concrete material cues (yield) while he was reflecting on the plausibility of the agricultural technology.

Similarly, Lito commented on the use of vermicast\textsuperscript{13}:

“If you are going to examine vermicast, it is just a soil. How can you tell that there are elements present in that soil like that of inorganic or commercial fertilizers like Nitrogen, Phosphorus, and Potassium [NPK]? .... I did not understand it.” (Lito, farmer, 13/12/2015, 5:54 PM)

Lito was linking vermicast (material cue) with the fertilizer elements (abstract ideas), because at that point he did not have an understanding of how these abstract ideas - such as NPK - could be present in decomposing soil.

In another interview, Boyet pointed out that observing a demonstration farm using organic farming was helpful, because he was able to observe the effects of the inputs, such as fertilizers and pesticides, on the rice plants. He commented:

“The demonstration farm using organic inputs was useful in helping me decide to use organic farming...” (Boyet, farmer 27/11/2014 5:19 PM)

From this conversation with Boyet, I noted that he referred to the demonstration farm and organic input (material cues) and linked the abstract idea of soil fertility to help him reflect on the plausibility of the intervention.

\textsuperscript{13}Vermicast - an organic/natural fertilizer created by using compost and earthworms.
7.2.1.2 Verbal Referencing

Another learning process that I observed occurring during the figuring stage was verbal referencing. Data showed that farmers used verbal references when learning how to use the technology. Verbal references allow the farmers to reflect on their tentative ideas without physically seeing or manipulating the object or idea. Farmers were found to verbally reference ideas by talking to other farmers and creating mental images of the ideas. This happened when Jimmy was telling Boyet about bad fumes when encountered that experience. When I asked Boyet about his conversation with Jimmy, he said:

“At first, I thought it was like a mist or smelly air that comes out of the rice field. But Jimmy told me it was not like that, but it is an abnormality in soil colour, that occurs when the soil becomes acidic.” (Boyet, farmer 27/11/2014 5:19 PM)

From this conversation, Boyet showed a tentative understanding of what bad fumes were. Boyet visualized bad fumes based on what he understood when he talked to Jimmy making an imaginary picture of ‘smelly air’ or ‘mist’ to represent his understanding of bad fumes. Without physically seeing bad fumes, Boyet was still able to understand the concept by talking to Jimmy, who had. Although this does not absolutely affirm that Boyet understood what bad fumes were, at that point he could describe and explain bad fumes, based on Jimmy’s description.

Another example of verbal referencing that emerged in my conversation with Lito concerned the effects of his fermented fruit juice (FRJ) concoctions – aimed at repelling insects. Lito said:

“At first, I thought fermented fruit juice concoctions killed insects. However, when I spoke to other farmers, they told me that, when they sprayed their rice
fields with FRJ, their rice plants were not infested by stem borer insects but their neighbours’ rice plants were. So, I thought, if FRJ kills insects, then at least the neighbouring farm would just have a minimal infestation, because insects must have been killed when FRJ was sprayed. But in this situation, insects were not killed, but simply moved from FRJ sprayed farm to another which was not sprayed.” (Lito, farmer, 13/12/2015, 5:54 PM)

Although Lito statements were inconclusive, the way he made reflections on his original understanding of FRJ was based on verbal reference. Even if he had not visited the farms, he created a mental image representing the event and made his understanding of how FRJ works based on this imagery of the non-infested farm.

7.2.1.3 Comparing and ‘sorting out’

From new information that came out of the conversations during the verbal referencing process, another learning process was observed to emerge. Farmers compared differences and similarities in rice yields, which led to comparing and sorting. Comparing in this study refers to identifying similarities and differences in the intervention, while sorting out is the process of separating ideas of a similar nature.

When I probed the responses of the farmers on how they came to decide whether the intervention was plausible, one farmer replied:

“… I had to weigh the advantages and disadvantages Sir. First, I had to consider if production would be good, the market price of the product, the cost of production, labour requirement and many more.” (Lito, farmer, 13/12/2015, 5:54 PM)

In this conversation, Lito was enumerating a set of aspects that he took into account in comparing his old farming practices and the new. In this case, he was sorting out outcomes
of accepting the intervention that he viewed to be beneficial, which made him reflect on whether he would adopt the interventions.

Similarly, Jimmy employed the same process of comparing and sorting out whether the intervention was worthwhile, by considering the cost and production in using the new agricultural technology. He said:

“It depends on the production and cost Sir, if the new intervention would give better production, as a user I would continue using it. If the production would be comparable to what I used to do, I would probably refrain from using it…” (Jimmy, farmer, 12/10/2014, 3:07 PM)

In addition, Boyet described how he decided when presented with the new AT, by comparing costs of chemical inputs and long-run effects of chemical use. He stated:

“Comparing organic to inorganic farming...chemicals and inorganic fertilizer are becoming very expensive and our soil is becoming acidic. Maybe in the future we will need more fertilizers and insects will become immune to chemicals, some of the farmers are even resorting to using Furadan 3G (a type of systemic pesticide that is absorbed by the plant), that is poisonous to humans because it stays with the plant for a long time.” (Boyet, farmer, 27/11/2014 5:19 PM)

In summary, during the figuring stage, farmers generally reflected on the potential of the interventions. They learned by linking abstract ideas with material cues and their experiences. In addition, farmers reflected by verbal referencing through conversation with other farmers to clarify tentative ideas, specifically those that they had not seen. In addition, farmers were also found to compare and sort-out ideas about the intervention with their previous experiences. This allowed them to make decisions by reflecting on the outcomes
such as production and cost in using the intervention. In performing these micro learning processes, farmers were able to reflect on the interventions, which ultimately led them to choose whether they would entwine with the interventions or continue with their traditional practices.

Table 7.1 shows a summary of the micro processes undertaken by farmers in the figuring stage, with some sample quotes.
<table>
<thead>
<tr>
<th>Learning stage</th>
<th>Micro-processes</th>
<th>Sample Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Figuring</strong></td>
<td><strong>Linking</strong></td>
<td><strong>Visual Referencing</strong></td>
</tr>
<tr>
<td></td>
<td>Vermi cast (material cue) is just soil. How can you tell that there are elements (abstract idea) present in that soil similar to that of inorganic or commercial fertilizers like Nitrogen, Phosphorus, and Potassium (NPK).</td>
<td>Fermented fruit juice kills insects (tentative idea) ... a farmer told me that when they sprayed their rice fields with FRJ, their rice plants where not infested by stemborer insects but their neighbours’ rice plants were infested (referencing)...</td>
</tr>
<tr>
<td></td>
<td>The difference between inorganic and organic (abstract idea) farming is the type of rice variety (material cue) ... and the fertilization (material cue)... and pest control (material cue) ...</td>
<td>At first, I thought it was like a mist or smelly air that comes out of the rice field (tentative idea), But Jimmy told me it was not like that, but it is a soil property that occurs when the soil becomes acidic (referencing).</td>
</tr>
<tr>
<td></td>
<td>Boyet, farmer 27/11/2014 5:19 PM</td>
<td></td>
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<tr>
<td></td>
<td><strong>Comparing and ‘sorting out’</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>... I have to consider if production will be good, the market price of the product, the cost of production, labour requirement and many more.</td>
<td>It depends on the production and cost Sir, if the new technology will give a better production, as user I will continue using it, if the production will be comparable to what I used to do, I will probably stop using it...</td>
</tr>
<tr>
<td></td>
<td>Boyet, farmer 27/11/2014 5:19 PM</td>
<td>Comparing organic between inorganic farming...chemicals and inorganic fertilizer are becoming very expensive and our soil is becoming acidic. Maybe in the future we will need more fertilizers and insects will become immune to chemicals, some of the farmers are even resorting to use Furadan 3G^{14}</td>
</tr>
</tbody>
</table>

^{14} Furadan 3G is a type of inorganic systemic granular insecticide and nematicide that has long term effects.
7.2.2 Configuring

As the farmers initially gained new understandings in the figuring stage, learning gradually moved to more complex learning processes. The configuring stage was characteristically where farmers refined their understanding of an event or issue, individually or in groups. It involves learning micro process such as: experimentation, incorporation of material objects, and storytelling.

7.2.2.1 Experimentation

Experimentation was one of the observed micro learning processes that farmers underwent as they learned about the new technology. Performing experimentation tested the plausibility that the agricultural technology would work in a given situation. For example, I observed that farmers were testing different varieties of rice in small areas, to determine which variety was best suited for their farm during a given season. Throughout the experimentation, farmers gathered data, such as yield, pest infestation, growth and other varietal characteristics and compared the results with their traditional practices\(^{15}\). During one of the informal talks with a farmer, I asked why he was experimenting and he replied:

“I do not have the experience in doing organic farming Sir. I cannot just depend on what the technicians told us [farmers]. We need to experience it ourselves, even just in small spaces, to observe if it [organic farming] is feasible.” (Lito, farmer, 13/12/2015, 5:54 PM)

Lito was testing the feasibility of the new agricultural technology by using this approach, observing and gathering sufficient information. Lito wanted to engage with AT and

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\(^{15}\) Traditional practices refer to the practices before the new technology was introduced. These include: choice of variety, planting distance, and production practices.
learn about it, not only by talking to technicians, but also by engaging in experimentation, gaining authentic experience and first hand evidence.

Boyet similarly explained:

“...before I decided to use the organic method, I conducted small experiments to test what variety I should use in my farm… I tested many varieties using 1 tablespoon of seed per variety as a trial…this is a season long experiment as I also observe pest infestation and productivity...” (Boyet, farmer, 27/11/2014, 5:19 PM)

Boyet explained that he did not jump into using the AT immediately. Like Lito, he conducted small experiments and explained that he was doing it as a season long practice to observe other production variables, such as pest infestation and productivity.

Furthermore, I noticed that even if individual farmers conducted experimentation, the analysis of the data was often done collectively. Of the four cases that I followed, most farmers shared their observations with the members of their community of practice during their weekly meetings. In this way, they could compare observations, raise issues, and relate their practices. Jimmy explained why he was sharing the information:

“...the most important thing in sharing the progress of our experiments with other farmers in the group is that I can get suggestions from other farmers who are also doing experiments. In addition, there are problems that may not be present in my situation but are happening in other areas.” (Jimmy, farmer, 12/10/2014, 3:07 PM)
The incorporation of sociomaterial artefacts in learning refers to the use of material objects to mediate the learning process. For example, use of ICT to reflect on new agricultural technology as a result of observations or experimentations. On the AT side, it could be the use of agricultural tools or inputs (e.g., fertilizers or concoctions) to demonstrate the effects of the practice.

As farmers were carrying out their small experiments, I noticed that new sociomaterial objects were emerging and being used. For example, during one of my visits to Jimmy’s farm, he was using a grass cutter/snipper to cut stalks in the rice field. This is not a usual practice conducted by farmers, because normal practice involves leaving standing rice stalks to be ploughed in, and to decompose in the field. The use of a grass snipper is also unusual because the common practice among farmers is to use a bolo (a bladed hand tool).

When I asked Jimmy why he was doing this, he answered:

“\textit{I was actually motivated to do this Sir, because of my concern with bad fumes. I discovered through the internet that bad fumes could only be reduced by deep ploughing the land. Now, if there are stalks standing there, the plough or even the mechanized rotary tiller cannot achieve the appropriate depth required to expose the bad fumes. So, I decided to cut the remaining rice stalks using the grass snipper, because it is the fastest way to do it.}” (Jimmy, farmer, 12/10/2014, 3:07 PM)
In this case, by incorporating the use of ICT to learn how to eliminate bad fumes, Jimmy was able to reflect on what agricultural equipment and practice would be appropriate to minimize the presence of bad fumes in his field. The outcome of this learning process (incorporating use of ICT) was the use of the grass snipper.

On another occasion, during one of the group meetings I attended, I noticed that one farmer (Boyet) brought an organic concoction with him to show to the group. On another occasion, I observed a farmer using a quadrat in his field, to identify and count beneficial and harmful insects. When I asked Boyet why he brought a concoction to the meeting, he replied:

“So that other farmers can physically see what I have done, smell it, and compare it with the concoctions they made, if they have made some. It is similar to showing them a demonstration farm Sir, so they [farmers] can observe the effects of these concoctions that we made. That is why we conduct meetings every week, so we can observe the farm regularly at the same time.
Boyet also explained that:

“...sometimes the agricultural technicians or NGO representative brings their laptop and projector to show us examples of farm disease practices. While we [farmers] also bring some sample materials like infected plants and our sample concoctions, so that they can suggest if there is something lacking...a small portion of my farm also serves as a demonstration farm to other farmers.” (Boyet, farmer, 27/11/2014, 5:19 PM)

From these conversations with Boyet, I noticed that sociomaterial artefacts being brought into the picture during the farmers’ meetings are objects which serve as concrete examples of ideas to help them organize their thoughts. For example, by observing the farm, farmers were able to see the effects (ideas) of using the concoctions or vermicast (sociomaterial) as shown in plant growth and by using ICT (sociomaterial). Farmers were able to reflect on how to control bad fumes (ideas) in the soil, which resulted in the use of the grass snipper (outcome) in practice.

7.2.2.3 Storytelling

Storytelling (Dujmović, 2006; Eck, 2006; Koki, 1998) is a learning process where farmers convey their experiences during the adoption of the intervention to each other where they reflect on their experiences to improve their practice. I observed that storytelling between or among farmers did not only happen during formal gatherings such as meetings or during seminars and training, but also in their free time.
In this section, I will illustrate this way of learning, using the specific example of a story I traced during my fieldwork. This is the story of Juan, and how other farmers reacted to how he treated snails (considered a pest, because they feed on rice leaves) after he realized their other uses. Juan shared his story with me during one of our conversations.

The funny thing when I started changing my practice was that some people thought I went crazy. It started when I stopped using pesticide to control the snails. Before, when I was not yet an advocate of organic farming, I sprayed pesticide to kill the snails in the rice field. I did this before planting and days after planting the rice seedlings. However, when I started practicing organic farming, I found on the internet that organic farmers were using snails as an ingredient in their organic fertilizers. I also learned that fermented snails contain microelements needed by plants such as calcium, magnesium, and traces of zinc. From there, I stopped killing the snails and I told my neighbours (advocates and non-advocates of organic farming), that we should not hate the snails anymore, but love them, as they were useful. Some farmers, especially those who are practicing inorganic farming thought I went crazy, because instead of killing the snails, I would pick them up at certain periods in the cropping season but leave them alone and allow them to reproduce during the cropping period where they could not feed on the rice plants anymore as the plants had become sturdy. The snails I picked were fermented and processed into foliar organic fertilizers and as components for my insect repellents. (Juan, farmer, 23/10/2014, 3:00 PM)

I substantiated Juan’s story and how it affected the farmers with one of the farmer leaders, specifically of those who advocated organic farming. The group leader stated:

“We do not always discuss problems in some of our meetings. There are times that we only share our experiences and stories. Sometimes the stories are funny, like the story of Nong Juan [a farmer], where his neighbours called him stupid, because before he was using mulloscicides\textsuperscript{16} to control snails and

\textsuperscript{16}Mulloscicides are pesticides used against molluscs, usually used in agriculture to control snails.
now he is picking them up and told his neighbours that he loves the snails.

He told us that he told his neighbours, instead of killing them [snails], he
would use them [snails] as fertilizer. They laughed at him, because to some of
the farmers, using snails to make fertilizers was new to them. Later, however,
they realized that snails were useful.” (Nita, farmer leader, 14/11/2014, 1:00
PM)

In conversing with Nita, I realized that storytelling made farmers retrospective in
relation to their practices and beliefs. I further probed the effects of Juan’s story, by talking
to Boyet:

“You know Sir, sometimes, stories can make you think. When I heard, Juan
tell me about his story, I went to the cybercom and asked Matet [ICT staff],
to help me search about concoctions made from snails. I investigated what
elements we could get if we would ferment it just like fruit juices. I found that
it could produce many trace elements, for example, magnesium, calcium and
many more, I cannot remember anymore. Now, I ferment snails and use it as
foliar fertilizer.” (Boyet, farmer, 27/11/2014, 5:19 PM)

The effect of Juan’s story as manifested in Boyet’s practice was, he was able to
develop his own concoction using snails. He was enticed to reassess his understanding about
snails by going to the village cybercom and researching snail concoctions. In addition, Juan’s
story brought about the emergence of a new practice for Boyet.

In summary, during the configuration stage, I observed three micro learning processes
that farmers underwent. Farmers were found to engage in experimentation to reflect on the
plausibility of the interventions in their context. They also integrated sociomaterial objects
to mediate their learning so that abstract ideas could be represented. Farmers were also found to engage storytelling to reflect, think retrospectively, and reassess their initial ideas.

Table 7.2 shows the summary and representative quotes for the learning micro processes in the configuring stage.

