Knowledge Transfer in Base of the Pyramid Markets

DISSERTATION

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Abstract

This dissertation examines knowledge transfer in Base of the Pyramid environments. The Base of the Pyramid (BOP) refers to environments characterized by high-degrees of poverty and informal institutional environments. While extant theory helps illuminate knowledge transfer, there are also distinct features of BOP environments which suggest important boundary conditions to current theory. The purpose of this dissertation is to explore how these boundary conditions influence theory regarding knowledge transfer. Specifically, I explore how resource constraints, embeddedness within informal institutional environments, and the autonomy of knowledge recipients in the BOP alter extant theory regarding knowledge transfer. This dissertation is comprised of three papers. Paper 1 explores the replication of knowledge in resource constrained environments and asks the question: when resource constraints necessitate adaptation from a proven template, what knowledge transfer tools best facilitate adaptation? I explore the role of social interaction in determining whether such necessity adaptations from a template prove to be beneficial or detrimental to the knowledge recipient’s performance. My results suggest that more frequent interactions between the entrepreneur and practice experts who understand the ‘why’ behind each practice within the template can result in improved performance while more frequent interactions with entrepreneurial peers can produce much more varied results. Paper 2 examines how embeddedness
within informal institutional environments creates difficulties for knowledge transfer and how such challenges can be overcome. In this study, I explore how a development organization in Nicaragua sought to dis- and re-embed rural dairy farmers into new cognitive, structural, and cultural contexts in order to facilitate knowledge transfer. I identify specific mechanisms used by the development organization for dis- and re-embedding and explore the role of human capital and intrinsic motivation in determining the extent to which re-embedding occurs. I develop a causal model to explain how such shifts in embeddedness influence the success of knowledge transfer. Paper 3 builds on Papers 1 and 2 by exploring the comparative advantages of distinct knowledge transfer arrangements within BOP environments. In this paper, I focus on how the heterogeneity and autonomy of knowledge recipients influence the choice of effective knowledge transfer arrangement. I develop a contingency framework for selecting efficient knowledge transfer arrangements and demonstrate how low-cost exchange-based knowledge transfer is more appropriate for relatively homogeneous recipients while more costly combinatorial knowledge transfer methods are necessary when the recipients are more heterogeneous. In addition, when uncertainty among recipients is high regarding the effectiveness of knowledge, more combinatorial knowledge transfer methods are needed to facilitate effective knowledge transfer as they require recipients to bear lower costs as compared to exchanged-based knowledge transfer mechanisms. Finally, trust influences the degree to which uncertainty matters – when trust is high, recipients are more likely to adopt new knowledge, even in the face of uncertainty. This dissertation contributes to theory regarding knowledge transfer by questioning standard assumptions regarding
resources, institutional embeddedness, and autonomy, and by developing new theory that helps explain and predict successful knowledge transfer in BOP environments.
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Paper 1: Adaptations to knowledge templates in Base-of-the-Pyramid markets: The role of social interaction

Introduction

There is increasing interest in the transfer of knowledge, especially in resource constrained settings (Dyer & Singh, 1998; Hall, Matos, Sheehan, & Silvestre, 2012; Nahapiet & Ghoshal, 1998). Two perspectives in this research are particularly important: the impact of templates on knowledge transfer (Nelson & Winter 1982; Winter & Szulanski, 2001) and the impact of social interaction on knowledge transfer and, ultimately, on performance (Kogut & Zander, 1992; Morris & Snell, 2011; Nahapiet & Ghoshal, 1998). Prior work has shown that, independently, both the use of templates and social interaction can facilitate knowledge transfer (Adler & Kwon, 2002; Szulanski & Jensen, 2006). However, relatively less work has focused on how the use of templates and social interaction, together, might affect knowledge transfer (Hass & Hansen, 2007; Morris et al., 2009). This is especially likely to be an important issue when, due to resource and other constraints, knowledge recipients may seek out additional information from peers or other individuals in order to decide how to adapt one or more of the practices prescribed within the template (Giddens, 1990; Jensen & Szulanski, 2007; Lin, 2011).
The purpose of this paper is to examine how social interaction can either enhance or impair the performance of entrepreneurs when adaptations to templates are necessitated by resource constraints. The particular context examined in this paper is the sharing of knowledge regarding best practices between a development organization and 1,812 dairy farmers in rural Nicaragua in an attempt to improve their milk production. Our results suggest that templates can serve as an important knowledge transfer mechanism for improving performance within base-of-the-pyramid (BOP) settings. However, when templates require modification, the source of the entrepreneur’s social interactions can have a significant impact on their subsequent performance. More specifically, frequent interactions with practice experts that understand the ‘why’ behind each practice, and combination of practices, can result in ‘principled adaptations,’ or practices that adhere to the underlying causal principles and thus improve performance, while interactions with peers can have a much more varied effect on performance, as such adaptations can be either ‘principled’ or ‘presumptive’ in nature.

The paper begins by discussing the extant literature on knowledge transfer, specifically as it relates to the use of templates as a mechanism of exchange. We then proceed to hypothesize a main effect between template adherence and performance within the context of base-of-the-pyramid (BOP) environments, as well as positive and negative moderating effects of social interaction dependent on the knowledge source. After describing the methodology and empirical analysis employed within our study, we present our results and conclude with a discussion of our manuscript’s contribution to existing theory and avenues of future research.
**Theory development**

*The transfer of knowledge*

Knowledge consists of both factual statements and know-how regarding the means by which specific activities are carried out (Kogut & Zander, 1992). Thus, while knowledge regarding routines or practices usually contains simple information, it is also often comprised of multiple components which are, at least in part, tacitly linked to one another (Orlikowski, 2002). Indeed, scholars have argued that building and maintaining such complex knowledge within the bounds of an organization can serve as a source of competitive advantage (Barney, Wright, & Ketchen, 2001; Grant, 1996; Peteraf, 2006).

The capability to transfer complex knowledge across individual and firm boundaries is often desirable for many reasons (Markman, Phan, Balkin & Gianiodis, 2005). From an international business perspective, research has demonstrated that the ability for multinational corporations to transfer unique routines to subsidiaries or alliance partners can be a key determinant in the success of geographic expansion (Dhanaraj, Lyles, Steensma, & Tihanyi, 2004; Inkpen & Tsang, 2005). Similarly, the ability of consulting firms to effectively infuse knowledge surrounding best practices into client organizations is a key component of their ongoing survival and growth (Dixon, 2000; Werr & Stjernberg, 2003).

While knowledge transfer from one actor to another is often desirable, it has also been characterized as ‘sticky’ given the difficulties inherent in the transfer process (Szulanski, 1996; von Hippel, 1994). The primary difficulty rests in the social complexity and causal ambiguity associated with what are often multiple interrelated routines and
practices. For example, knowledge of a particular business model may be composed of a large number of parts that, for reasons of interdependence, are each an important component to generating the desired outcome (Adler & Kwon, 2002; Kogut & Zander, 1992). These interdependencies can lead to uncertainty with regard to linking appropriate resources to performance (Rivkin, 2000). As a result, exploring potential mechanisms for overcoming knowledge stickiness in the transfer process has been a primary source of discussion for management scholars (e.g., Cohen & Levinthal, 1990; Dyer & Singh, 1998; Gupta & Govindarajan, 2000; Hansen, 1999; Nahapiet & Ghoshal, 1998; Tsai, 2001).

One critical tool that can help mitigate some of the impediments of knowledge stickiness in the transfer process is a template (Szulanski & Jensen, 2004; Greenwood & Hinings, 1993; 1996; Nelson & Winter 1982). Templates are working examples of the knowledge to be transferred and often represent accumulated experience regarding organizational practices (Winter & Szulanski, 2001). In other words, they constitute a “blueprint,” which can be referred to repeatedly throughout the transfer process, and can thus provide a procedural map for simplifying and ordering a complex and causally ambiguous series of actions (Szulanski, Cappetta & Jensen, 2004). Templates also allow knowledge recipients to view the work in practice, rather than artificially separating daily details from codified abstractions of knowledge (Brown & Duguid, 1991), and help persuade recipients of the value of the practices by serving as “proof” of the potential results, thus reducing motivational impediments to transfer (Jensen & Szulanski, 2007).
Prior research has linked the use of templates with increased knowledge transfer (Jensen & Szulanski, 2004), improved performance (Jensen & Szulanski, 2007), increased network growth (Szulanski & Jensen, 2006), and lower organizational failure rates (Szulanski & Jensen, 2008; Winter, Szulanski, Ringov, & Jensen, 2011). Templates have also been found to be a critical knowledge transfer mechanism when introducing new knowledge to nascent ventures (Szulanski & Jensen, 2006; 2008). However, previous research suggests that characteristics of the specific context, the knowledge source, and the knowledge recipients can affect the ability of organizations to transfer knowledge using templates (Gupta & Govindarajan, 2000; Kostova & Roth, 2002; van Wijk, Jansen, & Lyles, 2008). Thus, we attempt to explore the efficacy of templates to transfer knowledge within base-of-the-pyramid markets.

The use of templates within BOP markets

Base-of-the-pyramid markets are defined as the impoverished regions of the world, particularly within Africa, Latin America, and South-East Asia, where the average individual survives on less than two dollars per day (Prahalad & Hart, 2002; London, 2009). In addition to economic poverty, such individuals often suffer from illiteracy and a general lack of human capital due to poor educational systems (Webb, Kistruck, Ireland, & Ketchen, 2010). As a result, the vast majority of individuals residing within BOP markets are necessity entrepreneurs which operate within the informal economy at subsistence levels (Renko, 2012).