Table 7.2 Representative quotes in the configuring stage and micro-processes

<table>
<thead>
<tr>
<th>Learning stage</th>
<th>Micro-processes</th>
<th>Representative Quotes</th>
<th>Key words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuring</td>
<td>Experimentation</td>
<td>...before I decided to use organic methods, I conducted small experiments to test what variety I should use in my farm... I tested many varieties using 1 tablespoon of seed per variety as a trial...this is a season long experiment as I also observe pest infestation and productivity... (Boyet, farmer, 27/11/2014, 5:19 PM)</td>
<td>Activity: Small experiments</td>
</tr>
<tr>
<td></td>
<td>Integration of sociomaterial artefacts</td>
<td>...sometimes the agricultural technicians or NGO representative brings their laptop and projector to show us examples of farm disease, practices. While we (farmers) also bring some sample materials like infected plants and our sample concoctions...a small portion of my farm also serves as a demonstration farm to other farmers. (Boyet, farmer, 27/11/2014, 5:19 PM)</td>
<td>Sociomaterial artefacts: Laptops, projectors, infected plants, concoctions, farm</td>
</tr>
<tr>
<td></td>
<td>Story telling</td>
<td>You know sir, sometimes, stories can make you think, when I heard Juan told me about his story, I went to the cybercom and asked Matet (ICT staff) to help me search about concoctions made from snails. I investigated what elements could we get if we will ferment them just like fruit juices. I found that it could produce many trace elements, for example, magnesium, calcium and many more, I cannot remember anymore. Now, I ferment snails and use it as foliar fertilizer. (Boyet, farmer, 27/11/2014, 5:19 PM)</td>
<td>Instinctive story: Snails are pest Plausible Story: Can be used as fertilizers</td>
</tr>
</tbody>
</table>

7.2.3 Reconfiguring

Reconfiguring in this research was found to be an outcome of the figuring and configuring stages. Reconfiguring was the stage where farmers were able to create new knowledge, ideas, beliefs, and practices as a result of the first two stages of learning. Unlike the retention stage in the farmer’s sensemaking process (see section 6.2.2.3), the focus of
this section is not on sustaining the intervention (e.g., testing for plausibility or creation of new learning spaces), but specifically on how new knowledge, ideas and practices were created when farmers reflected on their ideas and practices. Reconfiguring in this stage was also focused on reinforcing current interpretations of the events.

Like the figuring stage, I noticed that farmers engaged in exploration. However, at this time, they focused on trying to learn new ideas or practices; while during the retention stage of sensemaking practices, they focused on verifying the plausibility of the intervention. For example, according to one farmer whom I followed:

“For example, there are cropping periods when our production is low, so we ask ourselves “what happened?” Or sometimes, we noticed that our rice plants are showing effects of zinc deficiency. ... I reflect on this and do research, so I can improve or else my family will not have something to eat.” (Juan, farmer, 23/10/2014, 3:00 PM)

From this conversation with Juan, his information about the AT was not sufficient to achieve his production goals. Thus, he was being constrained by the limitations of the information, thus making him take another step to address these limitations.

Similarly, in one conversation with another farmer, I asked what he was doing at that time, since he had been using organic farming for an extended period. He replied:

“At the moment Sir, I am working on a new formulation of concoction using banana sap instead of using water during the fermentation process. The procedure is...My purpose in doing this Sir, is to increase the microelements in my concoctions and at the same time increase the NPK elements. I assume that banana sap already contains processed NPK as the banana plant had already processed and the absorbed nutrients during the photosynthesis, so
all I need to do is to collect it and use it to ferment other compostable material.” (Pastor, farmer, 28/11/2014, 3:36 PM)

The response of Pastor illustrated that learning at this stage involved not only simple modification of material artefacts, but also extensive exploration of the sociomaterial artefact (concoction) that constrained him in some way from achieving his goals. It can be noted that he reflected on the assumption that banana sap contained readily available NPK elements that plants would absorb as they were already processed. This made him use it for fermentation as a replacement for water.

In these situations, both farmers were shifting from being controlled by technology to controlling the agricultural technology. As Wilyam said:

“The difficulty with simply following the procedures and protocol as suggested by the technology is that these procedures and protocols maybe done in other places where conditions are not like ours, which is why in some cases it fails, because we have varied conditions. So, if I make my own concoctions, I am sure that I am basing it on the conditions of my farm. In this case, I am more confident that the concoction will work.” (Wilyam, farmer, 15/12/2014. 3:35 PM)

Farmers at this stage demonstrated shaping the materiality of the agricultural technology in relation to their needs. For these farmers, reshaping the materiality of the intervention was easy, as it was within their control and was flexible enough for the changes to be made.

At this stage, observations of farmers’ learning processes were: (a) farmers noticed imperfections in objects they are using in their practice, (b) after noticing, they identified
causes for these imperfections, (c) they then took action to resolve the imperfections by creating a new sociomaterial object, practice, or idea.

In summary, the reconfiguration stage in farmers’ learning can be characterized as a progressive exploration stage. It involved micro learning processes, similar to the figuring process and experimentation in the configuring process, but the focus was on new sociomaterial objects, ideas, and practices. These new sociomaterial objects, ideas and practices were usually the result of farmers reflecting on the ideas and attempting to control the interventions. Farmers overcame imperfections in the interventions by augmenting the interventions and creating new ideas and practices that best suited their context.

7.3 Chapter Synthesis

This chapter presented three stages of learning, namely: figuring, configuring and reconfiguring. In the figuring stage, farmers could be found reflecting on the material cues with abstract ideas to confirm tentative understandings of the interventions. This stage did not involve material objects in the learning process but involved linking abstract ideas with material objects, verbal referencing and comparing and sorting out. During the configuring stage, farmers were found to engage in experimentation in the learning process. Their experimentation was done to obtain authentic experiences and ideas that they could use in their context. In addition, they also incorporated sociomaterial artefacts in their learning - serving as mediators in the learning process - and they used storytelling to convey ideas, resulting in new practices for some farmers. In the reconfiguring stage, farmers were engaged in radical exploration. Learning activities were not limited to existing practices or ideas, but were more focused on the creation of new ideas and practices as a result of learning in the figuring and configuring stages. These stages were also characterized as a period where farmers tried to take control of the intervention to suit their goals and contexts.
In relation to the research question: “How do individuals learn in their interaction with technology and how does their learning shape the emergence of new practices?”, this chapter identifies three stages of farmer learning. I was able to discover the various micro processes involved in their learning through their interaction with the intervention and how these micro processes deepen their understanding, change their practices, and shape the emergence of new objects. Generally, farmers learn by a continuous process of figuring, configuring and reconfiguring of their ideas, understandings and manipulating sociomaterial objects in their environment which they refine to suit their context.
Chapter 8. Discussion

8.1 Introduction

This chapter discusses the findings previously presented, specifically addressing the three research questions. It is divided into three sections, one for each research question. First, I will present farmer perspectives of affordance in relation to the literature. Second, I will discuss the farmer sensemaking processes and their implications on the adoption of an intervention. Finally, I will present farmer learning processes and their implications in relation to the literature.  

8.2 Farmers’ perspectives of affordance

One of the purposes of this study was to examine how the intervention and farmers entwine. This was done by exploring their perspectives of the interventions’ affordances. Through an ethnographic case study and using affordance as lens to explore sociomaterial entwinement, this study found three different perspectives of affordances that built on each other. This study revealed that as farmers entwined with the interventions, affordances shifted from individual to group, and in turn led to the emergence of new affordances, constraints and new interventions.

When farmers were first presented with an intervention, they perceived affordances of the intervention based on its features (Chapter 5, Figure 5.7). These features were inherent properties of the intervention, identified by its users as opportunities for action (Michaels, 2002).

17 In relation to WPL, DOI and TEL as mentioned in section 3.1, this study does not aim to explore the role of technology solely as a tool, nor aims to explore the social process of adoption in isolation from technology. Rather it adopts the lens of sociomateriality that allows us to look at practices as the social and technical assemblage. Unlike the DOI approach that has pro innovation bias, TEL where material objects are often considered as a tool, and WPL that has a characteristic social bias, the adopted perspective focuses on the entwinement of the social and the material. Thus, in this discussion, I explore the process of adoption in the context of learning where, where I consider the process of learning as a complex assemblage of humans and technology.
These features were farmers’ first impressions of the interventions, based on their prior knowledge. These perspectives differed from one farmer to another, depending on the context of their agricultural production. Michaels (2000) and Warren (1984) viewed these affordance perspectives as relative properties of the environment, thus, they would perceive affordances of an intervention differently. Furthermore, these perspective on affordances were found by Turvey (1992) to be a property of an object that manifests itself under specific circumstances and as an object in the world, defined by the functionality it provides (Arthur, 2009).

Based on the findings, first impressions on the affordances of the interventions are crucial. This study first revealed that farmers must be able to recognize an intervention, as this could lead to perceiving the affordances of the intervention. If farmers were unable to perceive affordances of the intervention, they would not choose to adopt that intervention. In contrast, if the farmers did recognise the affordances of the intervention, then they would show indications of entwinement with the intervention.

This study further indicated that for the affordances of the intervention to be recognized by the farmers, the implementers conducted seminars, symposiums and information drives in different villages. Through these activities, farmers were able to recognize the interventions. Gibson (2000) claimed that to perceive the interventions is to perceive what they afford.

This initial perspective however was found not to be sufficient cause for farmers to adopt an intervention. Findings in this study indicated that after they recognized the features of the intervention, they started to examine the intervention in terms of their context, which led to another perspective on affordances in its design.
Design affordance refers to the action possibilities that are readily perceivable by an actor (Norman, 2007). This study revealed two general design considerations that were found to affect farmers’ decisions to entwine or not to entwine with technology. First was the intrinsic design of the intervention. For example, in the use of ICT, farmers looked for ease of use in relation to accessibility (language used), feedback (timeliness and appropriateness), and context (resources fitting their learning styles). These perspectives of design affordance were found to be important, because these could facilitate adoption of an intervention. If farmers perceived complexity for example, in the language used in the intervention, they would be inclined to move away from an intervention. According to Thompson and Higgins (1991), this refers to the observed difficulty in understanding and use of an intervention. Moore and Bensabat (1991), suggested that technology design must allow users to believe that using a particular intervention would be free of physical and mental effort to facilitate its adoption.

Feedback was also found in this study to be essential in the design of the interventions. Findings showed that timeliness of feedback is essential because of the nature of their livelihood. According to Gibbs (2010) feedback should be timely, while it still matters to the person receiving assistance. Receiving immediate feedback allowed farmers to act on their problems immediately, which could save their plants from infestation, and in turn could lead them to have confidence in the interventions. In this study, timeliness of feedback was achieved both intrinsically, for example through video conferencing where farmers could immediately receive feedback from experts (See 5.2.2.1) and in the NMRice software, where calculation of fertilizer requirements are immediately revealed. Extrinsic to the intervention, farmers received feedback from their peers; specifically, from those farmers using similar farming practices or within their communities of practice. As discussed in section 5.2.2.1, the
emergence of communities of practice was part of the implementing design of the FITS interventions. These communities of practice served as a support network for farmers, where they could share experiences, practices and problems in farming.

In addition, Norman (2007) further suggested that the intrinsic design of technology serves as a direct communication between the designer and the user. This implies that when a farmer interacts with a designed object, they perceive affordances that imply or invite a certain way of interacting with the object. This intrinsic design affordance is demonstrated in Figure 5.2, where the technical design of the website incorporated five different languages, thus presenting content dependant on language preference to address different farmer learning styles. In addition, farmers in this study considered contextualization as an intervention’s intrinsic affordance that allowed them to use a medium that fit their circumstances. Circumstances as pointed out in section 5.2.2.1 include skills, education, and the learning preferences of the farmers. This design affordance existed in the RKB website (See Figure 5.1). In the domain of human-computer interaction, Gaver (1991) stated that affordances are a powerful approach to thinking about technology, as the effectiveness of an affordance depends on the attributes of both the artefact and the user. Affordance therefore is an instrument for focusing on links in design among the user, the actions, and the artefacts (Gaver, 1991) and the affordance role is both for ease of learning and ease of use (Hartson, 2003).

The second design considered by farmers in the interventions was the extrinsic design. Extrinsic design affordance included implementing designs such as geographic proximity, design of learning space and opportunities to interact with communities of practice. Geographic proximity as used in this research refers to both the physical proximity of the farmers to the FITS centre that hosts the interventions (computers and internet) and the
social proximity of farmers to each other. Findings show distance affects farmers’
perspectives of intervention affordance as it involves time and transport costs. It is well
known that physical proximity plays a role in the transmission of information and influence
(Breschi & Lissoni, 2001; Doring & Schnellenbach, 2006; Gaba & Meyer, 2008) as it facilitates
interaction between the humans and technology. The physical proximity of the ICT facility
allowed farmers to allocate their ‘precious’ time and use the resources without sacrificing
time allocated to work in the field. In addition, it allowed use of the facility without incurring
additional transportation costs.

Farmers also perceived social proximity as affecting their decision to entwine with the
intervention. According to Breschi and Lissoni (2001) nearness between users allows greater
frequency of interaction which encourages collaboration. Latané, Liu, Nowak, Bonevento, &
Zheng (1995) asserted that time spent interacting, recollecting, and attempting to persuade
others all declines with distance. This implies the degree to which farmers influenced each
other decreased as the distance separating their homes increased. From this study, the
information network of farmers came through friends that were near, thus proximity among
farmers and the interventions allowed interaction and exchange of ideas easily and at less
cost. I observed that due to the near proximity of the farmers, they could easily support each
other and in some instances, due to their regular interaction, farmer adopters did not find it
difficult to convince others to follow their practices.

Another implementation design consideration is the design of the learning space. This
refers to the physical location of the facility within the village, which impeded the use of the
interventions. Because of the ICT location in village centres, some farmers often felt ashamed
to use the facility as they did not want to bother others due to their presence or activities
(See section 5.2.2.1). This behaviour is due to a Filipino cultural trait ‘hiya’, which Guthrie
(1968 as cited in Herrington, 2015) defines as a feeling of inferiority, embarrassment, shyness, and alienation. As observed in this study, this feeling of inferiority relates to how one appears in the eyes of others. Thus, if the facility’s location was found to be near the offices of the village officials, some farmers would choose not to avail themselves of the services.

Based on the findings of this study, learning spaces should be designed enabling farmers to develop a sense of attachment, not only with technological features, but also with the farmers’ culture. For example, this research observed that some farmers identified themselves as students of the “University without Walls” which they organized to help them overcome the social barrier identified in the village cybercom mentioned above. This informal learning activity was usually conducted among farmers and technicians under the shade of a tree, free from noise and eyes of other villagers. The creation of the University without Walls led to personalisation of the learning space to farmers’ needs and contexts, creating feelings of connectedness to the space. This allowed them to discuss farming practices, use computer software, and research agricultural information via the internet without fear of embarrassment.

The third perspective on affordances that I observed in this study was relational affordance. Relational affordance is a result of the relationship between actors and technology (Gibson, 2000; Good, 2007; Stavros Valenti, 1991). Unlike the first two perspectives, farmers considered relational affordance as opportunities for actions, for example, when a farmer considered the intervention as means for sustainability. In this example, “means for sustainability” (See section 5.2.3) refers to opportunities of the farmer for action because of his entwinement with the intervention. The affordances of the intervention, as seen by the farmer in this case, were not the features of technology (e.g., tool for learning agricultural information) nor of the environment (e.g., design of learning or
inherent technological design) but emergent properties of the farmer-intervention environment that identified “what else could be done”. This finding is consistent with the finding of Stoffregen (2003), who claimed that affordances are opportunities for action rather than properties of the environment. This implies that interventions could offer different possibilities for action based on farmers’ abilities, age, and training.

In addition, farmers were also found to perceive affordances in relation to their goals, for example, getting a higher market price or minimizing the cost of rice production (See section 5.2.3). Note that in these examples, farmers perceived affordances independent of ICT, but in relation to their goals. In this study, these perspectives of affordance were only observed among farmers who adopted the intervention. Based on my observations, they identified affordance based on their goals. This is consistent with Norman’s (2007) claims, that the concept of affordance is dependent not only on the capabilities of an actor, but also the actor’s goals and plans.

In relation to the sub-question of the first research question, “how do farmers perceive intervention affordance before and during adoption?” This study showed that perspectives of affordance built on each other. It showed that, perspectives of affordance could differ from farmer to farmer depending on their engagement with the interventions. In this study, engagement between the farmers and interventions was essential, because if the farmers failed to notice the interventions, then they would not be able to perceive what it may afford. Once noticed, farmers were found to initially have a perspective on affordances in terms of its technological features. They then mapped these features in relation to their circumstances. During mapping, this study discovered that farmers shifted their perspectives to the design of the intervention. Their perspectives on design included intrinsic and extrinsic, which is essential for farmers to continue to entwine with the interventions. As farmers
continued to entwine with the interventions, a relational affordance perspective emerged. This perspective was found among farmers who adopted the intervention and viewed affordance as opportunities for action to achieve their goals and plans.

8.2.1 Conditions for sociomaterial entwinement

In this study, I explored not only how farmers entwine with the intervention, but also conditions entwinement. These conditions are important to understand the reasons why farmers chose to entwine with the interventions. According to Leonardi (2011), while most studies in sociomateriality discuss how the social and material imbricated or entangled, these studies are silent regarding the conditions in which these entwinements are likely to occur.

My findings showed that the entwinement of farmers and the interventions was affected by conditions of the sociomaterial environment. This study revealed that conditions for sociomaterial entwinement were affected by: (a) implementing conditions, (b) political conditions, (c) facilitating conditions, (d) habitual practice conditions, (e) land ownership and (f) perception of external affordance.

In this study, I defined implementing conditions as the flexibility of the intervention and implementation design. Thus, these conditions were not limited to the emergent functionality and feature of the technology (ICT), but included access to technical facilities, opportunities for social interaction and ease of use. These conditions were important for farmers because they have varying situations that intervention and implementation design need to respond to. One of the most common reasons farmers adopted the interventions was ease of use, shown in the use of NMRice, where farmers would simply enter basic information and the software would calculate their fertilizer requirement. The reason for this condition was due to the lack of farmers’ skill in using computers. Thus, having a tool that did not require complex operation attracted farmers to adoption. According to Davis, Bagozzi, and Warshaw
(1989) and Moore and Bensabat (1991), implementers of technology must make users believed that using an intervention is free of physical and mental effort. I also found that proximity of the facility was a necessary implementing condition to consider as discussed in section 8.2.

The next condition that I noticed was power condition. Usually the concept of power refers to dominance of one actor over another, based on their hierarchical position in an organization (Venkatesh et al., 2003). In the case of this research however, I found that even farmer groups with no formal power could bring about changes to an intervention and adoption decision. This is consistent with the Van de Ven (2005) claim that a large enough group could derive power to change technologies, also labelled ‘social pressures’ by Ajzen (1991) and Mathieson (1991). They claimed that large group of individuals could impose social pressure that may influence a change in technology. In this study, power condition was demonstrated by the large number of farmers who stopped going to the FITS centre located in the Town hall because of the distance and the cost of transportation. This prompted the leadership of the town to change their implementation design by having a mobile internet facility (See Figure 2.3) visited different villages to serve the farmers. A similar consequence was also observed as the reason for the establishment of the village cybercoms in FITS A.

On the farmers’ level, responses indicate, that power condition could influence change in farmers’ practices. I observed that as the number of farmers utilizing a particular farming practice increased, they were able to influence the practices of others (e.g., showing how things are done differently with similar or better outcomes). These findings were consistent with the findings of the studies on social influence by Venkatesh (2003), where he found that individuals came to believe that they should use a technology because of the proportion of other farmers using it.
Another condition that was found in this study that could lead to sociomaterial entwinement was facilitating condition. Facilitating condition refers to the organizational infrastructure that existed to support intervention adoption. This condition was vital to sociomaterial entwinement, as it was found that farmers with little knowledge of ICT were less likely to use, and more likely to develop a negative attitude toward its use. Similarly, farmers with less knowledge of the new AT perceived the adoption as risky, resulting in a negative attitude toward changing their practice. For example, farmers who had not used a computer were scared to use it because they feared they might damage the unit or because they believed that they were too old and did not have the education. In order to minimize these negative attitudes, FITS decided to hire temporary staff to serve as facilitators for the farmers. In this study, the FITS leadership tried to bridge the knowledge gap by using mediators between the farmers and the intervention (e.g., Cybercom staff to facilitate ICT use, agricultural technicians to facilitate new AT). Through this change, farmers were observed to develop a certain degree of confidence and their learning was facilitated. The findings of this study are consistent with the findings of Venkatesh (2003) where he found that facilitating conditions have a significant influence on an individual’s intention to use information technology. Those farmers who specifically did not have sufficient skills or education required assistance, especially when working with interventions. In addition, training and seminars were provided by the FITS centre to farmers and as well as dedicated cybercom staff to help farmers when using the interventions, particularly when they encountered difficulties in using the facilities. This was also found to be consistent with the findings of Thompson and Higgins (1991), where they found that assisting users of technology when they encounter difficulties could influence technology utilization.
I consider the next three conditions to be novel conditions related to sociomaterial entwinement.

Habitual practice was defined in this research in section 5.3.2. As observed in this study, habitual practice was difficult to destabilize, specifically for those farmers who were satisfied with the outcome of their traditional practices. In contrast, some farmers who did not maintain stability in their traditional practice were more open to changes in their routines. For example, a farmer who had been using an agricultural practice passed to her from her great grandfather was difficult to convince to change because she was accustomed to its use. While another farmer who was in similar circumstances adopted the technology and changed practices because he found some value in the new AT. From these examples, this study indicates, that aside from the first farmer’s embeddedness in traditional practice, it was also found to be stable and reliable as far as she was concerned. This meant she valued the practice and found no reason to change. On the other hand, the second farmer may also have a similar embeddedness of practice, but he saw value in the new AT. This example implies that in order to influence adoption of an intervention, there was a need to influence the value system of the farmers. Unfortunately answering how to influence the values of the farmers was beyond the scope of this research.

Another unique finding of this study was that one of the conditions for sociomaterial entwinement was farmers’ land ownership. Land ownership refers to the rights to the land the farmers are working and ownership of the benefits of intervention use over time. This research found that farmers who did not own the land they were farming were least expected to adopt the interventions. They perceived that the landowners would take back their farms if the land became more productive as a result of the new interventions. On the other hand, those farmers who owned the land they tilled were found to be more likely to adopt new
technology as they found it beneficial in the long run. Farmers who did not own their land viewed change in practice as a risk, thus preventing them from adopting new technologies unless they were sure of success. This issue was resolved by the FITS leadership by establishing demonstration farms to showcase new AT. The difficult challenge was the perception of farmers in relation to the land ownership of the benefits in the long-run (see section 5.3.5). As to how this could be addressed is beyond the scope of this study.

Lastly, the perception of external affordance of the intervention was found to facilitate sociomaterial entwinement (See section 5.3). External affordance in this study is defined as intentionally enacted affordances, to invite possible users to adopt the interventions. As found in this research, external affordance could be in the form of government subsidies (e.g., free fertilizers, free farm equipment, free technical services, etc.). In this study, I observed that external affordances were temporary incentives given to farmers to make them utilize the intervention. I noticed however, that such sociomaterial entwinement was temporary, because, when the incentives were lifted farmers went back to their old practices. There were however, farmers that stayed with the new AT because they felt satisfaction with its use (e.g., increase in production, less pest infestation). This implied that the use of incentives was not a sufficient condition to influence farmers to sustainably adopt the interventions, but instead, leadership must find other ways they can present the affordances of interventions that would convince farmers to adopt them sustainably.

In summary, I was able to identify the different prior conditions that farmers identified that influenced their decisions to adopt the FITS intervention, namely implementing conditions, power conditions and facilitating conditions. In addition, this study found three novel conditions for sociomaterial entwinement namely: habitual practice conditions, land ownership and external affordance. All of these conditions were found to influence the
decisions of farmers to adopt or not to adopt the interventions. In this study, the conditions that farmers may have perceived were dependent on their circumstances. For example, if a farmer lacked computer skills, then they would perceive facilitating conditions that would make him or her utilize the intervention. If the farmer did not own the land, then the decision to adopt or not to adopt was subject to the nature of land ownership. Therefore, it was not essential that all conditions be present during the implementation of technology, but it was dependent on the circumstances of the probable adopters of the intervention.

8.2.2 The shift from individual to group affordance

In this study, it was observed that farmers shared experiences and in some cases, farmers within an organization asked advice of each other. Findings shows, that farmers could hardly accomplish their production goals if they did not receive advice from their peers, as most of them did not have extensive knowledge in use of new interventions (e.g., use of computers and its applications or use of new AT). As a result, an informal advice network emerged (see section 5.2.3.1). This informal advice network allowed farmers to share ideas and issues among themselves, thus improving productivity and providing social support as the network allowed the flow of information among the members of the group. An example shown in this study was when farmers met weekly, not only to enhance their relationship, but also to share their experiences, materials, practices and problems with fellow farmers using the same practices. In doing so, farmers developed a sense of confidence, in that they had other people who would offer support at times when they were in doubt of their practices. It was further found that the informal advice network brought about shifts in practices and routines as farmers become more confident that the new intervention could help them achieve their goals. For example, instead of using the mixed farming method, they shifted to the organic method of farming because they knew that other farmers were there to help them
if they were unsure of what they were doing. Thus, the new information that farmers learned in their interactions with other members of the group afforded possibilities to change their practice.

Other research such as that of Blau (1955) and Perlow (1997) found similar results. They found that most work could not be accomplished if colleagues were not regularly turned to for advice. The results of Blau and Perlow’s studies are comparable to the results of this research, because although some farmers displayed a certain expertise in specific areas of farming, they had little information about other areas. This then made them turn to other farmers within their organization for advice. Thus, informal networks were important because of the social support they provided among the members of the organization as it enabled movement of pertinent information among its members (Cross et al., 2001; Gibbons, 2004).

Furthermore, farmers joined groups with different goals in mind. Leonardi (2011; 2013b) and Nan (2011) claimed that information shared with group members served as a catalyst for change in informal networks. In this study, this change in informal networks was observed in the shift from individual to group affordance (see section 5.2.3.1). For example, I noticed that when I asked farmers about affordances of new AT, the affordances mentioned were not ‘individual’ in nature, but affordances that the group wanted to achieve.

*Group affordance* is defined by Leonardi (2013b) as affordance shared by all members of a group and represents a differential feature that is necessary for completing non-interdependent tasks that when pooled achieve the group-level goal. For example, in this study Pastor and Jimmy are both organic farmers; however, both searched the internet with different goals in mind. Pastor was more interested in improving his *seawater and golden snail concoction*, while Jimmy his groupmate was interested in improving the *soil condition* of his farm by developing better post-harvest waste management. Both farmers usually
interacted during their meetings and farm visits. They observed each other’s practices to accomplish the group’s goal of promoting organic farming in their village. According to Guzzo & Shea (1992), this relationship is referred to as reciprocal interdependence, where group members must interact and depend on each other in order for the group to accomplish its work. By doing this, farmers perceived the needs of other farmers, not only to increase their understanding but also to achieve the groups’ goal.

As described above, the shift from individual affordance to group affordance strengthened the entwinement of the social and material because the affordance was perceived collectively. During this shift, the group affordance of AT was not only perceived by the individual, but was composed of multiple affordances, as perceived by different farmers in the group. For example, Pedro (farmer) may only have seen the AT affording pest and disease control, while Juan (farmer) on the hand, perceived it as helping with fertilization. Also, Jimmy thought it may assist with soil management, etc. Given these views of affordances, I noted that perceived affordances at were initially independent of what a farmer wanted to achieve for himself. However, since these farmers belonged to a group, this then became multiplied when viewed on a group level. However, when these multiple views were pooled together this could lead to the emergence of a group affordance, which in this study was found to be developing practices for organic farming. Each of these farmers could become experts in their areas of interest, with knowledge they could then share with the rest of the members of the group, eventually leading to achievement of the group’s goals.

In summary, the shift from individual to group affordance was driven by need to accomplish individual goals, the need for advice and the lack of knowledge on the interventions. This need was found to influence the emergence of an informal advice network, which served as a network for the flow of pertinent information among farmers
within the group. This advice network was observed to paved the way for the emergence of group affordances, which were composed of the individual views of affordances of the farmers, pooled together to achieve the organization’s goal. This move of affordance from individual to group was found to strengthen the sociomaterial entwinement, as individuals were found to develop confidence in their new adopted practices resulting from the support they received from other members of the group.

8.2.3 Emergence of new affordances and perceptions of constraints

In the previous sections 8.2.1 and 8.2.3, I discussed the different farmers’ perspectives of the interventions’ affordances and how individual farmer’s affordances shifted to group affordances. In this section, I will discuss the processes of entwinement that I observed between farmers and the interventions.

To demonstrate this, I will discuss the processes that I presented in Chapter 5, section 5.4. I will specifically discuss the entwinement process that occurred between farmers and NMRice software, and how it led to the emergence of new affordances and perceptions of constraints.

Findings in this study showed that farmers entwined with NMRice 1.0 when they found the affordance of NMRice (i.e., calculate fertilizer requirements and timing of fertilizer application) was aligned with their goals when still using inorganic rice growing practices (entwinement 1). After a few years, when the government shifted their priority to organic farming, the municipal government followed suit resulting in some farmers changing their practices and goals. With this shift in farmers’ practices and goals, farmers perceived shortcomings in NMRice 1.0, thus resulting in a perception of constraint. What is notable here, was at the start of the entwinement process, the change of farmers’ goals was not due
to NMRice 1.0, but as a result of changes in government priorities. However, the perception of constraints in NMRice 1.0 was a result of the change in goals and practices of the farmers.

Results indicates that the farmers were not in direct contact with the designers of NMRice 1.0, thus, the functionality of the NMRice 1.0 could not be easily changed. Thus, those farmers who changed their practices stopped using NMRice 1.0. According to Hutchby (2001), people may perceive that a technology offers no affordances for action. Thus, it resulted in the abandonment of NMRice 1.0. As the number of farmers who stopped using NMRice 1.0 increased, it was noticed by the MAO who reported the problem to the developers. They in turn modified NMRice 1.0 and introduced NMRice 1.1. What is notable here is that the perception of constraints of farmers resulted in the change or modification of technology. This finding is consistent with the findings of (Leonardi, 2011) among engineers in CrashLab Simulation Technology at Autoworks, where perceptions of constraints led to change in the material agency of the technology. In this study, developers NMRice software at IRRI overcame the constraints faced by farmers by changing the functionality of NMRice 1.0, thereby giving NMRice software new material agency in the form of NMRice 1.1.

At this point, the findings in this study showed that, as a result of the change of NMRice 1.0 to NMRice 1.1, farmer practicing the mix method of farming begun using the newly changed features of NMRice 1.1, calculating fertilizer requirements needed for the mix farming method. However, in the process of changing their practices farmers were formulating new goals. In this study, the formulation of new goals began when farmers changed their routine (e.g., working alone to working as a group). Farmers were found to organize themselves as a result of NMRice 1.1 (see section 5.4.2). When farmers organized themselves, group affordance developed in as a form of advocacy (i.e., organic farming), thus group goals emerged (see section 5.2.3.1). According to Leonardi (2011), technology could
sometimes afford people the development new goals, creating new social agency that is imposed on the technology.

After farmers organized themselves and formed new goals, new constraints were perceived. Farmers now wanted NMRice to have the functionality to calculate organic fertilizer requirements and timings of application. Because of this new constraint, developers changed the functionalities of NMRice 1.1 and called it RCMRice. Thus, re-starting the process as illustrated earlier in this section.

In summary, this subsection showed the process of sociomaterial entwinement between farmers and the NMRice application. It was found that the process of sociomaterial entwinement involved a process of changing views on the affordances of NMRice, changes in farmers’ practices and changes in NMRice itself. The process started with farmers viewing what NMRice afforded (calculation of inorganic fertilizer requirements). During the process of entwinement, farmers changed their practices in relation to the affordances of the NMRice (applying recommended amount of inorganic fertilizers and appropriate timing of application). However, outside factors such as government or municipal policies may have affected farmers’ views on their existing practices, resulting in the perception of limitations or constraints with NMRice 1.0. This perception of constraints among farmers led to a change in the functionalities of NMRice 1.0, resulting in a new version, NMRice 1.1, having new functionalities and affordance. These new functionalities of NMRice 1.1 led to changes in farmers’ practices. This change in routine lead to a change in farmers’ goals and different perspectives of affordance for NMRice1.1.

8.2.4 Synthesis

In this section, I have shown how perspectives of affordance led toward the entwinement of farmers and the interventions. How individual affordance shifted to group
affordance a specific example of the sociomaterial entwinement process of farmers and the NMRice application was presented.

Based on the findings of this study, prior to intervention adoption, farmers must be able to first notice the intervention. By noticing the interventions farmers would realize what it affords. Before sociomaterial entwinement took place, initially, farmers had a perspective on affordances of the interventions as a bundle of features, which they mapped with their goals. Second, farmers had a perspective on how the interventions were designed intrinsically and extrinsically. These two perspectives were found to influence farmers’ decisions to entwine or not entwine with the interventions. Sociomaterial entwinement would occur if the features of the affordance matched those of the farmers and the design of the intervention (intrinsically or extrinsically) meets their circumstances (e.g., age, skills, education, etc.). My analysis showed, that when farmers adopted the intervention, their perspectives also changed. At this point, their perspectives became relational, that is, they viewed affordance as opportunities for action in relation to their environment.