At a macro level, the transfer of best practices across and within least developed countries is seen as a critical factor in attempts at alleviating poverty (Bruhn & Zia, 2011;
At a more micro level, such efforts are typically undertaken by development-oriented nongovernmental organizations that seek to redress the underlying causes of poverty through capacity building, reducing transaction costs, and generating additional business opportunities for entrepreneurs (Kistruck, Beamish, Qureshi, & Sutter, 2013). Increasingly, development organizations are taking a holistic value-chain approach which consists of both forming new linkages between entrepreneurs and potential buyers, as well as transferring knowledge surrounding best practices to entrepreneurs in order to improve the quality and quantity of goods they currently produce (McKague & Oliver, 2012).

However, the problem of knowledge ‘stickiness’ is particularly pertinent in transferring knowledge within BOP markets (Kistruck, 2008). This concern arises for a number of factors including a lack of institutions and infrastructure which support knowledge transfer in more developed markets, such as educational institutions, internet, libraries, and so forth. Such institutional voids make it difficult for entrepreneurs to access and process the knowledge they need (Khanna, Palepu, & Sinha, 2005). Furthermore, knowledge surrounding best practices designed for BOP markets often consists of multiple, interrelated and sequenced components which amplifies problems surrounding ‘stickiness’. Thus mistakes involving a single practice can result in little improvement in overall performance, and even more detrimental outcomes.

We argue that the use of templates as a mechanism to transfer knowledge surrounding best practices within BOP markets may address a number of these concerns. As mentioned previously, templates consist of working examples of a set of procedures...
or routines which can be referred to throughout the transfer process (Nelson & Winter, 1982; Winter & Szulanski, 2001). These working examples, supported by codified pictures or drawings to illustrate each practice may help overcome some of the challenges inherent due to formal institutional voids, such as literacy problems, inadequate communications infrastructure, a lack of quality educational institutions and related challenges prevalent amongst BOP entrepreneurs. Templates also allow the recipient to imitate every aspect of an established process. Such imitation is particularly important within BOP markets, given that valuable tacit knowledge is often embedded within everyday practices and organizational routines (Orlikowski, 2002). Templates thus ensure that valuable cause-effect relationships are not lost through human error as recipients try to understand the complexity behind the practices (Szulanski & Jensen, 2008).

Deviations from established templates within BOP markets may exacerbate the problems associated with “knowledge stickiness” (Jensen & Szulanski, 2004). The more that entrepreneurs deviate from the practices prescribed within the established template, the more the template loses value as a referent when they might experience implementation problems because they can no longer rely on the template as a diagnostic tool (Szulanski & Jensen, 2006). Furthermore, adaptations made to even a single component of a template without an explicit understanding of the underlying causal linkages can have a number of adverse ancillary effects (Szulanski & Jensen, 2006). A great deal of the purported value of a template rests in not requiring recipients to understand “why” something works but only to know “how” it works—a much more manageable task in complex business models (Brown & Duguid, 1991). However,
perhaps the greatest detriment of template deviation is adaptation will likely entail a costly trial and error process without guaranteeing the ultimate success of the exercise (March, 1991; Shenkar, 2010; Winter & Szulanski, 2001). For entrepreneurs operating in BOP markets, which already face significant shortage of time and money, such additional costs can prove extremely consequential.

Therefore, we hypothesize, as a main effect, that deviating from a best practices template within BOP markets decreases the effectiveness of an otherwise valuable medium for knowledge transfer (Jensen & Szulanski, 2007; Winter & Szulanski, 2001). As a result, we would expect that the more exactly entrepreneurs replicate a template of multiple practices, the better their overall performance.

Hypothesis 1: Replication of practices within a template will produce higher levels of performance in BOP markets.

Necessity adaptations and the role of social networks

Virtually all of the research exploring the relative effects of replicating templates on performance has been based on the underlying assumption that knowledge recipients possess the ability to implement a template if so desired. However, in many knowledge transfer contexts, the ability to replicate within a new environment may be severely constrained by forces beyond the recipients’ control, such as government regulation (Teece, 1998), incompatible technologies (Kogut & Zander, 1992), or inadequate resources (Koburg, 1987; Pfeffer & Salancik, 1978). In such situations, knowledge recipients typically undertake a series of potentially suboptimal, but necessary, adaptations to an established template.
The transfer of knowledge to entrepreneurs residing within BOP markets is a prominent example of a context in which knowledge recipients often face severe resource constraints. Knowledge transfer within such settings is a common obstacle for businesses attempting to expand into the potentially higher growth markets of the BOP (London & Hart, 2004; Makino & Delios, 1996) as well as for nongovernmental and multilateral agencies seeking to improve the well-being of such countries’ inhabitants (Hoekman, Maskus, & Saggi, 2005). Necessity adaptations, as a result of resource scarcity, are an everyday reality within such environments: mechanics must use makeshift tools to work on cars, doctors must modify their treatments to account for the limited selection of medicines and facilities, and teachers must instruct with limited textbooks and classroom facilities. Of course, necessity adaptations due to resource constraints is not a unique challenge to the developing world — it is common for many organizations and individuals to face some degree of resource constraint that inhibits the exact replication of existing templates as a result of the uniqueness and heterogeneity of each of their resource sets (Maritan & Brush, 2003). However, the relative influence of resource constraints is much greater in BOP markets.

This prevalence of resource constraints in most environments, albeit to varying degrees, presents several important questions for the study of knowledge transfer. While adaptation may not deliver superior performance to replication, what are the prescriptions that can be offered to help mitigate the downside of template deviation? In the presence of necessity adaptations to existing templates, where do knowledge recipients turn for information to assist with their modifications to prescribed practices? Does the source
they turn to, and the frequency with which they interact, impact the quality of their solutions and ultimately their performance?

To answer these questions we turn to insights from the literature on social interaction, which provides a rich discussion of the relationship between social interaction and knowledge exchange (Adler, 2001; Granovetter, 1985; Reagans & McEvily, 2003; Uzzi, 1999). While previous academic work on templates as a mechanism for knowledge transfer has viewed templates in isolation, in practice, knowledge recipients may frequently interact with one another (Adler & Kwon, 2002; Kang, Morris, & Snell, 2007; Nahapiet & Ghoshal, 1998).

In considering the value of such social interaction, we follow recent work in placing special emphasis on the content of the knowledge provided through such interaction (Dokko, 2004; Kang et al. 2010; Rodan & Galunic, 2004). This literature contends that the attributes of actors within a network are important in determining the benefits of social interaction. For example, Adler & Kwon’s (2002) definition of social capital emphasizes not only relationships but also the different types of information that such relationships provide. Thus, the degree to which social interaction provides valuable new knowledge may depend on with whom the interaction takes place. We begin by hypothesizing the effects of more frequent social interaction with entrepreneurial peers on performance outcomes, and then proceed to contrast such predications with interactions with practice experts.

*Social interaction with other entrepreneurial peers.* Interaction between entrepreneurs in BOP markets and their vocational peers who are also attempting to
follow a prescribed template, may potentially provide a number of benefits. For instance, increased interaction can furnish the entrepreneur with access to similar perspectives, facilitating communication. This level of “perspective relatedness” may be somewhat helpful in sharing ideas regarding practices within a given template and designing adaptations in the face of resource scarcity (Granovetter, 1973; Hansen, 1999). Similarly, increased interaction with the entrepreneur’s peers may improve the overall efficiency of a trial-and-error process (Winter & Szulanski, 2001). Specifically, the sharing of stories could potentially speed up the overall learning curve and reduce the chances that adaptations that are detrimental to performance would be repeated.

However, frequent interaction with entrepreneurial peers also potentially leads to a number of pitfalls. As has been mentioned previously, when knowledge recipients deviate from a template, the template loses value as a referent, and recipients are forced to seek out other sources of knowledge (Jensen & Szulanski, 2007). These sources of knowledge are not necessarily unambiguously helpful; incorrect or misunderstood knowledge can also be transferred (Huber, 1991). While the entrepreneur’s peers may possess a great deal of knowledge regarding local practices or attributes of the local environment, they are unlikely to understand the causal relationships and interdependencies embedded within the template (Szulanski & Jensen, 2006; Szulanski & Jensen, 2008). Furthermore, frequent interaction with peers represents an opportunity cost in a resource-constrained environment where the ability to access knowledge from other sources is significantly diminished (Hansen, 1999). Thus, while shared understandings created through repeated peer interactions may be more homogeneous in
nature due to their perspective relatedness, the resulting adaptations are unlikely to grasp the complex nuances and interdependencies inherent in the model.

Such adaptations can be considered presumptive in nature, in the sense that they are based on untested (and often incorrect) assumptions (Szulanski & Jensen, 2006). While social interaction may facilitate the recombination of knowledge (Nahapiet & Ghoshal, 1998), the resulting aggregated ‘new knowledge’ will most likely be incorrect if part of the content upon which it was based was in some way flawed. Furthermore, such interaction may simply amplify confusion surrounding subsequent adaptations. As the template increasingly loses value as a referent through increased presumptive adaptations, entrepreneurs may be forced to rely even more heavily on the guesses and untested beliefs of peers. This reliance may be especially detrimental when there are fewer ‘correct’ adaptation solutions to a particular process (Nickerson & Zenger, 2004). In such cases, a wider variety of inappropriate solutions provided through peer interaction may simply decrease the odds of finding a solution that works.

A number of knowledge recipients within the same peer network who adopt a particular adaptation simultaneously may also confer a certain amount of unjustified legitimacy to the practice and encourage further emulation. Research on group dynamics has suggested that, when participants share similar characteristics, they are likely to follow the actions of others within the group without critically evaluating the decisions being made (Esser, 1998; Janis, 1982). This behavior is potentially problematic within a knowledge transfer setting involving multiple recipients who trust one another, as they are less likely to be critical of the information being shared (Levin & Cross, 2004; Lount
& Pettet, 2012). In the absence of a deep understanding of the template model, there is a risk that social interaction between trusting peers will simply reinforce incorrect ideas.

We therefore hypothesize that more frequent social interaction between knowledge recipients and their entrepreneurial peers is likely to decrease overall performance as the number of adaptations increase because the knowledge that is exchanged is predominantly presumptive in nature. In other words, rather than providing insight based on cause-and-effect principles, adaptations arising from peer interactions are likely to be based on untested beliefs and negatively amplified through increased social interaction. Thus, when resource constraints necessitate adaptation, interaction with peers is likely to produce a detrimental combinative effect in which the negative effects of deviating from the template are worsened with increased interaction. Therefore, we hypothesize:

*Hypothesis 2a: Increased interaction with entrepreneurial peers will negatively moderate the relationship between number of adaptations and performance in BOP markets.*

*Social interaction with practice experts.* An alternative source of information for entrepreneurs in BOP markets when undertaking adaptations within the knowledge transfer process is practice experts. Practice experts are those individuals who possess not only a detailed understanding of individual practices within the template but also a deep understanding of *why* things work. While using a template provides knowledge recipients with a detailed understanding of “how” the practices and routines within the template work, it typically contains very little information on “why” such practices work. Indeed,
one of the strengths of a template as a medium is that it allows for fast and simple communication of what are, in actuality, a very complex set of interrelated practices. Template experts are typically agents of the organization that initiates the knowledge transfer process and have undergone extensive training regarding the underlying intent of each template practice, or professionals who have received formal educational training in the field of study. As compared to knowledge recipients, practice experts are much more acutely aware of how different practices within a template are interrelated.

Prior research focused on the particular content of transferred knowledge has begun to untangle some of the differences between presumptive beliefs, which are based on untested beliefs and assumptions, and principled understanding (Baden-Fuller & Winter, 2005; Morris, Snell & Hammond, 2010). Such work has suggested not that adaptation from best practices is necessarily harmful per se, but rather that successful adaptations adhere to the principles underlying the original practices (Baden-Fuller & Winter, 2005). We argue that, when undertaking necessity adaptations, accessing principled knowledge through frequent interaction with practice experts is imperative. Because practice experts have a principled understanding of “why” practices work, the exchange of information with knowledge recipients can be highly targeted in nature and match appropriate adaptations with specific needs without destroying the intended value of the practice.

In addition, the recombination of knowledge between the practice expert, who possesses a deep knowledge of the principles underlying the interrelated practices, and the entrepreneur, who possesses a deep knowledge of his or her own unique resource
bundle, can lead to a valuable recombination of knowledge. In such instances, new adaptations can be created without violating the intended principles of the practices. Furthermore, by ensuring that such adaptations continue to meet the functional intent of the original practice, the template can maintain its value as a guide and referent throughout the remainder of the implementation process (Jensen & Szulanski, 2007). In this way social interaction can serve as a complement to templates as a knowledge transfer mechanism (Hansen, 1999; Regans & McEvily, 2003).

Therefore, we propose that increased interaction of entrepreneurs within BOP markets with template experts when undertaking adaptations to an established template will result in increased performance. By interacting frequently with such experts, the entrepreneur will be able to garner a more principled understanding of the often tacit meanings underlying the codified practices, and to engage in adaptations that maximize the intent of each practice within the bounds of his or her individual resource constraint. We refer to these adaptations as ‘principled’ because they adhere to the principles underlying the functioning of the template. Comparatively, without frequent interaction with experts, the entrepreneur may be more likely to undertake presumptive adaptations which are less likely to maintain the integrity of the overall template and thus more likely to negatively impact overall performance. Thus, we hypothesize:

*Hypothesis 2b: Increased interaction with practice experts will positively moderate the relationship between number of adaptations and performance in BOP markets.*

*Methods*
We tested our hypotheses using data from a large-scale development project undertaken in Nicaragua over a three-year period that entailed the transfer of best practice knowledge from “Milktech,” an international nongovernmental organization, to 1,812 rural dairy farmers. The primary objective of the project was to increase the quantity of high-quality milk that the farmers produced and link them with larger and more profitable urban markets. The project introduced a dramatic change in farm management, transforming the farms from traditionally-run, subsistence farms into business-oriented, technologically-managed ventures. The farmers, as the knowledge recipients within the project, were located within the Western Departments of Leon and Chinandega, which are two of the poorest regions of the country. The project had been in place for two years at the time the data were collected.

The primary tool used for transferring the knowledge surrounding best practices was a template that consisted of 45 interrelated dairy practices encompassing a number of distinct areas. Farmers had access to templates through several ways. First, farmers were taken to distant locations (either in a neighboring country or neighboring region of Nicaragua) to observe an established template in action. Second, one farm from each group of farmers was chosen to serve as a ‘model farm.’ This farm received extra inputs and help from Milktech in order to serve as a working template which other farmers could observe. Finally, Milktech had created six posters dealing with different aspects of the template, which together comprised the overall set of best practices that the organization was trying to convey to the farmers. Each poster had pictures and words describing 5-8 practices. The subjects for the posters included reproduction, the care of
newly born calves, the use of minerals, the use of sugarcane, the use of legumes, and hygienic milking.

The practices had been designed and validated by Milktech specifically for the Nicaraguan context and represented years of experience in and scientific research on best practices for milk production in sub-tropical regions. These practices had been designed specifically for BOP producers and were based on experience in similar regions in Honduras and Costa Rica. While each of the practices had the potential to provide some benefit if implemented independently, the practices were also highly interrelated. For example, while practices related to the cultivation and use of sugarcane were logistically separate from those related to the use of legume tree leaves in the cows’ diet, sugarcane is much more beneficial when combined with the protein-rich legume tree leaves. Similarly, the potential benefit provided by the practices associated with summer feeding depended significantly on the extent to which salts and minerals were also made available to the cattle.

Many of the 45 practices that comprised the overall template represented a vast departure from the practices used previously by the dairy farmers. Traditional means of operating a dairy farm within the regions of Leon and Chinandega typically dictated very little active management – cows were simply allowed to graze in open fields and then milked each morning. The newly prescribed best practices, such as the use of minerals, the division of pastures, or even hygienic milking practices, were therefore unfamiliar to the farmers and their efficacy not readily apparent. For instance, most dairy farmers did not see any real need for hand washing prior to milking or perceive any potential linkages
between the absence of hand washing and the high bacteria counts within milk that would limit the markets to which they could sell.

One of the biggest challenges for farmers participating in the project was that many of them did not possess sufficient financial resources to replicate all of the practices as designed. Nicaragua remains one of the poorest countries in the Western Hemisphere with per capita GNI per capita of approximately US$1,100 (World Bank, 2012). Furthermore, Leon and Chinandega are two of the poorest districts within the country. As a result, many farmers within these districts needed to undertake adaptations to one or more of the 45 practices that comprised the overall template; these farmers would, by necessity, implement makeshift or modified solutions for distributing the prescribed salts and minerals to the cattle, constructing physical structures, or planting certain types of grass and other feed. For example, in the case of providing salts and minerals, many producers could not afford to provide minerals to all of the cows every day. Thus, they needed to make a decision of whether to give the prescribed amount to only a subset of cows within their herd or to give less than the prescribed amount to all of their cattle. Such decisions could have very different implications for the overall level of milk production.

This research setting proved a fruitful context for the study of knowledge transfer using templates and necessity adaptation for a number of reasons. First, the dairy sector in rural Nicaragua was undergoing rapid transition and growth as it shifted from primarily serving small, local markets to engaging in multinational milk markets (Perez-Aleman, 2011). Successful integration into multinational markets required an
improvement in quality standards as well as an increase in quantity of milk per farm, both of which necessitate a significant change in farm management techniques. Second, the context involved very small farms where factors such as geographic co-location and the subsequent social interaction provided important opportunities for informal learning (Almeida, Dokko & Rosenkopf, 2003). Finally, the practices were complex and highly causally ambiguous to the rural farmers, but not to the veterinarians and Milktech technicians acting as experts.

The surveys were conducted by the first author or by one of two sixth-year veterinary students recruited from a local reputable university. The students were familiar with the geographic area as a result of a recent three-month internship. They were also given training by the first author on survey administration and traveled with the first author when conducting surveys. The survey was initially face validated by the five main managers of fieldwork for the consulting organization and then pretested with 20 farmers. Minor changes in formatting and wording were made subsequent to the pre-test. The surveys were conducted in person at both regional milk collection centers and on the farmers’ property. The surveys averaged approximately 15 to 20 minutes to administer.

The difficulty of road access to farmer communities, which at times required several hours of travel over dirt roads, made complete randomization logistically infeasible. However, efforts were made to obtain as representative a sample as possible. These efforts included making careful plans to obtain surveys from each of the four sub-regions involved in the project (northern Leon, southern Leon, northern Chinandega, and southern Chinandega) and from 11 of the 24 different municipalities within the sub-
region. A total of 165 surveys were conducted from the total population of 1812 dairy farmers who had participated in the project. Out of the 165 surveys that were conducted, 7 surveys were removed from our sample because the producers were not milking any cows at the time of being interviewed and thus failed to provide performance data. Thus, our final sample size was 158 farmers. To check for potential biases within our sample, we obtained baseline milk production data from Milktech for all their participating farmers gathered prior to the project and at the end of the first year of the project. We conducted a one-way ANOVA test and found no significant difference in production between those in our sample and the total population for either year in which data was available (p-values = 0.24 and 0.23 respectively).