In order to improve the opportunities of sociomaterial entwinement, six enabling conditions were important to consider: implementing conditions, habitual practice conditions, power conditions, facilitating conditions, land ownership, and presence of external affordance. These conditions need not occur simultaneously for the sociomaterial entwinement to take place, but at least one condition is necessary for sociomaterial entwinement to eventuate.

The shift from individual affordance to group affordance strengthened the bond of sociomaterial entwinement. Groups allowed the exchange of information, which led to farmers’ reconfiguration of their thinking and changes to practice, where they became more confident and knowledgeable about the technology-in-use. This change resulted in the
emergence of constraints, which led to the modification of a technology or practice, and eventually to the emergence of new affordances. This process of continuous entwinement produced new or modified technology allowing farmers to improve productivity through their agricultural practices.

Lastly, sociomaterial entwinement was found to be a process of changing practices, and the emergence of new interventions as a result of perceiving new affordances and constraints. This study found that perception of constraints resulted in a series of entwinements, while farmers perceiving new affordances in turn resulted in a series of entwinements that changed farmers’ practices.

8.3 Farmers’ sensemaking process

There were different views of sensemaking as mentioned in Chapter 2, section 3.2.2. Weick (1995), the father of sensemaking, suggests that the term means simply, the making of sense. It is the process of structuring the unknown (Waterman, 1990) by placing stimuli into some kind of framework that enables us to comprehend, understand, explain, attribute, extrapolate, and predict (Starbuck & Milliken, 1988). Sensemaking is the activity that enables us to turn the ongoing complexity of the world into a situation that is comprehended explicitly in words and that serves as a springboard into action (Weick & Sutcliffe, 2007). Consequently, it can be said that sensemaking involves and requires an articulation of the unknown. This is because how much we understand depends on how we can explain of the unknown.

From the descriptions above, sensemaking necessitates human understanding of new concepts in a changing world and exploration of new ideas and practices that are often considered risky tasks. For example, a farmer who used a new agricultural technology (e.g., organic farming) may become unpopular with those who were using inorganic methods, or seed producers who promoted hybrid varieties requiring the use of inorganic fertilizers. In the
area of agricultural production, sensemaking could include learning in discovering and developing new technologies and use of new agricultural technologies or use of ICT to obtain information and shift practices. This could include learning about the structure of a new practice or about new technologies a farmer had not used before (Maitlis & Christianson, 2014). In this way, sensemaking involves moving from a simple to complex practice and back again (Ancona, 2012). The move to a complex practice occurs as new information is collected and unfamiliar actions are taken. Then, as patterns are identified, and new information is labelled and categorized, the complex becomes simple once again, albeit with a higher level of understanding (Ancona, 2012).

This study observed three types of sensemakers: farmers who did not adopt the intervention and underwent a minimal sensemaking process (non-adopters); farmers who adopted the technology and underwent a complex sensemaking process (reflective adopters); and farmer adopters who underwent minimal sensemaking (quick adopters).

This section is divided into four parts. Firstly, findings on farmers who did not use the intervention and their sensemaking process will be discussed in relation to the literature. Secondly, reflective sensemaking processes of farmers who adopted the intervention will be discussed with reference to Weicks’ sensemaking stages. Thirdly, I will discuss the aspects that affected the minimal sensemaking of quick adopters, comparing it to the body of literature. Lastly, I will discuss how sociomateriality is embodied in the sensemaking process.

8.3.1 Non-adopters sensemaking process

As I mentioned in Chapter 5, when asked about how they made sense of the intervention, farmers’ sensemaking was focused on AT. In this study, I observed that some farmers who underwent minimal sensemaking were those who did not adopt the intervention. Sensemaking usually starts with interruptions (Christianson et al., 2009; Weick
& Sutcliffe, 2007; Weick et al., 2005) of individual or organizational routines. In some cases, interruptions could be imposed, and as such individuals or organizations are compelled to engage in sensemaking. However, in some cases, these interruptions are events that may cause disruptions to routines. Depending on how individuals interpret those interruptions, this may or may not trigger sensemaking.

The literature shows that not all interruptions, events, or cues trigger sensemaking (Maitlis & Christianson, 2014). This research discovered seven reasons (See section 6.2.1) why non-adopters did not undergo reflective sensemaking. In this subsection, I will discuss each of these reasons in relation to the literature.

Mismatched goals: farmers whose goals in farming did not match with the affordances of the intervention were observed to undergo minimal sensemaking. The previous section on affordances explained that when farmers were presented with an intervention, they perceived affordances. These affordances became meaningful when they matched an individual’s goals and objectives (Leonardi, 2011). However, when farmers failed to perceive relational affordances, they were found not to adopt interventions (see Rubens’ case in Chapter 5, section 5.3.1). In Rubens’ case, his goals (i.e., produce hybrid rice seeds) were mismatched with the intervention’s affordance (produce rice for consumption), resulting in minimal sensemaking. This result is similar to research claims that minimal sensemaking occurs when individuals fail to perceive a relational affordance of a technology (Balogun & Johnson, 2004; Maitlis et al., 2013).

Comparable production: As evidenced in this research, one of the reasons that non-adopters did not engage in reflective sensemaking, was that they did not find value in the benefits of the intervention. The affordances of the intervention were not important enough in relation to their expectations and experiences, thus impeding reflective sensemaking.
According to Sonenshein (2010), people may not be supportive of changes in their routine because they may perceive it as not significant enough to warrant changes in their practice. For example, farmers viewed that the affordances of the interventions (e.g., increase level of production) were not substantial compared to current practices. As such, they placed less value on adopting the intervention.

Lack of **accountability or agency** is another cause that inhibited reflective sensemaking. The FITS centre for example, promoted ICT use to obtain information on how to reduce inorganic inputs that would eventually lead to organic farming. FITS further informed farmers of the disadvantages of using inorganic inputs as they degraded soil fertility and slowly poisoned consumers. However, some farmers did not consider themselves accountable for these issues and continued to use their inorganic farming practices. Similar to the findings of Hoffman and Ocasio (2001), this failure to recognize individual responsibility explains why the intervention was not successful in attracting the interest of individuals to adopt any changes. According to Hoffman, et al., enactment on cues is determined by an individual’s processing of information. When people were concerned about the effect of their actions, they became accountable for it and changed their practice, otherwise, they continued to perform as per normal (Hoffman & Ocasio, 2001).

**Farmers’ personal circumstances** were also found to curtail sensemaking. Circumstances includes farmers’ ages and lack of formal education. My findings showed that the use of ICT to aid their farming was not given sufficient attention. For example, some farmers did not use ICT to help them obtain information on AT because they did not have the necessary skills to use computers and the internet. They explained that they did not use computers when they were still in school, and they believed they were too old to use ICT. As Maitlis and Sonenshein (2010) argued, a lack of skills can hinder sensemaking, as skills shape
the meaning of situations. Thus, those individuals that lacked the necessary skills could only undertake minimal sensemaking. These skills may vary, such as the political, emotional, physical, and mental skills of an individual (Gioia & Chittipeddi, 1991; Gioia & Mehra, 1996), thus, if farmers believed that they lacked these skills it could result in minimal sensemaking.

The lack of time was also considered by farmers as a roadblock for using ICT. They believed they could not allocate time to the village cybercom for ICT use as they were too busy tending their crops. Since rice farming production results in a crop turnover every 4 to 5 months, farmers had to intermittently perform other livelihood related activities to earn additional income. This is similar to the finding of Manalo et al. (2010), that farmers in the five top rice producing provinces in the Philippines could not find time to learn how to use computers because of their busy schedules.

Habitual practice is another aspect that resulted in minimal sensemaking. This study showed that some farmers viewed their farming practice as tested over decades, passed on for generations. It had not failed in the past to produce sufficient income and provide for their basic needs, and so with this belief, farmers paid less attention to the interventions. In this case, farmers’ traditional practices had achieved a certain degree of stability that had served them well. As such, the farmers did not make a conscious effort to change their practices. According to Dunbar and Garud (2009), individuals in this case become less mindful of an intervention because they simply assimilate the intervention into their existing interpretation.

Finally, land ownership was also found to inhibit sensemaking. Some farmers tended not to pay attention to the possibilities of using ICT or agricultural technology because they believed they would not reap the benefits of intervention adoption. For example, some farmers believed that if they applied the agricultural information they learnt through using ICT they would not benefit from the outcomes, but the land owners would (See section 5.3.5)
8.3.2 Reflective adopters

As mentioned earlier in the previous section regarding Weick (1995), the stimulus for sensemaking was derived from the occurrence of interruptions in organizations. When ecological or strategic changes occur, organization members have to restore normal order through three interdependent activities: enactment, selection, and retention.

In this subsection, I will discuss the findings of this research in relation to Weick’s (1995) stages of sensemaking. First, I will present findings related to the enactment stage, second, the selection stage, third the retention stage as the product of the enactment and selection stage and the micro processes that were involved.

8.3.2.1 Enactment stage

The process of enactment was defined in chapter 3, section 3.2.3, and entails the search for meaningful cues in ongoing experiences and provides a retrospective account of the incident an individual or a group encountered. My findings showed, that farmers who gradually adopted technologies in this research displayed similar sensemaking activities towards the adoption of an intervention as forwarded by Weick (1995). First, the farmers and farmer groups in this research were interrupted by the introduction of computers and the internet to their farming (i.e., towns established FITS centres where farmers could search for best practices in farming to improve production, control disease, and minimize cost of rice production). During this stage, farmers reconsidered current practices as a result of the interventions (See section 5.3.2.1).

In the previous section, it can be noted that farmers made sense of the interventions in relation to their goals. In the process of enactment, two processes were observed to have been undertaken by farmers namely, seeking out information and involvement. These are discussed below.
When farmer routines were interrupted by introduction of the interventions, this study found that farmers first sought information about the interventions (e.g., how the intervention would reduce costs, identify beneficial and non-beneficial insects, advantages of mechanized and non-mechanized farming, identify different soil properties, etc.). By seeking information about the interventions, farmers were able to compare different perspectives, identify flaws, and could in turn develop confidence in their decision to accept the interventions. Based on this retrospection, farmers were able to make decisions and clarify issues.

During the enactment process, farmers were observed forming or joining groups to test the ideas they developed. In doing this, farmers were able to explore the plausibility of the interventions and generated ideas to ensure some degree of certainty that the interventions would work. According to Ancona (2012), sensemaking is inherently collective, and as such, people felt better comparing their views with those of their peers. They negotiate and integrate until an appropriate type of practice learned in conjunction with an event. Sutcliffe and Vogus (2003) added that by soliciting and staying open-minded to a wide variety of inputs, adopters had a greater ability to create large numbers of possible responses to their problems, thus facilitating effective actions.

8.3.2.2 Selection stage

During this stage, individuals or groups tried to sort through the multiple images of realities generated by previous enactment activities and reach a common understanding that seemed to portray the situation in the most plausible manner (Ancona, 2012). In this study, three micro processes were found to occur namely, overlaying of an existing practice, abandonment and replacement, and cultural change.
My study showed that during the selection stage, farmers were trying to minimize the uncertainties of adopting the intervention and were cautious of their actions, such as in changing their farming practices. Weick (1995), referred to this behaviour as an attempt by individuals to reduce equivocality of the enacted information. My findings indicate, that instead of farmers immediately changing their practices, they tended to overlay old or existing practices with the new (e.g., adopted mix-farming approach - a combination of practices, rather than shifting from inorganic to organic farming immediately). By doing this, farmers reduced risk of failure while they were still in the process of exploring new practices.

The second process that I observed in this study was in Lito, Boyet, Pastor, Sally and Freddie’s practices (See Chapter 5, section 5.2.3). They totally abandoned their old practices and replaced them with the new ones. In this case, farmers used what information they had about how the new practices worked. Relevant people (technicians) become an integral part of understanding how the practices were carried out and guiding their actions. Farmers used this agricultural information to choose whether to enact a practice. This explanation is similar to performative explanations of change in organizational routines proposed by Feldman (2003), who claims that learnt information is focused on the effect of ‘doing’ the routine and on the production and reproduction of the routine.

Another noticeable process in the selection stage that came out of this study was that farmers moved out of their existing culture of farming. For example, when Lito started to change his practice from inorganic to organic farming, he also changed his view of farming to being a business rather than a hobby (See Chapter 5, section 5.2.3). In this case, Lito’s routine was permeated by the interventions, which prompted him to engage in sensemaking. In his sensemaking processes, Lito assimilated the interventions, leading him to change his practice. This finding is similar to (Levinthal, 2006; Weick, 1995; Weick & Sutcliffe, 2007) argument’s,
which state that if objects in the environment are seen as relevant, their integration into the system and routines of individuals is allowed. This in turn encourages the accommodation of new practices. For example, in Lito’s case, with his new practices (organic farming) and view of farming (from hobby to business), he was able to develop a new identity as an organic farmer. This is similar to the findings of Erez and Earley (1993), where they found that individuals who adopted new practices and concepts were able to construct a new identity, in ways that met their needs for self-enhancement.

8.3.2.3 Retention stage

Lastly, farmers in this study who underwent reflective sensemaking moved to the retention stage. The retention stage is the product of enactment and selection (Weick & Roberts, 1993). As mentioned in Chapter 3, section 3.2.3, for the retention stage to take place, shared meanings must fit into the prevailing norms of interpretations of the group, otherwise, they cannot filter through the cognitive framework and be stored in the collective mind of the organizations. Within this stage, two micro processes were observed, namely, the conduct of small experiments and the creation of learning spaces.

In this study, farmers who were gradual adopters of technology engaged in small experiments to verify the plausibility that new agricultural technology actually worked in their context. For example, several farmers eventually decided to produce organic rice. However, this farming practice was relatively new to these farmers and would put their income at risk as their experience was lacking. By performing small experiments, the farmers were able to choose what worked and what did not. According to Ancona (2012), this action is a key sensemaking tool. He claimed that it is often wiser to begin with and learn from small experiments, before broadening the action to drive change. In addition (Weick et al., 2005) forwarded that sensemaking involves people simultaneously interpreting their knowledge.
within trusted frameworks, yet they “mistrust those frameworks by testing new frameworks and new interpretations...” (p. 412).

In addition, farmers created their learning space. Sensemaking at this stage does not only involve trying new things resulting in emerging practices, but this activity also resulted in farmers creating new environments and spaces (see section 6.2.2.3). These emerging new AT and ICT ideas and practices usually had an impact on the farmers’ behaviour and the environment in which farming was occurring. For example, when FITS established the village cybercom they encouraged the farmers to use the facility to learn about new AT. The farmers then established the University Without Walls (See section 6.2.2.3). The creation of village cybercom and university without walls were results of the limitation of the FITS centre’s initial implementation strategies, where farmers were hindered in using the intervention because of proximity and cultural issues. These findings are consistent with Sutcliffe and Vogus (2003), who found that organizational systems are better able to deal with changes, and not become bogged down in finding blame about what might have been. Instead, members of the organization work to restore, invent, improvise, and recover in creative ways.

In summary, the reflective stage of sensemaking involved stages of enactment, selection, and retention. As found in this study, the enactment stage generally involves retrospection and farmers becoming involved with groups, developing a level of confidence by exploring the plausibility of the interventions working in their context. The selection stage is where farmers were found to overlay their practices when they were unsure if the interventions would work and those who developed some degree of confidence totally abandoned their traditional practice. During the selection stage, my study further found that farmers changed their views of farming from a form of livelihood to a business as they engaged with the interventions. Lastly, reflective farmers were found to undergo the
retention stage, where farmers engaged in small experimentations to test if the practices would work in their context. Furthermore, in the process of their entwinement with the interventions, they were able to create learning spaces to overcome issues of proximity and local cultural traits of shyness.

8.3.3 Quick Adopters

The third type of sensemakers observed in this study were farmers who adopted the FITS interventions but engaged in minimal sensemaking. In my study, this study suggests four influences that led to minimal sensemaking: external affordance, restricted sensemaking, guided sensemaking and gaya-gaya culture. These factors will be discussed below.