Measures

Performance. To measure our dependent variable, performance, we asked each farmer to indicate how many cows they had milked that morning and how many liters of milk they had produced that day. Preliminary discussions with project managers at Milktech had revealed that milk production does not vary greatly from day to day within any given month (the largest variance is between the wet and the dry season and all surveys were gathered within a four week period during the wet season). However, the managers also indicated that asking the farmers to average their milk production could be problematic and lead to either over or underestimation in their answers. Similarly, asking farmers directly about milk production per cow could lead to bias on the part of farmers or be associated with problems of numerical competency. Based upon prior experience, Milktech advised asking the producers how many cows they had milked that morning.
and, separately, how many total liters were produced that day would likely mitigate such problems. Both of these pieces of information were well known to the farmers because they were actively involved in the milking of all of their cows and were used to selling the milk they produced by the liter. This information was then used to calculate the average number of liters produced per cow per day.

Replications. Our measure of replications was based on a similar measure used by Westphal, Gulati, and Shortell (1997), as well as by Szulanski and Jensen (2006). For each of the 45 practices, the survey asked the farmer to indicate whether they replicated the practice exactly as it was laid out on the template, adapted the practice from what was prescribed on the template, or did not do the practice at all. Thus, replication was calculated by summing the number of practices the farmer indicated he or she replicated exactly as laid out in the template.

Adaptations. Similarly, our measure of adaptations was calculated by adding the total number of times each farmer indicated he or she adapted one of the 45 different practices from what was prescribed on the template.

Interaction with Entrepreneurial Peers. As part of the survey, each farmer was asked to indicate how often he or she spoke to other farmers participating in the program. Specifically, farmers were asked to indicate how many times each month, on average, they discussed the practices they were implementing on their farms with these peers over the last year. The respondents were asked to average the number of times they interacted with other farmers because prior research has suggested that individuals have an easier time recalling overall patterns of social interaction as opposed to recalling specific events
Interviews with technicians from the development organization as well as farmers indicated that prior to the project, seeking dairy advice from peers was relatively uncommon.

Interaction with Practice Experts. The survey also asked farmers to indicate how often they interacted with experts. Practice Experts included both technicians employed by ‘Milktech’ and veterinarians within the region who had a similarly deep understanding of the underlying function and interrelatedness of the practices being introduced. Again, we asked the farmers to indicate the average number of times each month that they interacted with such experts over the last year.

Controls. We included a number of theoretically-relevant controls within our statistical model to account for potential covariance. Three measures of human capital were included in the survey to account for individual-level differences that could affect the potential success or failure of an adaptation to the established template. The first measure, Education, was calculated by asking the farmer to indicate the highest level of education attained. Farmers were assigned a score from 0-13, depending on how many years of formal education they had received. Any formal education beyond grade 12 was coded as a 13, and 13 included formal training in a professional school, a vocational school or a university. The second measure of human capital was Experience, which indicated how many years the farmer had been engaged in dairy farming. Finally, Trainings was a measure of the number of trainings that the farmer had received outside of the development project with Milktech.
The control *Cattle* was calculated as the total number of cattle owned by the farmer as a proxy for the wealth level of the farmer. Inclusion of this variable within our models was important because it helped control for the correlation between farmer wealth and the need for adaptation rather than replication, as well as for a potential correlation between the amount of financial capital a farmer possessed and the potential quality of the adaptation. We also included a control for *Baseline Utility*, which was obtained from archival data possessed by Milktech. When the development project began, Milktech had gathered production information for all 1812 farmers and estimated their daily profitability in Cordobas (at the time 1 US$ was equal to approximately 20 Cordobas). Thus, we included baseline utility as an additional control for the a priori ability of producers to invest in new practices at the beginning of the project. A control was also included for whether or not the respondent had been designated as one of a handful of *Group leaders* who would have experienced increased levels of social interaction simply as a result of assuming this role. *Employees* was a control for the number of paid employees on the farm and was included to help account for differences in the organizational size of the farms. Finally, *Farm size* was a measure included to account for differences in the number of manzanas (one manzana is approximately 1.73 acres) for each farm, which may have affected farmers’ physical ability to implement some of the practices as prescribed by the template.

*Analysis and Results*

To statistically test our hypotheses, we used ordinary least squares regression with a robust variance estimator. The regression models were estimated using Stata version 11.
The models included the dependent variable *performance* and the independent variables outlined in Table 2. One potential concern in estimating the regression models was a potential lack of independence for observations from farms in the same geographic cluster that may be subject to a host of group effects. In order to account for the potential correlation of the error terms for farms within the same geographic cluster, we used a robust variance estimator (“cluster”) in our models (Huber 1967; White 1980, 1982). This technique accounts for the within-group correlation of error terms. An alternative option for addressing potential interdependence would have been to include a fixed effect for geographic cluster in our models. We ran this analysis as a robustness check, and the results were not qualitatively different from the analysis presented herein.

Table 1 provides the means, standard deviations and minimum and maximum values for each variable, and Table 2 shows the correlations between variables. To reduce potential problems with multicollinearity, we centered all variables prior to creating the interaction terms. A post-hoc analysis of the variance inflation factors showed that multicollinearity was not a significant concern. Model 1, illustrated in Table 3, includes all of the control variables but excludes independent variables of interest.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
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<tr>
<td>Performance</td>
<td>3.64</td>
<td>1.23</td>
<td>0.75</td>
<td>7.33</td>
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<td>Education</td>
<td>4.95</td>
<td>3.76</td>
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<td>13</td>
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<td>13.08</td>
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<td>Trainings</td>
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<td>0.52</td>
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<td>Cattle</td>
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<tr>
<td>Employees</td>
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<tr>
<td>Baseline Utility</td>
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<td>323.19</td>
<td>99.94</td>
<td>2258.58</td>
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<tr>
<td>Farm Size</td>
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<td>34.08</td>
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<tr>
<td>Replicate</td>
<td>24.30</td>
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<td>Adapt</td>
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<tr>
<td>Expert Contacts</td>
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<td>16</td>
</tr>
</tbody>
</table>

Table 1: Mean, standard deviation (SD), minimum and maximum (n=158)
Table 2: Correlations

<table>
<thead>
<tr>
<th></th>
<th>Performance</th>
<th>Education</th>
<th>Experience</th>
<th>Training</th>
<th>Group Leader</th>
<th>Cattle</th>
<th>Baseline Utility</th>
<th>Farm Size</th>
<th>Peer</th>
<th>Expert</th>
<th>Replicate</th>
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</thead>
<tbody>
<tr>
<td>Education</td>
<td>0.28***</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>Experience</td>
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<td>-0.19*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Trainings</td>
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<td>0.10</td>
<td>-0.04</td>
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<td></td>
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</tr>
<tr>
<td>Group Leader</td>
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<td>0.11</td>
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<tr>
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<td>0.15*</td>
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</tr>
<tr>
<td>Employees</td>
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<td>0.23**</td>
<td>0.07</td>
<td>0.09</td>
<td>0.05</td>
<td>0.56***</td>
<td></td>
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<tr>
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<td>0.10</td>
<td>0.16*</td>
<td>0.08</td>
<td>0.47***</td>
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<tr>
<td>Farm Size</td>
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<td>0.17*</td>
<td>0.06</td>
<td>0.05</td>
<td>0.41***</td>
<td>0.28***</td>
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<td></td>
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<tr>
<td>Peers</td>
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<td>0.12</td>
<td>0.03</td>
<td>0.26***</td>
<td>0.05</td>
<td>0.06</td>
<td>0.17*</td>
<td>0.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experts</td>
<td>0.22**</td>
<td>0.07</td>
<td>0.08</td>
<td>0.27***</td>
<td>0.15†</td>
<td>0.08</td>
<td>0.08</td>
<td>-0.02</td>
<td>0.36***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replicate</td>
<td>0.34***</td>
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<td>-0.02</td>
<td>0.13†</td>
<td>0.20*</td>
<td>0.23**</td>
<td>0.08</td>
<td>-0.05</td>
<td>0.28***</td>
<td>0.18*</td>
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</tr>
<tr>
<td>Adapt</td>
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<td>0.01</td>
<td>0.02</td>
<td>-0.03</td>
<td>-0.00</td>
<td>-0.03</td>
<td>0.00</td>
<td>0.15†</td>
<td>0.15†</td>
<td>0.05†</td>
<td>-0.39***</td>
</tr>
</tbody>
</table>