I noticed in my study, that one of the reasons why farmers underwent minimal sensemaking was due to the existence of external affordance of the interventions (See chapter 5, section 5.3.6). This situation became a deterrent to the sensemaking process as the intervention was unable to influence how farmers develop meanings, and they were more interested in the benefits attached to intervention adoption. According to Gibson (2000), affordances are not limited to the inherent properties of an object, but also the properties of the environment. This implies that affordances could be extrinsic features of technology, which could be setup by people who are part of the environment that surround the technology. In this research, the analysis showed that external affordances of the interventions were intentionally put in place by the implementers of the intervention, so farmers would be able to notice them (see section 5.3.6). I found that, implementers provided incentives for use of the interventions in the form of subsidies such as fertilizers, chemicals, etc. As a result, farmers adopted the interventions after quickly making sense, not because of what they afforded, but because of the incentives attached to them.
My study further showed that farmers resorted to quick sensemaking because the situation surrounding the event was restricted. For example, some farmers adopted the intervention quickly because it was a government program. As a government program, it was highly controlled and managed by agricultural technicians who were driving and controlling the process of adoption. According to Maitlis and Christianson (2014), restricted sensemaking occurs when leaders promote events which farmers tend to accept with relatively few attempts to achieve understanding. Leaders in this situation performed high levels of sensemaking and sensegiving processes, thus, minimizing sensemaking among adopters (Monin et al., 2013).

In addition, this study further discovered that minimal sensemaking occurs when the process of sensemaking is being guided. Guided sensemaking was observed in this study, when agricultural technicians were found to be highly involved in attempting to convince farmers to use the FITS interventions. For example, they were organizing seminars about the interventions, and they were observed to serve as trainers, speakers and facilitators in some instances. I further found, that they served as mediators with some agricultural technology (e.g., Palay Check), where they guided farmers on how Palay check practices were conducted. As mentioned in the literature in section 3.2.4, guided sensemaking occurred when leaders became ‘energetic’ in constructing and promoting understanding of an event and at the same time, they were also actively engaged in attempting to shape beliefs of individuals about a certain issue (Maitlis & Christianson, 2014). Wiesenfeld, Wurthmann, and Hambrick (2008) argued that leaders might impose their bias on the event or issues based on their professional standards and prior knowledge. Thus, if farmers had a high regard for the leaders in their context, then the tendency was to accept what was promoted by their leaders with minimal sensemaking.
Lastly, my findings showed, that imitating the behaviour of others or *gaya-gaya* diminishes sensemaking among farmers (See chapter 6, section 6.2.3.3). In this study, it was found, that some farmers were simply imitating others based on the belief that if farmers used a specific practice (e.g., organic farming) and benefited from its adoption, then those doing the same would benefit also.

In summary, minimal sensemaking could occur when farmers perceived an external affordance of an intervention rather that its relational affordance. In addition, when leaders tried to influence the adoption process by restricting and guiding sensemaking, this could lead to minimal authentic sensemaking among farmers. When this occurred, farmers tended to become dependent on their leaders for the information they required. In this study, it was revealed that a contextual cultural trait known as “*gaya-gaya*” attitude could also lead to minimal sensemaking activity, with farmers simply imitating others in the hope of acquiring similar benefits.

**8.3.4 The embodiment of sociomateriality in sensemaking**

In the above subsections, I illustrated how farmers made sense of the interventions. In this subsection, I will discuss how sociomateriality was embodied in the sensemaking process. The findings showed that sociomateriality could be embodied in sensemaking processes by exploring the embeddedness of farmers’ practices in relation to the interventions. The embeddedness of farmers in interventions, as discussed in section 6.3.1 is the tightness and looseness of the relationship or the sociomaterial entwinement of the farmers and the interventions. Thus, I could categorize farmers in terms of the embeddedness of their farming practices with the interventions and examination of patterns in their sensemaking processes.
Leonardi & Barley (2010), Nicolini (2009), Orlikowski (2007) and Suchman (2005) showed how embodiment of sociomateriality creates, and in turn is influenced by, human artefacts such as tools and other material objects, which are themselves materially produced through human processes. Thus, if human processes influence embodiment of sociomateriality, then it is possible that we could look at human practices to capture how sociomateriality could be embodied in sensemaking. As mentioned section 3.2.6, many researchers made use of human processes and practices to embody sociomateriality in sensemaking. The human processes researchers used were: bodily gestures (Cunliffe & Coupland, 2012), felt senses (Whiteman & Cooper, 2011), practices on shifting from individual to group sensemaking (Stigliani & Ravasi, 2012), events (Anand & Jones, 2008; Glynn, 2008; A. L. Oliver & Montgomery, 2008; Zilber, 2007) and use of spaces and interactions (Kellogg, 2009). Drawing from this research, my study identified the type of sensemaking practices farmers underwent, in order to explore the embeddedness of farmers’ practices in the interventions.

As demonstrated in the findings of this study, farmers’ entwinement with the interventions could be placed on a continuum that represents the degree of their sociomaterial entwinement. This degree of sociomaterial entwinement revealed four patterns namely: (a) entwined sociomaterial, (b) mediated entwined sociomaterial, (C) loosely entwined sociomaterial, and (d) unentwined sociomaterial (See Chapter 6, section 6.3.1 for the definitions).

My study showed that, farmers appeared to be entwined sociomaterially with the interventions when they understood the peculiarities in the interventions. For example, in relation to AT, farmers were said to be entwined sociomaterially with AT if they understood the peculiarities of farming in relation weather, planting seasons, varieties to use, soil type,
etc. In relation to ICT, this study considered farmers to be sociomaterially entwined when they could operate a computer, browse the internet by themselves, use search engines, and YouTube. Farmers who were characterized under the pattern of entwined sociomaterial showed greater frequency of opportunities to engage in sensemaking, enabling them to improve their practices. In this case, individuals categorized in this pattern could easily familiarize themselves with the changes in the interventions (Whiteman & Cooper, 2000).

The second group of farmers seemed to express a pattern that could be considered as mediated entwined sociomaterial. These were farmers characterized as having knowledge of the intervention but their actions were mediated by experts, or their use of knowledge was based on the knowledge of others (See Chapter 6, section 6.2.3.2). In this study, farmers were found not have control on driving the adoption under this pattern, but the processes of adoption and sensemaking were driven by the technicians. Farmers in this pattern had generic knowledge of the interventions, and could hardly cope with changes without the presence of mediators. These findings were consistent with the studies of Whiteman and Cooper, 2011 and Whiteman (2000) where they found that, in cases where events and sensemaking processes were mediated, individuals had less developed abilities to make sense of the events on their own (Whiteman, 2010; Whiteman & Cooper, 2011).

My study further showed that some farmers’ sensemaking and farming practices appeared to be loosely entwined sociomaterial. Farmers were categorized under this pattern when they only know a few of the interventions features (See Chapter 6, sections 6.3.2). Farmers were also found to belong to this pattern, when their relationships with the interventions were temporary and their sensemaking minimal. I say temporary, because the sociomaterial entwinement became dependent on the experiences of the farmers in their interaction, level of satisfaction and experiences with the interventions. I considered that
sensemaking was minimal because, they could quickly entwine with the interventions without reflection upon them. An example of this relationship occurs when farmers adopt the technology because of external affordance attached to it (See Chapter 5, section 5.3.6).

The last pattern that I observed in my study was of farmers that indicated no relationship to the intervention. Thus, they were considered to be *unentwined sociomaterial*. In my study, these were farmers who did not have detailed knowledge of, or experience with the intervention. These were non-adopters, farmers whose practices and sensemaking processes, were restricted because of imposed protocols in their farming practices. Furthermore, farmers who did not abandon the traditional farming practice were included in this pattern.

In summary, this section explored how sociomateriality can be embodied in sensemaking. Findings in my study indicated that the embodiment of sociomateriality could be captured by categorizing the farmers’ embeddedness of practices with the intervention and examining the pattern of their sensemaking processes. The degree of embeddedness was represented by four different patterns, namely, (a) entwined sociomaterial, which was considered as the strongest pattern of entwinement due to the embeddedness of the farmers practices within the interventions, (b) mediated entwined sociomaterial, where farmers practices where characterized to be guided by mediators, (c) loosely entwined sociomaterial, wherein farmers relationships with the interventions were found to be temporary, and (d) untwined sociomaterial where the non-adopters were found to exist.

### 8.3.5 Synthesis

Farmers’ sensemaking was usually triggered by an interruption to their routines (Maitlis & Christianson, 2014). This interruption could be in the form of an intervention or anything that disrupts customary practices. Farmers’ sensemaking processes can be
differentiated into three types, namely, non-adopters who underwent minimal sensemaking, reflective sensemakers, and quick adopters.

The first type of sensemakers were characterized as those who were hindered in sensemaking because of mismatched goals (Leonardi, 2011), comparable production (Sonenshein, 2010), lack of accountability (Hoffman & Ocasio, 2001), farmers personal circumstances (Gioia & Chittipeddi, 1991; Maitlis & Sonenshein, 2010), habitual practice (Dunbar & Garud, 2009), lack of time (J. A. Manalo et al., 2010) or land ownership.

The second type was those who were characterized as reflective sensemakers. These farmers were found to undergo the sensemaking stages proposed by Weick (1995), namely, enactment, selection, and retention. For my study, in the enactment stage farmers were observed to undergo the micro processes of seeking out information and involvement (Ancona, 2012). These two processes were undertaken to verify tentative understandings and confirm the plausibility of technology. In my study, in the selection stage micro processes were evidenced by the overlaying of an existing practice with new practices (Ancona, 2012), abandonment and replacement (Feldman, 2003), and cultural change. Overlaying occurred when farmers lacked confidence in the practices, thus change was gradual. Alternatively, when farmers were confident they immediately abandoned and replaced their practices and in the process, changed their culture. This study showed that during the retention stage, complex sensemaking was observed, farmers were found to engage in small experiments to explore the plausibility of a practice and created learning spaces to facilitate sharing of ideas and experiences (Weick & Roberts, 1993). These two micro processes within this stage reinforced the practices in the previous stages of sensemaking.

The last type of sensemakers were the quick adopters, in this study referred to as farmer adopters who underwent minimal sensemaking. These farmers were characterized to
have perceived an external affordance of the interventions, and those for whom sensemaking was restricted because leaders and clients who bought their products drove and controlled the adoption process. In addition, guided sensemaking (Maitlis & Christianson, 2014) was also found to have caused minimal sensemaking for some farmer adopters because they became dependent on their leaders and technicians for the information they required. Lastly, gaya-gaya culture was found to minimize farmers’ sensemaking, because they simply followed other farmers’ behaviours to avail themselves of the benefits.

From analysing the data, this research also found that sociomateriality could be embodied in sensemaking. Findings of this study showed that this could be done by exploring the degree of farmers’ entwinement with the interventions. The embodiment of sociomaterially in sensemaking could be represented by four patterns of sociomaterial entwinement: (a) entwined sociomaterial, (b) mediated entwined sociomaterial, (c) loosely entwined sociomaterial, and (d) unentwined sociomaterial.

8.4 Farmers’ learning process

This subsection aims to answer the research “How do individuals learn in their interaction with interventions in a sociomaterial context?”. In this section, I will focus my discussion on the stages of learning undertaken by the farmers and the related micro learning processes. Unlike the sensemaking process in the previous section where the focus was on how farmers make sense leading to intervention adoption, this section will specifically focus on learning processes that led to the emergence of new practices and new interventions. As mentioned in Chapter 7, section 7.2, learning was considered in this study as a process of reflection and critical examination of the interventions, which led to farmers to changing their practices and changing the technologies.
In this study, the analysis showed three stages of learning that farmers underwent: figuring, configuring and reconfiguring, which will be discussed in detail in the succeeding subsections.

I structured this section by first, discussing the findings related to the figuring stage. Second, I present the configuring stage, by discussing how farmers learned in this stage. Third, I present the reconfiguring stage. I will discuss these stages in relation to the literature and discuss the micro learning process undertaken by farmers in each stage.

8.4.1 Figuring

As I mentioned in Chapter 7, section 7.2.1.1, *figuring* is the stage where farmers linked with material, compared then sorted out ideas and practices. For example, traditional ways of accessing agricultural information (use of printed materials, attending seminars, etc.) compared to use of ICT in accessing agricultural information, and differentiating between present farming practices and exploring new agricultural practices.

Analysis showed that farmers in this stage were reflecting on their existing knowledge and the relational affordance of the intervention. As mentioned in Chapter 7, section 7.2.1.1 to 7.2.1.3, this stage of learning involved micro processes such as linking ideas and farming practices with the intervention, verbal referencing, comparing and sorting out.

In this study, farmers engaged in these processes because they were trying to reflect on the plausibility of an idea (e.g., Agricultural Technology) working in their context. During the process of linking, farmers in this study were found to engage in conversation with other farmers, which I termed verbal referencing. These conversations were purposively aimed to reference ideas by conversing with other farmers and create mental images or representations of those ideas. In doing this, farmers were able to open the ideas to their peers, allowing them an opportunity to obtain opinions. These findings were similar to those
of (Weick et al., 2005), when he studied the Centre for Disease Control (CDC) diagnosis of the West Nile Virus. Weick (2005) found that CDC workers engaged themselves in conversational practices to help articulate tentative understandings. Spinosa, Flores, and Dreyfus (1997) added that during this stage of learning, which they termed articulation, individuals usually made their implicit knowledge open to others, so they would be able to enrich their initial understandings of an event.

In this study, it was also observed that farmers reflected on their learning by comparing and sorting out ideas as they learned. Farmers were found to engage in these activities so they could reflect on the advantages and disadvantages, identifying similarities and differences of traditional and new practices in the interventions, any benefits, and the plausibility for application. By doing this, farmers were able to reflect and create new ideas (e.g., sustainability of farming, health effects). These findings are similar to those of Stigliani and Ravasi (2012), where comparing or sorting out resulted in the formation of new mental models, causing the refining of ideas through sorting out. Stigliani and Ravasi (2012) added that by sorting out, individuals were able to reduce general ideas to specific ideas, by organizing them according to what would fit into their context.

8.4.2 Configuring

The next stage of learning that farmers underwent was the configuring stage. In this study, farmers at this stage were found to refine their initial understanding gained during the figuring stage. In the literature, the configuring stage is considered a point where learning shifts to more complex processes, and new ideas were linked to existing environments (Engeström, 2004; D. A. Norman, 1982b; Spinosa et al., 1997; Stigliani & Ravasi, 2012).

A shown in my analysis, this stage involved three micro learning processes: experimentation, incorporation of material objects in the learning process, and storytelling.
As discussed in chapter 7, section 7.2.2.1, this study found that farmers conducted experimentation in order to have an authentic experience of how the interventions worked, and at the same time, gather ideas that could be used in their context. This process involved trial and error (e.g., trialling different varieties of rice in small areas and explore which variety adapted well in the existing environment). By engaging in experimentation, farmers were able to verify the plausibility of their emergent practice. It further allowed them to compare different rice production aspects to strengthen their practice. Through experimentation, farmers were able to shape their emergent practice and ensure productivity. In this study, it was observed that experimentation was done based on observations and not employing formal scientific inquiry. I observed that farmers conducted these small experiments not only to explore the feasibility of using new AT, but also to gain first hand evidence and experience in using the new AT. According to (Engeström, 2004), experimentation allows the construction of new knowledge, through gradual acquisition and internalization of knowledge and skills embedded within a given activity. In addition, (D. A. Norman, 1982a) described it as tuning, where as a result of the activity, individuals fine tune their practices to suit their situation. Fleck (1994) added that experimentation was essential for the improvement and modification of practice, he termed it “learning by trying” (p. 648), where individuals tried to improve their practices by carrying out activities involving ‘trial and error’.

Another noticeable characteristic of this stage of learning was the incorporation of material objects. For example, during one farmers’ meeting, a farmer showed the group his new concoction and in another instance, how they used a quadrat to identify harmful and beneficial insects. During this meeting, farmers used these materials to demonstrate to their fellow farmers how they formulated their concoctions (e.g., showing their concoction and telling fellow farmers its components) or performed the activity (e.g., using a quadrat to
identify harmful and beneficial insects). By showing these sociomaterial artefacts, farmers were able to have something tangible that could support their existing interpretations and practices, which allowed them to receive feedback from their peers. In addition, having these objects allowed them to organize their thoughts and reinforce their understanding. Previous research by Stigliani and Ravasi (2012) indicated that showing sociomaterial artefacts allows refinement of tentative understanding, reinforcing emerging belief and serving as building blocks for tentative interpretations. In addition, according to Engestrom and Ahonen (2001), this process of configuration allowed real-time feedback on the information of an individual’s activity, facilitating interpretation, negotiation and synthesis of the information among individuals. In this study, these conversations using objects as a tool allowed the construction of new collaborative understandings. These findings further confirmed those of Bechky (2008) and Carlile (2002), who claimed that boundary objects acted as tangible explanations that facilitated the transfer of understandings across different communities. With these roles of for sociomaterial artefacts in the organization, sociomaterial artefacts facilitated the resolution of individual issues and resolve representational gaps (Cronin & Weingart, 2007).

What was noticeable in the micro learning processes mentioned above was that a farmer’s learning was not confined to their own, but it was observed that farmers generally learned with other farmers. One interesting observation in the configuring learning stage was that farmers shifted from individual learning to group learning. I observed that a farmer usually turned to their groups and engaged in conversations whenever they had doubts, thus causing the emergence of group learning. Group learning involved group visits to the farms of others employing similar practices, which was found to stimulate the assimilation of early individual ideas into practice. As farmers at this stage perceived an increasing sophistication of their activity, sociomaterial artefacts (e.g., concoctions, demonstration farms, etc.) served
as a common visual reference as the farmers interacted (See section 7.2.2.2). As a common reference for group conversation, sociomaterial artefacts facilitated resolution of inconsistencies in practice and understanding, and at the same time, helped strengthen the relationships among farmers. These findings were similar to the findings of Stigliani and Ravasi (2012), where they claimed that group learning is essential for the gradual assimilation of a new practice that is developed through collective refinement. Stigliani and Ravasi (2012) further indicated this as a process of building on other’s ideas or practices, wherein individuals with the aid of sociomaterial artefacts are able to collectively refine their ideas and facilitate feedback. In addition Spinosa et al. (1997) found that communities of practice were necessary to validate tentative interpretations of individuals and facilitated the reinforcement of ideas and practices. In addition, Henderson (1991) also found that knowledge is created through group interaction. He found that members usually share objects so that they can explore abstract ideas with other members of a group, which enabled them to engage, manipulate, and confirm their ideas.

As the learning moved from simple to a more complex stage, conversations among farmers were observed to shift from instinctive to plausible story telling (see section 7.2.2.3). This study suggests that storytelling was used by farmers to reassess their understanding of their practices or beliefs. By listening to stories, they became of aware of what other farmers were doing and allowed them to retrospectively consider their own practice. These findings were found to be consistent with the findings of Spinosa et al. (1997), with storytelling seen as a result of overlapped sensemaking and sensegiving processes, where individuals are forced to retrospectively reassess their initial thoughts and reassure themselves regarding the appropriateness and logic of an emerging practice and change. Spinosa et.al. (1997) added that this stage permits disclosure of experiences and problems among individuals that
describe how they overcame problems in the course of their everyday practices and thereby brought about new practices.

In summary, configuring was the stage where farmers fine-tuned their understanding of their ideas, beliefs and practices through experimentation, and to reassess or allow retrospection by incorporating material objects in the process of learning and storytelling.

During experimentation, farmers were able to have an authentic experience of how technology worked and gained additional information on the interventions. They shared results of their experimentation with their peers to confirm their findings and observations. In addition, this stage of learning was also found to involve the use of sociomaterial artefacts that provided farmers with a tangible basis (e.g., demonstration farms) that could support their existing interpretations, organize their thoughts, and reinforce their understanding. In addition, group visits to demonstration farms allowed a process of building on other’s ideas by observing other farmers’ practices. This allowed gradual assimilation of a new practices and incorporation of new material objects that were developed through collective refinement. Furthermore, storytelling permitted disclosure among farmers of their experiences and problems and described how they overcame problems leading to the emergence of new practices. Lastly, farmers in this learning stage, shift their learning from individual to group, resulting in circumstances that allowed them to create new practices and artefacts, building on a range different of individual and collective practices and experiences. As the farmers built on each other’s ideas, they collectively reproduced and reconfigured their understanding. This reconfiguration will be discussed in detail in the next section.

8.4.3 Reconfiguring

In this study, reconfiguring was the stage where farmers learned by progressive exploration. I considered this as progressive exploration because farmers at this stage were
engaged changing, improving, modifying and creating new practices and sociomaterial objects as a result of the figuring and configuring stages.

During this stage, the connection between the farmers and the intervention that occurred in the configuration stage encouraged farmers to perform further revisions of their plausible practice and understandings. Their exposure to new experiences as they interacted with the technology in the configuration stage caused them to reconfigure their actions and the sociomaterial material artefacts they were engaging with.

As discussed in section 7.2.3, the process of reconfiguring involved the following: (a) farmers notice imperfections in objects they are using in their practice; (b) after noticing they identify causes for these imperfections; and (c) they then take action to resolve these imperfections by creating a new sociomaterial object, practice, or idea. To demonstrate this process, we can look at how one of the farmers noticed, identified imperfections of the material artefact and how he resolved these imperfections in reference to the processes above. Pastor (farmer) saw an imperfection in his concoction, as it did not contain sufficient NPK elements. He identified that the cause of this imperfection was the use of water as one of the fermenting agents. He resolved this imperfection by using banana sap as a fermenting agent instead of water, thus creating a new sociomaterial object.

In the example above, during the first process farmers referred to noticing the imperfection of the object as deficiencies of the intervention. In this process, the farmer reassessed the effectiveness of his concoctions and its ingredients to supply the necessary nutrient requirement of the plant because he was uncertain of its effects. This imperfection led to possibilities for modifying the object to fit with his needs. This finding is similar to the findings of Mazmanian, Cohn and Dourish (2014), where an anomaly of understanding in
practice could result in possibilities of action that allows individuals to examine other practices to resolve the irregularity.

In the second process, farmers were identifying the causes of the imperfection of the concoction. The farmer looked at what the concoctions were made of (i.e., its ingredients), and by doing this he was able to recognise the possible cause of the ineffectiveness of the concoction. According to Kahn (1990), at the point when an individual observes inconsistencies, they ask themselves the question, what is going on here? The answer to this question describes how they will engage with the situation. Kahn (1990) added that for those individuals who look for solutions, meanings are developed around the situation, which allows the individual to look for answers. This will in turn lead to the next process, the resolving of imperfections.

In this study, imperfections were resolved by modifying the concoctions to fit to the needs of the farmer. I found that it was not difficult for farmers to change an object to suit their purpose because the concoctions could easily be modified. This finding is consistent with the studies of Balogun and Johnson (2004), Johri, (2011) and Leonardi (2011) who found that the human agency can shape material properties, as individuals could purposely shape the materiality of an object to suit their purpose. In addition, Leonardi (2011) emphasized that, “today’s workers have many opportunities to make material changes to the technologies with which they work” (p. 148).

Lastly, the analysis indicates that, processes of reconfiguration, as discussed in section 7.2.3, resulted in farmers controlling the interventions rather that the interventions controlling them. This finding is consistent with Engeström (2004) who claimed that reconfiguring is the creation of new knowledge and new practices, and that learning is embedded in the entire activity system of an individual. In addition, Spinosa et al. (1997)
claimed that reconfiguring is about creating change or making a difference to human life. Thus, it is a way of no longer managing a practice, but controlling it and with this, control may be seen as a change of method for humans.

In summary, reconfiguration is the stage where farmers learned about the imperfections of the new interventions, identifying their causes and modifying them to suit their needs. These imperfections could result in exploring possibilities for actions that allowed farmers to examine other practices or ideas to resolve the inadequacies of the interventions. Identifying these deficiencies led farmers to explore the causes, which led to the identification of solutions that could result in the modification or creation of a new intervention. The result of the processes in this stage ultimately resulted in farmers controlling the technology, rather than the technology controlling them.

8.4.4 Synthesis

In summary farmers learn through the process of figuring, configuring and reconfiguring the intervention to suit to their needs. This process is illustrated in Figure 8.1, which commences with the figuring stage that involved micro learning processes such as linking ideas with material cues, verbal referencing and comparing and sorting out. These micro processes were undertaken to reduce and refine broad practices and ideas to fit specifically into the context of the farmers.

As farmers refined their ideas, they moved to the configuring stage, wherein they were found to engage in experimentation, incorporating sociomaterial objects in learning and storytelling. These micro processes were undertaken so that farmers would have authentic experiences with how technology works (experimentation with existing ideas and technologies), representation of practices and ideas (incorporation of sociomaterial objects) and to be able to reassess and focus retrospectively on their practices through storytelling.
As a result of the figuring and configuring stages, farmers engaged in reconfiguring of new practices and ideas obtained in the configuring stage, and engaging in progressive exploration. During this stage, farmers underwent the process of noticing imperfections of the new interventions, identifying the causes and modifying or creating new ideas or practices to suit their needs. It was further found during this stage that autonomy in farmers’ learning increased, which led to the creation of new knowledge and new practices. As an outcome of this process, farmers were found to control the interventions rather than the interventions controlling the farmers.

By tracing this learning path that farmers undertook, we can explore the microprocesses involved in the sociomaterial entwinement of farmers and intervention. The learning path farmers undertook involved continuous sensemaking and continuous enactment of shared affordances. Because of these microprocesses, agencies of both social and material were changed and eventually led to change in practice and technology.
Figure 8.1 Farmers’ learning processes
Chapter 9. Conclusions and recommendations

9.1 Introduction

The purpose of this study was to understand intervention adoption in the context of developing countries like the Philippines. To achieve this purpose, this study used perspectives of affordance as a lens to explore how farmers and interventions entwine. In addition, this study also utilized farmers’ sensemaking processes to understand the process of adoption, and identified the learning processes that helped shape their understanding, leading to the emergence of new practices and technologies and sustainable engagement with interventions.

This chapter first presents a summary of the findings of this study, then the contributions of this research to theory and practice. I then identify some limitations of the study and make suggestions for future research. The chapter ends with a summary of key insights from the research, aimed at crystallising the key contributions.

9.2 Synthesis of findings

There were three research questions this study aimed to answer. The first question was related to how farmers entwined with interventions. The second was on exploring the sensemaking of farmers that led to the adoption of the interventions. The third was related to understanding the farmers learning processes, helping shape their sustainable engagement with the interventions, and how this led to the emergence of new practices and new technologies. In the following section, the answers to the research questions are summarized.
Research Question 1 - “How do technology and individuals entwine?”

The findings of this study indicated that the process of entwinement of farmers and technology started by the noticing of the interventions. As the features of the technology were recognized, farmers then viewed the interventions considering how they were designed. This perspective related to the circumstances of the farmers and the intrinsic and extrinsic design of the interventions.

One of the significant findings of this study under the relational perspective on affordances was the shift from individual to group affordances. This shift was found to influence the creation of new intervention affordances and constraints, which in turn led to the emergence of new practices, strengthening the entwinement of farmers and the interventions.

There were however, conditions that were necessary to consider before entwinement could occur. In this study, there were six conditions that farmers perceived before they could entwine with the intervention, namely, (a) implementing conditions—referring to accessibility of the information and ease of use, (b) power condition—referring to the flexibility to change the design of the intervention through the influence of its users, (c) facilitating conditions—referring to the social structures that were put in place to assist farmers, (d) habitual practice conditions—referring to embeddedness of traditional practice, (e) land ownership—referring to the rights of farmers to the land they till, and (f) external affordance—referring to the incentives for adoption attached to the interventions. In this study, these conditions need not occur simultaneously for sociomaterial entwinement to take place. It was dependent on the circumstances viewed by farmers that would impede their adoption.
Research Question 2 - How do individuals make sense during the process of technology adoption?

As revealed in my study, farmers’ sensemaking begins because of an interruption in their routine. These interruptions, when recognized by the farmers, prompted them to act or ignore them, depending on how they perceived the interventions affordances.

Forms of sensemaking were found to be influenced by nature of the farmers’ entwinement with the interventions. Non-adopters underwent minimal sensemaking for some reasons. Similarly, quick adopters were also found to undergo minimal sensemaking because, adoption was guided or mediated, or their motivation is on the external affordance of the intervention or maybe be influenced by the culture ‘gaya-gaya’. The third level was reflective sensemaking. Farmers who engaged in this sensemaking process were found to undergo the complex sensemaking process proposed by (Weick, 1995).

When farmers underwent the reflective sensemaking process, the reflective sensemaking started in the enactment stage. After enactment, farmers undergo a selection process where they overlayed or abandoned their old practices, and replaced them with new practices. Farmers were also found to engage in the creation of learning spaces to overcome cultural issues and accessibility.

This study further revealed that sociomateriality could be embodied in sensemaking by exploring the degree of sociomaterial entwinement between farmers and interventions. The degree of sociomaterial entwinement was explored by looking at the four degrees of embeddedness of farmers and intervention, namely, (a) entwined sociomaterial (b) mediated entwined sociomaterial (c) loosely entwined sociomaterial- and (d) untwined sociomaterial-referring to non-adoption or use of the intervention.
Research Question 3 - How do individuals learn in their interaction with technology in a sociomaterial context?

This study revealed that the farmers learned through a continuous process of figuring, configuring and reconfiguring ideas, understanding and manipulating sociomaterial objects in their environment to suit their context.

These stages of learning were found to involve micro learning processes, which allowed farmers to reflect on their ideas and practices. In this study, the figuring stage of farmers learning was characterized as an exploration stage. Farmers at this stage were linking abstract ideas with material objects, verbal referencing, and sorting out. Farmers then engaged in configuring, where they were observed engaging in experimentation to gain authentic experiences and obtain ideas they could use in their context. The stage of configuring was also the stage where the farmers were found to incorporate material objects in the learning process to serve mediators in learning. They were also observed to engage in storytelling to convey ideas resulting from a new practice. As a result of figuring and configuring stage, farmers further engaged in reconfiguring new ideas and material objects. I recognised that reconfiguring was a stage of progressive exploration, where learning processes were not focusing on the newly introduced interventions, but aimed at creating new ideas and objects. During this stage, farmers were found to be trying to control the interventions, rather the interventions being in control.
9.3 Contributions to theory and practice

This section summarizes the contributions to theory and practice on the adoption of interventions in developing countries in informal education settings.

9.3.1. Contributions to theory

First, this study contributes to the understanding of processes of sociomaterial entwinement between routines and technology (Leonardi, 2011; Leonardi and Barley, 2008; Orlikowski & Scott, 2008; Scott & Orlikowski, 2009), as embedded in individuals and organizational dynamics. The findings indicated that the sociomaterial entwinement process was influenced by how affordances of an intervention were perceived by likely users of the intervention. This study has shown how the shift from individual perspectives of affordance into a group perspective on affordances strengthens sociomaterial entwinement and how the sociomaterial entwinement of farmers and interventions within the FITS centre led to perspectives of new affordances, technologies, and constraints. The findings also address the lack of studies identifying prior conditions for sociomaterial entwinement to occur (Leonardi, 2013). This study was able to identify conditions that influenced entwinement and un-entwinement of the social and material: implementing, facilitating, power, habitual practice conditions, land ownership, and perception of external affordance. Habitual practice, land ownership and perception of external affordances were found as novel conditions revealed in this study.

Secondly, this study contributes to the perspectives on sensemaking (Weick, 1995). Findings in this study provide insights into the processes of sensemaking, showing that farmers engaged in sensemaking in different ways. Farmers who were reflective sensemakers underwent the traditional process of enactment, selection and retention. However, farmers who were quick adopters adopted the technology without undergoing complex sensemaking.
Non-adopters were observed to undergo minimal sensemaking. Novel to this research was the finding that the cultural trait of ‘gaya-gaya’ influenced quick sensemakers. The findings further contribute by alleviating the paucity of research on the embodiment of sociomateriality in the sensemaking process (Maitlis, 2014). This study showed how sociomateriality is embodied in sensemaking, by examining the degree (looseness and tightness) of sociomaterial entwinement between farmers and interventions, exploring their sensemaking practices, and by examining the various patterns of sociomaterial entwinement that eventuated.

Lastly, this study contributes to the exploration of the learning processes during the adoption of an intervention. As evidenced in this research, learning among farmers is not only a mental activity but embodied in sociomaterial practice. While exploring farmers’ learning processes, this study has shown how a number of micro-learning processes ensued in the stages of learning. Learning occurred because farmers were adjusting to interventions and responding to interruptions to their customary practice. These findings contribute to the lack of research involving micro learning processes from a sociomaterial perspective during technology adoption. The findings also support the claim of critical realists such as Leonardi (2013) and Mutch (2013), who argue that the social and material are indeed separate entities that are placed into a relationship with one another and come to appear inseparable through human activity occurring over time. These findings do not support an important assumption of agential realists in sociomateriality that the social and material are inextricably related from the start (Orlikowski & Scott, 2008). The findings indicate that during the first stage of learning (figuring), learning practices generally rely on mental and verbal activities and a lack direct interaction with material objects and engagement with material practices. It is during
the configuring and reconfiguring stages that materials artefacts become entwined into the learning process.