n = 158  † p < 0.1 (two-tailed)  * p < 0.05 (two-tailed)  ** p < 0.01 (two-tailed)  *** p < 0.001 (two-tailed)
With model 2, we examine hypotheses 1, which predicts that replication of practices within a template will produce superior performance. The results of model 2 are shown in Table 3. The replication of practices within the template is positively related to performance ($\beta=0.05$, $p<0.01$) and the overall model is significant ($p<0.000$). Thus, Hypothesis 1 is supported. Model 3, again shown in Table 3, examines the moderating effects of social interaction, and the overall model is statistically significant ($p<0.000$). Hypothesis 2a, which predicted that the relationship between adaptation and performance would be negatively moderated by higher levels of interaction with entrepreneurial peers, did not receive statistical support as the interaction was nonsignificant ($p=0.64$). However, Hypothesis 2b, which predicted that the relationship between adaptation and performance would be positively moderated by interaction with practice experts did receive support ($\beta=0.12$, $p<0.05$).
<table>
<thead>
<tr>
<th></th>
<th>Model 1: Controls</th>
<th>Model 2: H1</th>
<th>Model 3: H2a and H2b</th>
</tr>
</thead>
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<tr>
<td><strong>Constant</strong></td>
<td>2.96*** (0.27)</td>
<td>1.60 (0.47)</td>
<td>1.70*** (0.39)</td>
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<tr>
<td><strong>Education</strong></td>
<td>0.06* (0.03)</td>
<td>0.06* (0.03)</td>
<td>0.06* (0.03)</td>
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<tr>
<td><strong>Experience</strong></td>
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<td>-0.00 (0.01)</td>
<td>-0.00 (0.01)</td>
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<tr>
<td><strong>Trainings</strong></td>
<td>-0.00 (0.22)</td>
<td>-0.04 (0.21)</td>
<td>0.01 (0.20)</td>
</tr>
<tr>
<td><strong>Cattle</strong></td>
<td>-0.00 (0.00)</td>
<td>-0.00 (0.00)</td>
<td>-0.00 (0.00)</td>
</tr>
<tr>
<td><strong>Group Leader</strong></td>
<td>0.40 (0.25)</td>
<td>0.27 (0.25)</td>
<td>0.32 (0.24)</td>
</tr>
<tr>
<td><strong>Employees</strong></td>
<td>0.11† (0.07)</td>
<td>0.07 (0.07)</td>
<td>0.04 (0.07)</td>
</tr>
<tr>
<td><strong>Baseline Utility</strong></td>
<td>-0.00 (0.00)</td>
<td>-0.00 (0.00)</td>
<td>0.00 (0.00)</td>
</tr>
<tr>
<td><strong>Farm Size</strong></td>
<td>0.00 (0.00)</td>
<td>0.00 (0.00)</td>
<td>0.00* (0.00)</td>
</tr>
<tr>
<td><strong>Interaction with</strong></td>
<td>0.35* (0.13)</td>
<td>0.28* (0.12)</td>
<td>0.23 (0.14)</td>
</tr>
<tr>
<td>Entrepreneurial Peers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Interaction with</strong></td>
<td>0.20 (0.20)</td>
<td>0.17 (0.20)</td>
<td>0.14 (0.21)</td>
</tr>
<tr>
<td>Practice Experts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Replications</strong></td>
<td>0.05** (0.02)</td>
<td>0.06** (0.02)</td>
<td></td>
</tr>
<tr>
<td><strong>Adaptations</strong></td>
<td>0.02 (0.03)</td>
<td>0.04 (0.03)</td>
<td></td>
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<tr>
<td><strong>Adaptation X Interaction</strong></td>
<td>0.02 (0.04)</td>
<td></td>
<td></td>
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<tr>
<td>with Entrepreneurial Peers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Adaptation X Interaction</strong></td>
<td>0.12* (0.05)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>with Practice Experts</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < 0.05, ** p < 0.01, *** p < 0.001

Table 3: Regression results

n=158, Standard errors in parenthesis.
Discussion

Consistent with prior literature, our main effect results suggest that replicating an established template that consists of a large number of complex and interrelated practices within BOP markets results in an increase in performance (Jensen & Szulanski, 2007; Szulanski & Jensen, 2006). Specifically, the more practices that knowledge recipients are able to copy exactly as instructed by the template, the better their performance. Thus, the use of templates within contexts characterized by extreme economic and human capital deficiencies remain a valuable knowledge transfer mechanism.

Our subsequent tests for moderating effects suggest that, when recipients make necessity adaptations to a template, the types of actors those recipients interact with serves as one piece of the explanatory puzzle for why adaptations may lead to both positive and negative outcomes. To better interpret how social interaction with practice experts moderates the relationship between adaptation and performance, we graphed the interaction effect at +1 and -1 standard deviations (see Figure 1). The graph indicates that, as the number of adaptations increased, the performance of farmers that interacted frequently with experts improved, while the performance of those in the infrequent interaction condition declined. The performance implications of interacting with template experts while adapting are large; farmers in the high social interaction condition produced 19% more milk than their peers in the low interaction conditions when undertaking a high number of adaptations. This is a substantial difference in real economic terms. Interestingly, there was very little performance difference between farmers who interacted frequently or infrequently with practice experts when there were very few
necessity adaptations; it is only when the number of adaptations increased that a significant performance gap began to emerge.

Figure 1: Interaction graphed at +1 and -1 standard deviations

There were a number of anecdotal stories relayed by managers and technicians at Milktech that may help shed further light on how the source of social interaction (entrepreneurial peers or practice experts) impacted the quality of the adaptations (presumptive or principled). For example, a farmer in the city of Los Zarzales did not possess sufficient financial capital to set up an electric fence to divide his land into separate pastures as the template prescribed. The farmer adapted the practice, creating a “living fence” by planting small trees for fence posts and stringing them together with barbed wires. However, the farmer quickly realized that the cows would eat the variety of
small trees he had planted. The functional intent of the particular practice, as the farmer learned by establishing a dialogue with one of Milktech’s technicians, was to improve grass growth by alternating where the cows walked and grazed. Together, they developed an inexpensive solution of “painting” the newly planted trees using a mixture of manure and water so that the cows would not eat the fence and the functional intent of the practice could be fulfilled.

Similarly, a number of producers in Achuapa lacked the capital to build the milking shed indicated by the template. By conversing with technicians, they understood that the purpose of the milking shed was to prevent manure or mud from splashing into the milk pail during milking. Together with the technician, they developed the solution of milking their cows in the road, thus avoiding the mud and manure present in the corral, where milking was traditionally done. Thus, by interacting with experts who both understood the “why” of each individual practice and how the multitude of practices were interrelated, the knowledge recipients were able to experience some performance improvements within the confines of their resource constraints.

This finding suggests that adaptation need not always be detrimental, even in the case of resource scarcity (Kostova & Roth, 2002). However, it also suggests that the effectiveness of such adaptations depends significantly on the degree to which the adaptor possesses a sufficient understanding of the functional intentions underlying the practices within the template. When knowledge recipients interact frequently with practice experts, they are more likely to access such knowledge and engage in principled as opposed to presumptive adaptations (Baden-Fuller & Winter, 2005). As a result, the
more adaptations the knowledge recipient undertakes, the more important it is for them to engage in frequent interaction with practice experts.

When compared to the high number of positive stories relayed to us regarding frequent interaction with experts when undertaking adaptation, accounts involving frequent peer interaction contained much more mixed results. For instance, one farmer within a small community in El Sauce had noticed that mud was only visible on the udder during the wet season and not during the dry season, and thus the farmer only engaged in thoroughly washing the cow’s udder during the wet season. Through social interaction with other farmers within the same community, this presumptive adaptation received widespread adoption, resulting in a significant drop in the quality of milk in the area due to high bacteria counts. Similarly, a group of farmers in Chinandega decided collectively to undertake the castration practice only during a particular phase of the moon. A myth had developed amongst the farmers within the community that, if the moon were in the wrong phase, the calf would bleed to death. Again, the farmers in this case had elected not to seek out advice from practice experts, and the end result was a strong constraint on the timing of routine practices, which could undermine the overall management of the farm. These peer interactions present a potential increase in negative adaptation.

At the same time, however, there were a number of illustrations in which interaction with peers played a very positive role in preventing detrimental adaptations. For instance, one farmer placed larger quantities of nitrogen in the mineral mix than prescribed by the template in an attempt to increase milk production even further. However, this practice had the opposite effect and actually killed some of his cows. The results of this dangerous and presumptive adaptation were quickly spread to other farmers within
the region, who did not make a similar mistake. Similarly, a farmer in Sabana Grande reported to other farmers that his crop of legumes had failed when he had boiled the seeds and planted them immediately, rather than adding the seeds to the water after it had cooled and allowing them to soak overnight as the template prescribed. Several other examples of presumptive versus principled adaptation are detailed in Table 3. Such insights suggest that the effectiveness of traditionally examined knowledge transfer mechanisms, such as templates and social interactions (e.g., Schreyogg & Kliesch-Eberl, 2007; Zollo & Winter, 2002), are contingent upon whether or not the social contacts can help to effectively identify the cause-and-effect relationships necessary to maintain performance while making adaptations. In our study, it was clear that experts were much more likely to understand these vital relationships than peer contacts. Nonetheless, it was not clear that peer contacts were necessarily detrimental to successful adaptation.

Hence, some of the purported benefits of social interaction with peers emphasized in prior literature, such as the sharing of trial-and-error results, appeared to be much more relevant than anticipated in our study. It is also possible that at least some of the farmers, having dealt with severe resource constraints as part of their day-to-day lives in the poor regions of Nicaragua, had developed a capability to innovate successfully – and become bricoleurs, so to speak (Mair & Marti, 2009). Prior research on born-global firms in least-developed countries has noted a particularly strong ability for such firms to adapt to resource constraints when expanding overseas (Knight & Cavusgil, 2004). Some degree of this ability might similarly reside within individual entrepreneurs in such contexts as a result of their environment.
Table 4: Examples of presumptive and principled adaptation

<table>
<thead>
<tr>
<th>Introduced Practice</th>
<th>Presumptive</th>
<th>Principled Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen introduced as part of mineral supplement at a ratio of 1 pound Nitrogen per 100 pounds salt</td>
<td>Added more Nitrogen, killing a cow</td>
<td>Add less than required amount of Nitrogen</td>
</tr>
<tr>
<td>Cows to be given a salt/mineral supplement of 100 pounds salt with 50 pounds of minerals</td>
<td>Reduced the minerals to 5 pounds per 100 pounds of salt, very little benefit for cows</td>
<td>Focus on providing minerals on animals that targeted for breeding or to those that are pregnant</td>
</tr>
<tr>
<td>Provide water in all of the pastures in plastic barrels</td>
<td>Provided water in some of the pastures where convenient</td>
<td>Cut tires in half and nail them to trees, providing water in all pastures</td>
</tr>
<tr>
<td>Construct a shed for milking with a grated concrete floor</td>
<td>Milked in corral, where manure can contaminate milk</td>
<td>Milk in roadway, where there is no manure to contaminate milk</td>
</tr>
<tr>
<td>Milking shed floor to be made of textured concrete</td>
<td>Milking shed floor was very smooth, causing animals to slip and fall</td>
<td>Milking shed floor is made of compact gravel</td>
</tr>
<tr>
<td>One person ties the legs of the cow and another person milks</td>
<td>The same person ties up legs and milks the cow, wiping hands with a cloth in between</td>
<td>The same person ties up the legs and milks the cow, but washes hands in soap and water between each process</td>
</tr>
</tbody>
</table>

Our study makes a number of important theoretical contributions to the literature on knowledge transfer. First, we delineate between two distinct types of adaptation - principled and presumptive. While presumptive adaptation is based on unproven beliefs
by the recipient unit, principled adaptation is based on a deep understanding of the cause-and-effect relationships underlying the replicated routines and practices. Previous research exploring the effects of adaptation in the process of knowledge transfer has focused almost exclusively on presumptive adaptation and its corresponding negative effects on performance when deviating from existing templates (e.g. Szulanski & Jensen, 2006). As a result, impetuous deviations from such templates are likely to result in negative performance outcomes as the recipient unit attempts to presumptively “guess” at the meaning of causally ambiguous and complex practices. However, our study suggests that, when this option is not available to the knowledge recipient and he or she needs to adapt, frequent social interaction with a template expert may serve to significantly overcome such “guesswork,” and can lead to more principled deviations from the initial template.

Our study also considers the mechanism of social interaction in combination with the use of templates. Prior work examining the transfer of complex routines has considered the use of templates independent of alternative complementary mechanisms for facilitating knowledge transfer (Nelson & Winter, 1982; Winter & Szulanski, 2001). In so doing, our study suggests that, while templates may be ill suited to lead to principled adaptation as a standalone mechanism, they likely serve as a conversation guidepost around which discussion during interactions can occur. In fact, we would argue that the utility of social interaction would be greatly reduced in the absence of a template, as the knowledge exchanged during such interactions would potentially be so unstructured and confusing that the ability of the recipient unit to attain a level of principled adaptation may be severely inhibited.
Finally, our study also contributes to knowledge transfer more generally by suggesting specific boundary conditions. Our study was undertaken in a Base of the Pyramid context where resource constraints were a major trigger for template deviation. In this context, the assumption of resource availability that underlies much prior work is potentially problematic. Specifically, prior work involving knowledge transfer has typically assumed that sufficient levels of financial capital or access to credit, human capital, and other factors of production such as land either exist or can be readily acquired from the surrounding environment. As a result, in the traditional context, the primary obstacle to effectively leveraging knowledge is found in organizational governance structures, informal social interactions, or even individual behavioral mechanisms (e.g., Kang, Morris & Snell, 2007).

However, in the developing market context, where foreign and indigenous firms are increasingly seeking to explore new areas as developed markets become saturated, the levels of such capital are often lacking. Thus, while in an ideal context, “adaptation should potentially be delayed until the practice has been completely transferred and implemented” (Jensen & Szulanski, 2004, p. 518), developing markets often necessitate high levels of adaptation from the outset. Thus, our study suggests that resource constraints posed from the external market must be incorporated into existing models of knowledge transfer to a much greater degree to account for the impact that such variance can have on descriptive and prescriptive outcomes.

While this study makes several important contributions, it is not without its limitations. First, our study is cross-sectional in nature, and thus we are unable to make strong assertions regarding the direction of our causal relationships. For example, it is
possible that the decision of how to engage in adaptations could subsequently influence
the level of social interaction rather than occur simultaneously. Notwithstanding, our
correlation table (Table 1b) provides some information which reduces the concern that
the frequency of social interaction is driven by the decision to adapt: our results show that
the variables for number of adaptations and frequency of social interactions are not
significantly correlated but rather operate independently. Another potential concern is the
uni-dimensional nature of our measure for social interaction. We would encourage future
research examining social interaction and templates to use richer measures such as
network analysis to explore theoretical and empirical nuances regarding the role of social
interaction. Finally, we do not directly measure whether adaptations are principled or
presumptive, but infer this from their effect on performance. We encourage future
researchers to build more precise measurements for the adaptations themselves.

Another potential limitation is that our data were also drawn from a single large
project undertaken within a single developing country, and, as such, the generalizability
of our results is constrained. However, we feel that the underlying theoretical claims do
generalize to other contexts where resource scarcity is present. For example, small
international firms in emerging and developing markets would likely experience resource
constraints and thus, may face the challenges inherent in trying to adapt in the face of
resource scarcity. Large multinational corporations, on the other hand, have more ability
to transfer resources such as economic and human capital, and our discussion of resource
constraint as a driver of adaptation seems less appropriate. Furthermore, we would argue
that our study is generalizable beyond the developing world. The need to adapt in the face
of resource constraints may be more pronounced in a developing context but is certainly a
factor in the replication of knowledge in more developed contexts as well (Koburg, 1987; Maritan & Brush, 2003). Another possible boundary condition for our theory is that it does not generalize to cases of complete causal ambiguity. If the knowledge to be transferred is completely causally ambiguous and causal relationships cannot be understood, even *ex post*, then it seems unlikely that social interaction could positively moderate the relationship between adaptation and performance. In such cases ‘template experts’ as defined in this paper, would simply not exist. While these are important boundary conditions to our theory, we would argue that in many cases, some actors have a deeper understanding of the principles embedded within a template. In such cases, social interaction with such experts could provide valuable knowledge regarding the potential for principled adaptation and our theoretical claims should generalize to such circumstances.

Overall, we believe that the results of our study suggest several potentially fruitful directions for future research. While we chose to focus our study on the source of social interaction as a key network interaction moderator determining the effectiveness of adaptation, prior literature on social interaction has unearthed a number of additional network characteristics which may impact the flow of knowledge in the context of a knowledge transfer (Abrahamson & Rosenkopf, 1997; Burt, 1995; Granovetter, 1973; Hansen 1999; Reagans & McEvily, 2003). Thus, further consideration of the implications of broader network characteristics (such as density, the presence of structural holes, the rate of change and closure, etc.) and specific tie characteristics (such as cohesion, range, strength, etc.) that determine the extent to which such characteristics facilitate effective adaptation could similarly prove to be insightful. For instance, strong ties have been
found to facilitate the flow of complex knowledge but also to provide more redundant information (Granovetter, 1973; Hansen 1999). Thus, tie-strength may play an important role in determining the extent to which knowledge recipient units are able to access principled information from particular sources of information.

Similarly, while we considered social interaction with experts as one general complementary mechanism to the use of templates, future research could examine in more detail how specific types of social interaction with experts facilitate knowledge transfer differently. For example, it may be interesting to explore how formal social interaction (i.e. training sessions) compares to informal social interaction in complementing the role of templates. Future research could also incorporate the costs of social interaction to a much greater degree. The costs of social interaction were minimal within our study because knowledge recipients typically lived in close proximity to both peers and experts and thus could interact with either quite cheaply should they so choose. However, examining the relative costs of different types of interactions (formal vs. informal) with different sources (peers vs. experts) can provide much greater insight into the relative efficiency of alternative interaction combinations. For example, does face-to-face interaction work more effectively than communication over the phone or other forms of media? Do recipients and experts from different cultures hinder principle-based transfer?

Finally, this study departs from much of the work on knowledge transfer in that examines knowledge transfer across (rather than within) organizational boundaries. Such inter-organizational knowledge transfer may play a critical role in fostering entrepreneurship in the Base of the Pyramid. However, we know comparatively less
about how knowledge can be leveraged across organizations in ways that spark entrepreneurship, and research in this area may lead to a re-examination of our understanding of knowledge transfer. For example, a prominent perspective in knowledge management literature downplays the role of motivation in the knowledge transfer process (e.g. Szulanski, 1996). However, when knowledge is transferred to autonomous entrepreneurs, the role of motivation may be much more critical. Future work could re-examine knowledge management theory in this context. Such work could potentially integrate insights from other literatures, such as the diffusion of innovation (e.g. Rogers 2003), to more fully account for agency on the part of the knowledge recipient.

Conclusion

Our study examines the comparative efficacy of replication versus adaptation in the transfer of knowledge templates in resource-constrained environments. We also more closely explore the role of social interaction as a potential explanatory mechanism for why adaptations may often produce both positive and negative outcomes among entrepreneurial recipients. While prior studies have focused solely on the negative impacts of deviating from a prescribed set of causally ambiguous and complex practices, we argue that certain types of social interaction can help knowledge recipients overcome the challenges associated with necessity adaptation. Specifically, increased interaction with practice experts can produce principled adaptations that maintain the functional intent underlying the set of interrelated practices. Comparatively, infrequent interaction with experts and interaction with peers often leads to presumptive adaptations based upon untested assumptions and myth.
Paper 2: Changing the cassette: Overcoming embeddedness challenges in BOP markets

Introduction

So then more than anything it’s changing the ideology. As someone used to say, ‘Change the cassette.’ Turn the cassette around. Don’t continue doing the same thing, the same routine. So then it’s about understanding what the benefit is and how to work better and you even work more comfortably. More comfortably, and from the same cattle there’s enough (money) for the farm.