The theoretical framework constructed in this study that links sociomateriality and sensemaking perspectives provides a lens to systematically analyze the influence of perspectives of affordance on patterns of sociomaterial entwinement of farmers and interventions. Using affordance as a lens, conditions that led to the sociomaterial entwinement were identified. Using a sensemaking perspective, it demonstrated how sociomateriality can be embodied in sensemaking. This study illustrated that the processes of sociomaterial entwinement, sensemaking and learning do not occur in isolation, but with distinct co-entwinements and in co-creation. This study showed that these processes involve farmers, farmers and artefacts, farmers and government and non-government organizations, organizational policies, farmers’ circumstances, local culture and contextual conditions, etc. Based on these results, the phenomenon of intervention adoption can only be understood if all aspects are taken into account.

Finally, this study contributes new empirical evidence to the sociomaterial studies of technology use and adoption in developing countries. In particular, the understanding of how the social and material entwine, resulting in the emergence of new practices and technologies and how learning shapes the creation of new practices and technologies.

9.3.2 Implications for practice

This study provides explanations of why some FITS centres were less successful in adopting ICT and disseminating agricultural technologies to farmers. That is, it offers explanations centred on how the farmers perceived affordances of the interventions, farmers’ sensemaking processes and how farmers learn. Findings in this study allow for deeper insights into why some FITS centres have not reached their full potential. This
potential has not been reached as implementers have lacked sufficient understanding of the processes of adoption, thus simply relying that technological features and inherent design of the interventions to convince farmers of the benefits of intervention adoption. The findings identified conditions that influence adoption, which are: implementing, facilitating which is similar to the findings of Sargent (2012), power as found in Ibarra and Andrews (1993) and Leonardi and Barley (2010), habitual practice conditions as observed by Dunbar and Garud (2009), land ownership, and perception of external affordance. These conditions were found to be influential when implementing interventions and farmers may only need to experience one of these conditions to facilitate intervention adoption.

Findings on farmers’ sensemaking processes offer intervention implementers evidence as to why some adoptions are temporary and why some farmers choose not to adopt interventions at all. Implementers lacked understanding of farmers’ sensemaking processes and assumptions were made that farmers were similar when it came to making intervention adoption decisions. The findings of this study shed light on the forms of sensemaking farmers undertake. By understanding these forms, implementers may be able to develop implementation strategies that will stimulate farmers’ sensemaking, eliminate barriers to sensemaking and minimise the effect of external affordances on minimal sensemaking and the effect of cultural traits such as ‘gaya-gaya’.

For policy makers and project implementers of similar FITS intervention in the Philippines or in other developing countries with similar context, the findings of this study may be useful in developing implementing guidelines when undertaking similar projects. These implementing guidelines could be anchored on how to influence adoption of technological intervention that would lead to change in practice of farmers or how intervention would be embedded sustainably in their work practices and routine.
Findings on the learning process show how learning may be facilitated in relation to the micro-processes found in this study. The lack of understanding on how farmers learn resulted in a lack of support by implementers for the learning activities of farmers. If farmers are not provided with the learning support they need, it may result in frustration, leading to the untwining of the relationship between farmers and the interventions. In addition, by understanding these micro-processes, implementers may be able to design strategies that will support specific learning processes. Examples include providing learning objects (sample materials, demo farms, etc.) that may facilitate learning processes, and organizing communities of practice so farmers can support each other in various ways.

Although these findings may not work in other context, these may work in specific cases in other developing countries undertaking similar technology intervention with similar audience. Specifically, in the Philippines were commonalities of the context where this research is conducted, considerations and understanding on how the above-mentioned factors could influence adoption maybe useful. In summary, these findings show the importance of the understanding of adoption among implementers, the conditions underlying as particular context and the significance of farmers sensemaking during the adoption process.

To sum up, this study could contribute to the management of FITS centres at local and regional level. This management of FITS centres should focus on technology role in farmers’ practices, rather than on what technology can do. For example, this can be done by developing manuals for FITS management or simple toolkits for agricultural technicians on how FITS centres can be run in ways that are appreciated by farmers.
9.4 Limitations of the study

This study was conducted using an ethnographic case study and relied heavily on observations of current practices and participants’ historical accounts and experiences. Thus, the analysis and interpretation of the adoption process mainly builds on the reconstruction of these events from participants’ accounts, rather than direct evidence collected during these events. The effects of this were tempered by confirming the data with accounts of other farmers prior to being introduced to the interventions. In addition, during the identification of the stages of sensemaking and learning, human practices were not seen to be well structured and linear, so that on a micro-scale various practices and stages may overlap. In order to address these issues, primary characteristics and processes were identified to represent each of the stages.

A further limitation of the study arises from its detailed focus on one particular setting. However, perspectives were sought from a range of key informants to obtain rich data to describe the adoption process. It may not be easy to generalise the findings of this study to all FITS centres and other contexts, however, theoretical and practical contributions outlined in this chapter provide a deep insight into intervention adoption processes and conditions that shape these processes may be of assistance in informing future studies. Since this study was done in the context of a developing country, results of this study may not apply in other contexts, however, some features and important contributions of this study could still be utilized.

9.5 Suggestions for further research

This study focused on the sociomaterial entwinement of humans and interventions, and on understanding the processes of adoption using sociomaterial and sensemaking perspectives. Examining these issues through other theoretical lenses would likely enhance
the body of knowledge on this topic. Specifically, further research pursuing this topic in the context of informal education in developing countries may benefit from considering the following:

1. Conducting similar studies in other settings. In doing so, findings and interpretations could be substantiated by looking at other contexts that may lead to identifying other practices that embody sociomateriality in learning and sensemaking processes in different ways;

2. The use of an alternative lens and methodology that would provide additional insights by examining processes of sociomaterial entwinement among individuals and organizations (e.g., Doornbos, Simons, & Denessen, 2008; Vaughan, 2008);

3. Further investigation of the influence of culture could provide better understanding of non-adoption of interventions (Melitski, Gavin, & Gavin, 2010; Zakour, 2004);

4. Extending sensemaking to include sensegiving processes\(^{18}\), could provide an additional understanding of the role of mediators in the process of intervention adoption (Rouleau & Balogun, 2011);

5. Consider the effects of motivation (intrinsic and extrinsic) in sustainable sociomaterial entwinement and how culture supports this relationship (Hofstede, 2011; Hofstede, 1997);

6. Trace further the processes of perception of affordance and sensemaking leading to emergence of shared affordance (Leonardi, 2011) and its continuous enactment in other organizational context.

\(^{18}\) As it was observed in section 3.3.2, sensegiving refers to intentionally changing how people think during the adoption process.
9.6 Synthesis of key insights

In conclusion, an intervention’s affordances, despite inherent features, are not essentially a product of the artefact itself. An intervention’s affordances are processes of human perspectives, enacted based on human plans of action and evaluated according to circumstances and goals, and thus, can be viewed as relational.

This study showed that for humans in the process of sociomaterial entwinement, affordances were initially perceived for their inherent general features, and that these perceptions can change as the interaction between humans and an intervention strengthens. Perspective on affordances shift from inherent technological features, to how an intervention was designed - in terms of its accessibility, internal and external feedback, circumstances of the users, etc., and how these were reinforced by other individuals within an organization. As perspectives of affordance change, humans perceive intervention affordances in relation to their goals, thus, perspectives become relational in nature, moving away from the idea that affordances are simply a bundle of features or how it was designed, but as properties of the environment surrounding humans and the interventions.

Therefore, viewing the adopters’ way of seeing affordances of interventions as changing and relational is a significant aspect in developing sociomaterial explanations on the entwinement of farmers and interventions. The implication of accepting a relational view of affordance is to assume that affordances are about actions in an environment involving both humans and technologies. In using affordance as a lens in exploring the sociomaterial entwinement, it is important to note how specific practices unfold during the process of entwinement, what farmers integrate during the process and how farmers’ view of affordances affect the environment.
The unfolding of practices during the process of adoption was explored using a sensemaking perspective. This study demonstrates how individuals make sense during the process of intervention adoption and how their sensemaking processes became an integral part in shifting tentative ideas to plausible practices.

The understanding of how individuals make sense in intervention adoption leads to an understanding of individuals’ decision-making to adopt or not to adopt. It further reveals the effect of other influences on the reasons of minimal sensemaking, such as perception of external affordance and ‘gaya-gaya’ culture, but which might be translated into sustainable adoption because of their impermanence. Therefore, relying on these two factors (external affordance and ‘gaya-gaya’) might not be sufficient to ensure sustainability of adoption, unless individuals perceive value in an intervention’s continuity.

From the findings of this study, we could therefore argue that sensemaking occurs when individuals try to make the interventions plausible within their own context. However, in order to attain this kind of engagement with the intervention, implementers must make sure that their actions will not inhibit the sensemaking process. In addition, it is fair to assume that sensemaking serves as a foundation for decision-making and learning processes among individuals and groups, as it allows the exploration of the plausibility of tentative ideas.

Lastly, this study on the learning process of farmers revealed that learning could be understood as embodied in practice. The informal learning setting examined, learning focus shifts from acquiring knowledge to actively interacting with peers and artefacts and improving one’s own practice. In the case of this study, learning is about figuring, configuring, and reconfiguring of the ideas, beliefs and practices to suit to the context of the farmers.
References


https://doi.org/10.1057/palgrave.ejis.3000290


https://doi.org/10.1002/hrdq.1231


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Appendices
Appendix A. Techno-Gabay Program Monitoring and Evaluation Form

**TECHNO GABAY PROGRAM MONITORING AND EVALUATION FORM (FITS level)**

<table>
<thead>
<tr>
<th>MAJOR FINAL OUTPUT (MFO)/PERFORMANCE INDICATORS (PIs)</th>
<th>TARGET</th>
<th>ACHIEVEMENT</th>
<th>RESPONSIBLE UNIT/PERSON</th>
<th>REMARKS/PROBLEMS ENCOUNTERED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td><strong>Information Services</strong></td>
<td></td>
<td></td>
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<tr>
<td>No. of IEC materials in various multi-media formats provided</td>
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<td></td>
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<tr>
<td>No. of new technologies, products and services exhibited</td>
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<tr>
<td>Pieces of information/technologies accessed through internet</td>
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<tr>
<td>No. of Information inquiry through SMS</td>
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<tr>
<td>No. of encoded records uploaded in the FITS IS Database</td>
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<tr>
<td><strong>Technology Services</strong></td>
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<tr>
<td>No. of technology training and fora conducted (FITS and MS)</td>
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<tr>
<td>No. of technical consultancy provided to clients (techno clinics)</td>
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<tr>
<td>No. of clients linked to experts, financial institutions, input suppliers and market</td>
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</tbody>
</table>
### Appendix A continued

| No. of technical assistance on enterprise development rendered |   |   |   |   |   |   |
| No. of quality planting materials and animal stocks made available to clients |   |   |   |   |   |   |

### Value-Adding Services

<table>
<thead>
<tr>
<th>Service</th>
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<tbody>
<tr>
<td>Product Packaging</td>
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<tr>
<td>Product Labeling</td>
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<tr>
<td>Food Safety and Handling</td>
<td></td>
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<td></td>
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<tr>
<td>S&amp;T support services to enterprise development</td>
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</tr>
<tr>
<td>Testing</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Other Value-adding services (please specify)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Prepared by: ___________________________

Noted by: ___________________________

Manager, FITS________________

RTGC, (Consortium)
Appendix B. Approval from the University of Sydney Ethics Committee

Research Integrity
Human Research Ethics Committee

Tuesday, 27 August 2013

Dr Lina Markauskaite
Fac Ed & Soc Wk - Research; Faculty of Education & Social Work
Email: lina.markauskaite@sydney.edu.au

Dear Dr Lina Markauskaite,

I am pleased to inform you that the University of Sydney Human Research Ethics Committee (HREC) has approved your project entitled “Learning and Enactment in Techno-Human Ecosystems: Implications for sustainable learning and innovation of farmers in the Philippines”.

Details of the approval are as follows:

Project No.: 2013/675
Approval Date: 26 August 2013
First Annual Report Due: 27 August 2014
Authorised Personnel: Markauskaite Lina; Importante Gilbert; Goodyear Peter;

Documents Approved:

<table>
<thead>
<tr>
<th>Date Uploaded</th>
<th>Type</th>
<th>Document Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/08/2013</td>
<td>Participant Consent Form</td>
<td>PIS</td>
</tr>
<tr>
<td>04/07/2013</td>
<td>Advertisements/Flyer</td>
<td>Advertisement / Flier</td>
</tr>
<tr>
<td>02/07/2013</td>
<td>Interview Questions</td>
<td>Interview Questions</td>
</tr>
</tbody>
</table>

HREC approval is valid for four (4) years from the approval date stated in this letter and is granted pending the following conditions being met:

Condition(s) of Approval

- Continuing compliance with the National Statement on Ethical Conduct in Research Involving Humans.
- Provision of an annual report on this research to the Human Research Ethics Committee from the approval date and at the completion of the study. Failure to submit reports will result in withdrawal of ethics approval for the project.
- All serious and unexpected adverse events should be reported to the HREC within 72 hours.
- All unforeseen events that might affect continued ethical acceptability of the project should be reported to the HREC as soon as possible.
- Any changes to the project including changes to research personnel must be approved by the HREC before the research project can proceed.

Research Integrity
Research Portfolio
Level 2, Margaret Tefler
The University of Sydney
NSW 2006 Australia
T +61 2 8627 8111
F +61 2 8627 8177
E r.humaneres@sydney.edu.au
sydney.edu.au
Chief Investigator / Supervisor’s responsibilities:

1. You must retain copies of all signed Consent Forms (if applicable) and provide these to the HREC on request.

2. It is your responsibility to provide a copy of this letter to any internal/external granting agencies if requested.

Please do not hesitate to contact Research Integrity (Human Ethics) should you require further information or clarification.

Yours sincerely

[Signature]

Professor Glen Davis
Chair
Human Research Ethics Committee

This HREC is constituted and operates in accordance with the National Health and Medical Research Council’s (NHMRC) National Statement on Ethical Conduct in Human Research (2007), NHMRC and Universities Australia Australian Code for the Responsible Conduct of Research (2007) and the CPMP/ICH Note for Guidance on Good Clinical Practice.
Appendix C. Observation Guide

Background of the Instrument

This guide is designed for observing the activities of the members of the organization in process of negotiation on technology adoption and sustainability. The observation will be conducted by participating in the organization and fieldwork. The observations will be conducted at a time and place where participants of the research are using the technology, during meetings, training programs and project implementation.

Purpose

The purpose of this observation is to specifically determine:

a. The learning capacity of individuals in the organization;

b. The process of sense-making and sense-giving cycle that occurs in the organization in resolving conflict; and

c. How are boundaries (boundary-in-practice and boundary–in- infrastructure) formed and changed by organizational agents who enable the diffusion of innovation.

The Observations

The observations will be conducted during the following:

1. Meetings of the Municipal Agriculture Office (MAO, agricultural officers and technicians)
2. Meeting of technicians, agricultural officers and farmers
3. Technicians’ visits to farmers
4. Processes of technology dissemination
5. Processes of resolving issues arising in technology use
6. Writing of technical reports
7. Other events encountered on-site
### Areas of observation

<table>
<thead>
<tr>
<th>Initial list of aspects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>How are the participants behaving?</strong></td>
</tr>
<tr>
<td>• How are they undertaking the activity?</td>
</tr>
<tr>
<td>• How are farmers seeking help and resources?</td>
</tr>
<tr>
<td>• How are farmers interacting with the learning environment?</td>
</tr>
<tr>
<td>• How are farmers motivated to join the activities of the FITS?</td>
</tr>
<tr>
<td><strong>How are the participants interacting?</strong></td>
</tr>
<tr>
<td>• Is there dialogue?</td>
</tr>
<tr>
<td>• How is the dialogue conducted?</td>
</tr>
<tr>
<td>• Who is talking/listening?</td>
</tr>
<tr>
<td>• What is their body language/non-verbal information?</td>
</tr>
<tr>
<td>• Is there evidence in the dialogue that farmers are learning?</td>
</tr>
<tr>
<td>• How are farmers learning from the dialogue? (e.g., staff-farmer, peer-peer discussion, group inquiry, etc.)</td>
</tr>
<tr>
<td>• How do support staffs responding to farmers learning needs?</td>
</tr>
<tr>
<td><strong>What is the evidence that farmers have learned?</strong></td>
</tr>
<tr>
<td>• Change in behaviour and dialogue?</td>
</tr>
<tr>
<td>• Ability to engage with other technological tools?</td>
</tr>
<tr>
<td>• Ability to improve productivity?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Technological Resources</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• What ICT resources are used to promote a particular agricultural technology?</td>
</tr>
<tr>
<td>• How does the innovation perform in terms of visual, sound, contents, structure of contents?</td>
</tr>
<tr>
<td>• How are farmers introduced to the resource (verbal information, written information, demonstration, training, etc.)?</td>
</tr>
<tr>
<td>• What information is given to farmers about</td>
</tr>
<tr>
<td>- Their learning?</td>
</tr>
<tr>
<td>- How to access and use it?</td>
</tr>
<tr>
<td>- How and where to get help if needed?</td>
</tr>
</tbody>
</table>
|  | Project implementation  
(some items may be based on documents of the FITS centers) |
|---|---|
| • How are farmers using it?  
- What do they seem to find helpful?  
- What do they have difficulty with?  
- How are they using it to interact with other users? |  |
| • How is the project been implemented?  
- Who is involved?  
- What project management approach has been adopted?  
- What are the roles and responsibilities and how were these were decided?  
- What are the timescales and milestones?  
- What resources are available (e.g., time, money, technology, personnel with appropriate skills/expertise etc)?  
- What documentation has been produced? How is this being used?  
- How is time managed?  
- How are decisions being made? |  |
| • How is the project team behaving?  
- How are they undertaking their own responsibilities?  
- How are they collaborating with other team members?  
- How are they participating in decision making? |  |
| • How is the project team interacting?  
- How often?What is being discussed?  
- Is dialogue constructive and collaborative?  
- Who is talking/listening?  
- What is the group dynamic? |  |
Appendix D. Interview guide for farmers

**Interview guide for farmers**

(Text in bracket is the translation of the questions in the native language)

1. Demographics
   i. Job Description
      (Kahulagwayan sa trabaho)
   ii. Educational Background
      (Nahuman nga edukasyon)
   iii. Work history
      (Kaagi sa Trabaho)

2. Understanding of the innovation introduced, limitations and benefits
   a. What do you know about the FITS center? How will you describe the FITS center as an innovation?
      i. (Ongsa may imong na hibal-an mahintungod sa FITS center? Isaysay ang imong pag sabot sa FITS center isip usa ka kabag-ohan o inobasyon?)
   b. What are the benefits and limitations of the technology provided by the FITS center that you incorporate in your farming activities?
      i. (Onsa may mga kaayohan sa teknolohiya nga nahatag kanimo sa FITS center nga nakatabang kanimo sa imong kalihokan sa pag-uma?)
   c. How did the benefits and limitations of the technology affect your view of your typical farming practices?
      i. (Sa mga kaayohan sa teknolohiya, gi onsa man ini pag apekto sa imong panglantaw sa pagkat-on sa teknolohiya?)
   d. Did the innovation change your farming practices? If yes how?, if no why not?
      i. (Naka usab ba kini sa imong kalihokan? Kung OO, gi onsa, kung wala, nganong wala?)
   e. How do you find the learning process on how to use the technology? How will you describe the process of learning the content and use of technology?
      i. (Sa proseso sa pag tu-on sa teknolohiya, onsa may imong masulti sa pag tulu-an sa pag kat-on sa teknolohiya? Onsa man ang proseso sa pagtu-on sa unod og pag gamit sa teknolohiya?)
   f. What are the changes in your practices due to technology?
      i. (Onsa may mga kausaban nga imong nasinati sa pag gamit sa teknolohiya?)
   g. How did you adapt to the changes in using the technology?
      i. (Gi-onsa man nimo pag dawat niining mga nasinati nimo nga pag gamit sa teknolohiya?)
Appendix E. Interview Guide for Municipal Agricultural Officers and Farmer Scientists

**Interview Guide for Municipal Agricultural Officers and Farmer Scientists**

(Text in bracket is the translation of the questions in the native language)

1. **Demographics**
   
i. **Job Description**
   
   (Kahulagwayan sa trabaho)
   
   ii. **Educational Background**
   
   (Nahuman nga edukasyon)
   
   iii. **Work history**
   
   (Kaagi sa Trabaho)

2. **Understanding of the innovation introduced, its limitations and benefits.**

   a. **What do you know about the FITS center?**
   
   (Onsa may imong na hibal-an mahintungod sa FITS center?)
   
   b. **How can you describe the FITS center as an innovation? What is innovative about it?**
   
   (Isaysay ang imong pag sabot sa FITS center isip usa ka kabag-oohan o inobasyon?onsa may naka-bag-0 ni ani?)
   
   c. **How do you engage with the center?**
   
   (Gi-onsa man nimo pag gamit ni ini?)
   
   d. **What are the benefits of the FITS center?**
   
   (Onsa may mga nahatag nga kaahoyan sa FITS center?)
   
   e. **Why do you think the FITS can improve your practices?**
   
   (ngano naka huna-huna ka nga ang FITS maka hatag og pag asenso sa imo mga kalihokan?)
   
   f. **What are its limitations?**
   
   (onsa may mga kakulangay o limitasyon ?)
   
   g. **Describe the process of implementation of FITS centers in your area.**
   
   (Ihulagway ang proseso sa pag implemntar sa FITS center sa inyong lugar.)
   
   h. **How does technology introduce by the FITS center fit in your routine work? How does it change your routine work? If yes, how? If No, how?**
   
   (Gi onsa pag apektos sa technolohiya nga gi hatag sa FITS center sa imong pang aadlaw-adlaw nga buluhaton, aduna ba kini konplikto sa imong tinuhu-an? Og naa,ngano? Og wala, ngano?)
   
   i. **How does the FITS center support your organization to solve farmers’ problems? If yes. How? If no, why?**
   
   (Sa imong kabahin, adunay bay natabang ang FITS center sa inyong grupo, para ma sulbad ang inyong mga problema isip mga mag-uma? Kung oo, gi-onsa? Kung wala,ngano?)
   
   j. **What are the challenges of sustaining the FITS center in your organization? Why do you consider this as challenges?**
   
   (Sa imong panglataw , onsa may mga hagit sa alang sa paglahutay sa FITS center alnang sa inyong grupo? Ngano imo man kining gi gi huna-huna nga hagit?)
   
   k. **How did you endorse the FITS centers to the farmers in the community?**
I. How did you manage the process of adopting the services of the FITS centers to farmers?

( Gi-onsa man nimo pag dumala ang proseso sa pag dawat sa mga serbisyo sa FITS centers sa mga mag-uma?)
Appendix H - Statutory Declaration of Translation Accuracy

Commonwealth of Australia

STATUTORY DECLARATION
Statutory Declarations Act 1959

1. DENNIS A. ALONZO, a student of University of New South Wales, Kensington Campus, New South Wales, with student ID number 3381316, a Filipino citizen presently residing in 842 Weeks Street, Kingsford, New South Wales, 2032.

make the following declaration under the Statutory Declarations Act 1959:

HEREBY AFFIRM THAT THE TRANSLATED QUESTIONNAIRE DOCUMENTS OF MR. GILBERT IMPORTANTE, a PhD student of the University of Sydney are true and accurate representation of the English language versions submitted to the Human Research Ethics Committee (HREC) of University of Sydney.

I understand that a person who intentionally makes a false statement in a statutory declaration is guilty of an offence under section 11 of the Statutory Declarations Act 1959, and I believe that the statements in this declaration are true in every particular.

[Signature]

Declared at [Name of University] on [Day] of [Month] before me.

[Signature]

Note 1: A person who intentionally makes a false statement in a statutory declaration is guilty of an offence, the punishment for which is imprisonment for a term of 5 years - see section 11 of the Statutory Declarations Act 1959.

Note 2: Chapter 2 of the Criminal Code applies to all offences against the Statutory Declarations Act 1959 - see section 5A of the Statutory Declarations Act 1959.

Kensington, 2052, NSW, Australia.
Appendix G. Initial codes during reading and re-reading the transcripts (75 open codes)
Appendix H. Codes generated from open coding

| 1. Enactment          | 49. Age  |
| 2. Figuring           | 50. Skills (Farmers)  |
| 3. Configuring        | 51. Skills (Leaders)  |
| 4. Reconfiguring      | 52. Learning space    |
| 5. Cultural conditions| 53. Sustainability    |
| 6. Power conditions   | 54. Feedback          |
| 7. Interpretive conditions | 55. Social interaction |
| 8. Ownership (Leaders)| 56. Economic         |
| 9. Ownership (Farmers)| 57. Access to experts |
| 10. Selection         | 58. Overcoming constraints (Leaders) |
| 11. Retention         | 59. Overcoming constraints (Farmers) |
| 12. Exploring         | 60. Functional affordances |
| 13. Verifying         | 61. Emergent practice |
| 14. Culture change    | 62. Technology design |
| 15. Experimentation   | 63. Old practices     |
| 16. Creation of learning space | 64. Discourses and processes |
| 17. Restricted sensemaking | 65. Source of information |
| 18. Culture (Gaya-gaya) | 66. Meaning making |
| 19. Guided sensemaking| 67. Learning process  |
| 20. Strong sociomaterial entwinement | 68. Location |
| 21. Mediated sociomaterial entwinement | 69. Involvement |
| 22. Loose Sociomaterial entwinement | 70. Verification |
| 23. Sociomaterially untwined | 71. External affordances |
| 24. Visual referencing | 72. Linking new ideas |
| 25. Sorting out       | 73. Observing and comparing |
| 26. Incorporating sociomaterial artefacts | 74. Resources |
| 27. Group learning    | 75. Financial         |
| 28. Story telling     |                |
| 29. Farm visits       |                |
| 30. Coordination and alignment |            |
| 31. Institutional     |                |
| 32. Cognition         |                |
| 33. Socialization     |                |
| 34. Cost              |                |
| 35. Information drive (Leaders) |            |
| 36. Information drive (Farmers) |            |
| 37. Infrastructure (Farmers) |            |
| 38. Infrastructure (Leaders) |            |
| 39. Interest (Leaders) |                |
| 40. Interest (Farmers) |                |
| 41. Ownership (Farmers) |            |
| 42. Ownership (Leaders) |                |
| 43. Physical ability (Farmers) |            |
| 44. Physical ability (Leaders) |            |
| 45. Time (Leaders)    |                |
| 46. Time (Farmers)    |                |
| 47. Education (Leaders) |            |
| 48. Education (Farmers) |                |
Appendix I. Sample Theme Descriptions

Descriptors for conditions for sociomaterial entwinement

<table>
<thead>
<tr>
<th>Themes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Technological and implementing design conditions</em></td>
<td>Referring to the flexibility of the technology and implementing design. These conditions are found not to be limited to the emergent functionality and feature of the technology (ICT) but also include access to technical facilities and opportunities for social interaction.</td>
</tr>
<tr>
<td><em>Habitual Practice conditions</em></td>
<td>Referring to routines or behaviours that are customarily undertaken because of cultural or inherent factors of technology.</td>
</tr>
<tr>
<td><em>Power conditions</em></td>
<td>Referring to the ability of the group or individual to influence change or modifications of the technology due to their collective influence.</td>
</tr>
<tr>
<td><em>Facilitating conditions</em></td>
<td>Referring to the organizational and technical infrastructure that exists to support the technology.</td>
</tr>
</tbody>
</table>
Appendix J. Sample cluster analysis by word similarity
Appendix K. Sample cluster analysis by coding similarity
Appendix L. Sample concept map generated from theme (initial iterations)
May 30, 2013

Mr. Gilbert Importante
PhD Candidate
Faculty of Education and Social Work
University of Sydney

Dear Mr. Importante,

This is to acknowledge receipt of your request to conduct ethnographic study for your research in one of the projects of our institution the Farmers Information and Technology Services (FITS) Center which is one of the leading projects of the University in partnership with the Department of Science and Technology (DOST) and the Local Government Units (LGUs) in the Region. Please accept my commitment, and that of the University of Southeastern Philippines (USEP) extension staff, to your proposed research project: Learning and Enactment in Techno-Human ecosystems: Implications for sustainable learning and innovation of farmers in the Philippines to be conducted here in one of our project recipients. Your research will surely benefit the State Universities and Colleges (SUCs) here in the Philippines who are implementing similar projects in community development. With this, I strongly support you and will give you enough assistance for your research here in USEP.

I am pleased to serve as your partner in this quest to improve community development delivery systems of SUCs in the Philippines. As such, I will assist you in (1) disseminating information regarding your research and (2) invite extension stakeholders in the region, who may be interested to participate in your research.

You may contact me through ryanjoyofmel@yahoo.com or through +63 82 227 5524 (208)

Yours truly,

DR. CARMELITA MARTINEZ
Director, Extension Services
University of Southeastern Philippines
June 20, 2013

Mr. Gilbert Importante
PhD Candidate
Faculty of Education and Social Work
University of Sydney

Dear Mr. Importante,

This is to acknowledge receipt of your request to conduct ethnographic study in the Farmers Information and Technology Services (FITS) Center in Municipality of Banay-banay, Davao Oriental. Please accept my commitment, and that of the Municipality of FITS Center staff, to your proposed research project: Learning and Enactment in Techno-Human ecosystems: Implications for sustainable learning and innovation of farmers in the Philippines. Your research will surely benefit the FITS Centers in the Philippines who are utilizing technology for community development. With this, I strongly support you and will give you enough assistance for your research here.

I am pleased to serve as your partner in this quest to improve community development as such, I will assist you in (1) disseminating information regarding your research and (2) invite farmers and stakeholders, who may be interested to participate in your research.

You may contact me through _______ or through _______.

Yours truly,

[Signature]

Manager
Farmers Information and Technology Services Center
Municipality of
Appendix O. Letter of Support FITS Centre B

Republic of the Philippines
Municipality of
8207 Davao Oriental, Philippines

May 30, 2013

Mr. Gilbert Importante
PhD Candidate
Faculty of Education and Social Work
University of Sydney

Dear Mr. Importante,

This is to acknowledge receipt of your request to conduct an ethnographic study in the Farmers Information and Technology Services (FITS) Center in Municipality of Davao Oriental. Please accept my commitment, and that of the Municipality of center staff, to your proposed research project: Learning and Enactment in Techno-human ecosystems: Implications for sustainable learning and innovation of farmers in the Philippines. Your research will surely benefit the FITS centers in the Philippines who are utilizing technology for community development. With this, I strongly support you and will give you enough assistance for your research here in

I am pleased to serve as your partner in this quest to improve community development as such, I will assist you in (1) disseminating information regarding your research and (2) invite farmers and stakeholders who may be interested to participate in your research.

You may contact me through

Yours truly,

[Signature]

Manager
Farmers Information and Technology Services Center
Municipality of Davao Oriental
WANTED: RESEARCH PARTICIPANTS  
(FITS Farmers)

Research participants are needed for a research aimed at investigating sustainability of technological innovation in community development in Region XI, Philippines.

Participation will involve one-on-one interview, focus group discussions and farm activity observations. Your participation will provide you with an opportunity to share your experiences and practices in utilizing technology in your respective farms.

Travel costs associated with the participation in the study will be reimbursed.

Interested participants may contact:

**Gilbert A. Importante**  
PhD Candidate, University of Sydney  
+639102479163 (Philippines)  
+61450467510 (Australia)  
gimp2244@uni.sydney.edu.au
The Centre for Research on Computer Supported Learning & Cognition
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Facsimile: +61 2 93515027
Email: lina.markauskaite@sydney.edu.au
Web: http://www.sydney.edu.au

PARTICIPANT CONSENT FORM

I, ..........................................................[PRINT NAME], give consent to my participation in the research project

Learning and Enactment in Techno-Human Ecosystems: Implications for sustainable learning and innovation of farmers in the Philippines

In giving my consent I acknowledge that:

1. The procedures required for the project and the time involved have been explained to me and any questions I have about the project have been answered to my satisfaction.
2. I have read the Participant Information Statement and have been given the opportunity to discuss the information and my involvement in the project with the researcher/s.
3. I understand that being in this study is completely voluntary – I am not under any obligation to consent.
4. I understand that my involvement is strictly confidential. I understand that any research data gathered from the results of the study may be published however no information about me will be used in any way that is identifiable.
5. I understand that I can withdraw from the study at any time, without affecting my relationship with the researcher(s) or the University of Sydney, University of Southeastern Philippines, Farmers Information and Technology Services (FITS) center in the municipality now or in the future.
6. I understand that I can stop the interview at any time if I do not wish to continue, the audio recording will be erased and the information provided will not be included in the study. I also understand that the data I provided in the focus group discussion cannot be withdrawn if the focus group discussion has commenced.
7. I consent to:
• Audio-recording YES ☐ NO ☐
• Video recording YES ☐ NO ☐
• Farm observation YES ☐ NO ☐
• Receiving Feedback YES ☐ NO ☐

If you answered “YES” to “Receiving Feedback”,
I want to receive feedback through the following:

Presentation YES ☐ NO ☐
A written summary of findings YES ☐ NO ☐
Copy of publication YES ☐ NO ☐
Communicating with the researchers YES ☐ NO ☐

through post or email

If you answered YES to the “Receiving Feedback” question, please provide your
details i.e. mailing address, email address.

Feedback Option

Address: __________________________________________________________
_________________________________________________________________

Email: ____________________________________________________________

..............................................................
Signature
..............................................................

Please PRINT name
..............................................................

Date