-Dairy farmer, Leon, Nicaragua

Significant portions of developing and emerging economies can be characterized as base-of-the-pyramid (BOP) markets wherein the average person subsists on two dollars per day (Hammond, 2007; Prahalad & Hammond, 2002). This desperate poverty is characterized by challenging living conditions, widespread health issues, social instability, and muted economic development (Kates & Dasgupta, 2007). Recently, management scholars have engaged in research to better understand how business might offer a path out of poverty (Bradley, McMullen, Artz, & Simiyu, 2012; Kistruck, Webb, Sutter, & Ireland, 2011). However, the current understanding of business in areas of poverty remains limited, and there have been increasing calls for further research (Bruton, Ireland & Ketchen, 2012; Seelos & Mair, 2007).

One important route to economic development in the BOP is to integrate producers into more developed markets (Karnani, 2007; London, Anupindi, Sheth, 2010). Such efforts generally require extensive knowledge sharing of productive practices so that these producers can meet the more demanding standards such markets require.
(Perez-Aleman, 2011; Pietrobelli & Rabellotti, 2007). However, the successful transfer of new practices across institutional contexts is quite difficult (Kostova, 1999). One of the difficulties stems from the fact that both the source and recipient of the practices are embedded within distinct contexts, which creates difficulties in transferring, interpreting, and integrating knowledge (Cohen et al, 1996; Inkpen & Crossan, 1995). Such challenges are particularly acute in BOP settings, where producers are often embedded in a complex web of cognitive, social, and cultural institutions (Mair, Marti & Ventresca, 2012). In such environments mental heuristics, social relationships, and culture may constrain individuals from changing their productive practices. Thus, transferring practices to a new context may lead to unexpected difficulties as those receiving the knowledge are embedded in distinct environments (Inkpen & Crossan, 1995; Kostova, 1999).

Successful knowledge integration requires a dramatic change – a change of the cassette as described in the opening vignette. Thus, organizations seeking to foster development in the BOP must help small producers overcome challenges related to embeddedness. However, while prior research has investigated the nature of embeddedness, as well as how it constrains or facilitates action, (Dacin et al., 1999; Uzzi, 1996; Zukin & DiMaggio, 1990) little is known about how challenges related to embeddedness may be overcome. In this paper we seek to fill this gap by exploring the tactics undertaken by development organizations seeking to overcome the challenges related to how potential knowledge recipients are embedded in BOP environments.

To understand how embeddedness may be overcome, we explore a specific effort by a development organization to introduce new practices to over 1800 dairy farmers in northwestern Nicaragua. We were particularly interested in the informal institutional
environment in which producers were embedded and how the development organization worked to change the embeddedness of producers so as to facilitate the transfer of new knowledge. We use a qualitative methodology to explore complex dynamics and local individual, social, and cultural nuances. Guided by prior work on embeddedness, knowledge sharing, and the BOP context, we collected data from semi-structured interviews, non-participant observation, and archival data. We find that the development organization engaged in a number of tactics designed to both dis- and re-embed producers at the cognitive, social, and cultural levels. We find that these tactics were not universally successful in re-embedding producers, but rather the producers’ human capital and intrinsic motivation determine the extent to which re-embedding take place.

Our study makes a number of important contributions to both theory and practice. First our work contributes to the literature on embeddedness by exploring how embeddedness may change and shedding light on the consequences of such change. We find that when potential knowledge recipients in the BOP were re-embedded in a new cognitive, structural, and cultural context, they were much more likely to implement newly introduced practices. Second, our paper explores the specific tactics used by a development organization for both dis- and re-embedding at the cognitive, structural, and cultural levels. Finally, our study also highlights the role of agency in the re-embedding process, thus shedding light on the ‘paradox of agency’ inherent in the study of institutions and embeddedness (Seo & Creed, 2002). While prior work has focused on how individuals act to shape institutions (DiMaggio, 1988; Battilana, Leca, Bauxenbaum, 2009) we find that individuals in BOP also exercise their agency by choosing the institutional set in which they are embedded. From a practical perspective, this research
provides guidance to organizations seeking to re-embed producers in the BOP as part of an effort to integrate them into larger, more developed markets.

*Embeddedness at the Base-of-the-Pyramid*

The concept of embeddedness refers to the ongoing contextualization of economic activity within cognitive, social, and cultural structures (Dacin et al., 1999; Granovetter, 1985; Polanyi, 1944; Zukin & DiMaggio, 1990). The core intuition of embeddedness is that economic activity is not carried out by rational, completely autonomous actors, but rather that economic activity occurs within the context of broader structures (Dacin et al., 1999). Embeddedness may confer certain advantages. For example, structural embeddedness often entails trust which provides access to fine-grained information and reduces transaction costs (Granovetter, 1985; Uzzi, 1997). At the same time, it is possible for individuals to become ‘over-embedded,’ which may have several negative consequences such as reducing the flow of novel information, requiring attention to social obligations at the expense of economic concerns, or even creating a scenario where negative behavior such as spite and revenge reverberate through-out the social structure (Uzzi, 1997). Finally, scholars have also explored the notion of dis-embeddedness, or being removed from a particular context (Polanyi, 1944), though research on the topic is sparse (Dacin et al., 1999).

Individuals’ behaviors are embedded within institutions at cognitive, structural, cultural, and political levels (Zukin & DiMaggio, 1990). Given our focus on BOP markets, which are dominated by informal institutions and often lack formal political structures (London, 2009), we have chosen to focus on the cognitive, structural, and cultural levels. Cognitive embeddedness refers to ways in which social regularities of
mental processes shape economic action (Zukin & DiMaggio, 1990). Because economic actors cannot know everything (Dequech, 2001), cognitive frameworks guide the selection and interpretation of information and, thus, influence what actions are taken. Formed via individuals’ education and experiences (or lack thereof), cognitive frameworks refer to how individuals mentally structure and apply knowledge (Baron & Ensley, 2006). Cognitive embeddedness may manifest in individuals’ heuristics or biases – that is, mental routines for doing things the way they have always been done or relying on performance of limited experiences to guide future action.

A second way economic action may be embedded is within social structures (Uzzi, 1997). Social embeddedness refers to how interpersonal relationships or patterns of ongoing interactions guide economic relationships (Granovetter, 1985). Individuals are socially embedded when expectations and obligations of existing relationships influence an individual’s economic-related decisions. As opposed to arm’s-length ties, embedded ties are stronger relationships that facilitate relational routines, reducing the need for monitoring and enforcement, enabling cooperation to meet environmental demands, and offering advantages associated with individuals’ willingness to share knowledge and jointly solve problems (Uzzi, 1997). Again, social embeddedness has strong implications for guiding action. Social ties facilitate otherwise impossible transactions through trust (Gulati, 1995). Social ties may also spread new norms and sanction those who break these norms (Coleman, 1988).

Finally, cultural embeddedness refers to how shared collective understandings shape economic action (Zukin & DiMaggio, 1990). Cultural embeddedness manifests when individuals ask themselves what others, whether having direct ties with these others
or not, might expect them to do in a given situation (Mead, 1922). “Culture has causal significance not because it spells out the desired ends of action, but rather because culture shapes choices for action. In particular, culture provides a repertoire of evaluation schema, scripts, and frames people use to understand their social context and to choose courses of action” (Kirk & Papachristos, 2011). Culture facilitates individuals’ decision making by narrowing the set of factors considered when making decisions. While individuals make decisions autonomously, cultural embeddedness increases general expectations among individuals within society as to how to operate and transact in socially acceptable ways (Ivens & Blois, 2004). As such, culture provides a lens through which to evaluate and interpret new knowledge that might seek to change how individuals behave.

A discussion of embeddedness is particularly relevant for BOP environments (Webb et al 2010). BOP markets are often rooted in traditional means of subsisting, which vary dramatically from conceptualizations of ‘efficient markets’ (Mair et al 2012). Individuals within the BOP are likely to rely on traditional knowledge bases when engaging in economic activities (i.e., they are cognitively embedded). Moreover, they are less likely to be exposed to ideas from other areas given limitations in education and infrastructure such as roads and the internet (Kistruck et al., 2009). They are also likely to have high levels of social embeddedness. The fragmented nature of BOP markets creates a distrust of outsiders (Karnani, 2007). Moreover, the lack of formal institutions leads to strong relational routines regarding mutual expectations and obligations based on trust (Webb et al., 2010). Finally, given the lack of formal institutions in BOP markets, economic action also relies more on culture, which acts to provide predictability and
stability to economic interaction (Coleman, 1988). That is, economic action is guided by
not only the mutual expectations and obligations that come with social embeddedness but
also the strong cultural expectations of community-based ideologies, interpersonal norms,
and rules that represent cultural embeddedness. Culture is a particularly important guide
of behavior when overarching coercive frameworks (such as a comprehensive formal

Embeddedness has important implications for the economic activity in the BOP.
One important avenue for poverty alleviation involves integrating small producers into
larger, more formal markets (Karnani, 2007;). Such efforts often require upgrading the
skills and practices of the producers (Perez-Aleman, 2011; Pietrobelli & Rabelloti, 2006).
While such approaches are promising, transferring new knowledge to producers can be
extremely challenging. One primary reason for this difficulty results from differences in
the context in which different actors are embedded (Lam, 1997). When the source and
recipient of knowledge are embedded in distinct contexts, the initiation stage is more
difficult and costly (Kostova, 1999). After knowledge transfer proceeds, differences in
cognitive, social, and cultural embeddedness may create difficulties in understanding new
knowledge as it is presented (Inkpen & Tsang, 2005; Kostova, 1999; Nahapiet &
Ghoshal, 1998). In addition, contextual differences may decrease motivation to
implement new knowledge (Kostova & Roth, 2002). The sum impact of these difficulties
is that new practices are less likely to become fully integrated when there are large
differences in the contexts in which the source and recipient of the knowledge are
embedded (Lam, 1997).
Thus, embeddedness is especially relevant for economic activity in the BOP and has profound implications for economic development. While extant research has explored how individuals and organizations are influenced by the way in which they are embedded in their environment, less is known about how challenges relating to embeddedness may be overcome. The purpose of this study is to explore how organizations may overcome embeddedness-related challenges when seeking to transfer knowledge to producers in BOP environments.

**Methodology**

Our qualitative study examined a three-year project undertaken by a development organization with the objective of improving milk production among small-scale dairy farmers in Leon and Chinandega, Nicaragua. Table 5 provides a sample of the intended knowledge to be transferred and changes sought by the development organization. This knowledge included both technical practices (i.e. practices related to reproduction, feed, herd management, clean milking) and organizational practices (i.e. accounting, record-keeping). The development organization hired approximately thirty technicians, as well as four regional managers, all assigned to specific locations. All technicians and managers were Nicaraguan and had backgrounds in agriculture.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Sample Practices</th>
</tr>
</thead>
</table>
| Care of Calves               | Build a shed for the calves  
                               Cut the umbilical cord to 15 cm  
                               Keep the calves apart from other cattle                                                                                                        |
| Reproductive Management      | Use one good quality bull for every 20 cows  
                               Provide ample minerals for cows  
                               De-worm cattle                                                                                                                                       |
| Correct Use of Minerals      | Mix 100 pounds of salt with 50 pounds of minerals  
                               Allow cows to consume all they want  
                               Inject minerals into cows each month, injecting into muscle                                                                                     |
| Use of Sugar Cane as Feed    | Make rows 20cm deep and plant cane  
                               Allow sugar cane to grow all rainy season  
                               Cut cane into 1 inch chunks and mix with legume leaves                                                                                         |
| Hygienic Milking             | Wash hands with soap and water prior to milking  
                               Have a separate person tie up the cows legs  
                               Filter the milk before putting it in the pail                                                                                                   |
| Protein Banks                | Leave seeds soaking in cloth or paper the day before planting  
                               Plant with a handspike placing three seeds in each hole  
                               Harvest after seven months and then every two months thereafter                                                                                   |
| Organizational Practices     | Keep records of pregnancies, births, illness, and treatments  
                               Keep a basic accounting of the farm  
                               Involve the family in the farm work                                                                                                               |

Table 5: Sample practices from the development organization

The dairy sector in Leon and Chinandega provided an ideal opportunity to examine how embeddedness may be altered. Local farmers were deeply embedded at the cognitive, social, and cultural levels in ways that had profound influences on the success of knowledge transfer. The development organization actively sought to change the nature of embeddedness of the farmers as part of their knowledge transfer efforts. However, their efforts were not universally successful. Archival data provided by the
development organization after the completion of the project indicated that, by the 
organizations own analysis 1,062 farms were considered successful in adopting new 
technologies and improving production, while 571 were considered unsuccessful (a 
further 172 farms were not evaluated for various reasons). This variance allowed us to 
examine both successful and unsuccessful incidents of dis- and re-embedding within our 
data. Below, we describe how producers were embedded at the cognitive, social, and 
cultural levels, and the difficulties which this created for knowledge transfer. 

Cognitive embeddedness

Dairy producers manifested cognitive embeddedness in a variety of ways which 
had important implications for knowledge transfer. Producers often viewed their farm as 
a tradition or lifestyle, rather than as a business and relied on knowledge that had been 
handed down from their fathers or on knowledge that was gathered directly through 
experience or observation.¹ The producers simply did not view cattle as assets for which 
value should be maximized, but rather as a part of an important tradition. This 
conceptualization of the farm had several consequences. First, while the farm was 
expected to provide for the producer, it also carried important symbolic meaning as land 
and cattle ownership denote status, and producers often felt a deep emotional attachment 
to their farms and livestock. Thus, producers were reluctant to make decisions such as 
culling the herd, even when it was the most technically efficient alternative. Second, 
producers did not approach the farm with an economic perspective of evaluating costs 
and benefits when making investment decisions. The producers did not keep written 
records regarding their farms. Instead, the farm was viewed as a subsistence activity

¹ Our respondents did note the presence of a few larger farms in Leon and Chinandega, Nicaragua with a 
business-orientation, although none participated in the development organization’s program, as the program 
was not intended for these larger farms.
which should function with little or no investment. This approach was compounded by
the fact that the producers had a relatively low education level (on average about a 5th
grade education, though there was variance) and some were quite uncomfortable with
mathematical calculations. In consequence of the subsistence view and the lack of a
cost/benefit approach, producers were extremely sensitive to expenditures incurred, even
when investments had the potential to create major economic gains. Thus, the producers’
cognitive norms influenced the way in which the farm was managed and also affected
how new knowledge was interpreted and evaluated.

Structural embeddedness

The existing social structures of producers were often obstacles to the
development organization’s efforts for two primary reasons: (1) social ties provided
either redundant or farming-irrelevant information, and (2) social ties created resistance
to changes. In this context, social ties did not provide adequate farming information as
family relationships, political affiliation, and religious membership were all more
influential drivers of network formation than dairy farming, per se, and knowledge
related to productive dairy activities was not necessarily available through these
networks. The little dairy-related information that was available through such strong ties
typically provided redundant information, limiting its usefulness in improving practices.
Furthermore, individuals embedded in existing social arrangements often resisted change
as these innovations could lead to a disruption to the existing social order. Some non-
participating producers even went so far as to sabotage the improving operations of those
producers working with the development organization. Producers sometimes experienced
strong peer pressure to not participate with the development organization. In one region
there were several occasions where neighbors who had decided to not participate in the project burned the pasture of producers working with the development organization, apparently as attempts to maintain the status quo.

Cultural embeddedness

Cultural embeddedness such as shared myths and norms at times ran counter to the efforts of the development organization. For example, a commonly held myth in rural Nicaragua is that rapid temperature change results in illness. Thus, producers were reluctant to wash their hands prior to milking because they believed the rapid transition from cold to hot would cause arthritis. Furthermore, the producers were skeptical that their milk could be contaminated by dirty hands, especially when both the hands and the milk appeared ‘clean’ to the naked eye. Thus the development organizations’ knowledge transfer efforts at times ran counter to culturally accepted beliefs regarding what constituted “clean” milk. Another example of cultural embeddedness related to respecting the wisdom and opinion of elders. An oft-repeated saying reflecting this norm is “the devil knows more because he’s old, than because he’s a devil.” This social norm created specific challenges for knowledge transfer as the majority of the development organizations’ technicians were either recent college graduates or at a relatively early stage of their careers. Shared cultural norms regarding the traditional role of males in the countryside also created challenges for knowledge transfer as new models of farm production involved women more heavily. Thus, cultural embeddedness had important implications for knowledge transfer.

Data Collection and Analytic Approach
We used a qualitative methodology to examine our research questions for several reasons. First, we were interested in how embeddedness might be changed in order to facilitate knowledge transfer, but we did not possess an a priori understanding of what the particular tactics might entail. Our qualitative methodology allowed for an exploratory approach for identifying and evaluating potential tactics by the development organization. A qualitative approach was also particularly useful for dealing with the complexity of the topic at hand. The development organization worked with approximately 1800 producers over a three-year period. Moreover, the development organization’s activities and interactions with the local individuals occurred in a highly embedded context, for which it was important for us to understand the local nuances. A qualitative approach facilitated our efforts to capture this complexity of both the BOP context and the development organization’s diverse efforts to improve dairy production through knowledge transfer (Mintzberg, 1979).

Our data collection efforts sought to capture information from various perspectives and through various modes to (1) avoid biases resulting from using a single perspective or social desirability and (2) develop a comprehensive theoretical model for explaining how the nature of embeddedness might be altered and the affect this would have on knowledge transfer. Therefore, we collected data from a variety of sources using semi-structured interviews and focus groups, non-participant observation, and archival documents (Bernard, 2006; Lofland, Snow, Anderson, & Lofland, 2006). Tables 6 and 7 provide a description of these data collection efforts.
<table>
<thead>
<tr>
<th>Semi-structured Interviews</th>
<th>Number of interviews</th>
<th>Number of focus groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE Managers</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>SE Technicians</td>
<td>24</td>
<td>3</td>
</tr>
<tr>
<td>Milk collection center leadership</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>Producers</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>MNC representative</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Local government representative</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Non-governmental organizations</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>61</strong></td>
<td><strong>6</strong></td>
</tr>
</tbody>
</table>

Table 6: Interview data

<table>
<thead>
<tr>
<th>Archival documents</th>
<th>Non-participant observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recorded radio clips produced by SE</td>
<td>6 weeks of observation in the field</td>
</tr>
<tr>
<td>Video clips from SE</td>
<td>2 weeks of observation in local SE office</td>
</tr>
<tr>
<td>Technical material from SE</td>
<td></td>
</tr>
<tr>
<td>Strategic plans of SE</td>
<td></td>
</tr>
<tr>
<td>SE’s internal powerpoint files</td>
<td></td>
</tr>
<tr>
<td>Newspaper articles</td>
<td></td>
</tr>
</tbody>
</table>

Table 7: Non-interview sources of data

The data were collected in three waves: the first week-long trip to Nicaragua occurred in December of 2009 to conduct an initial round of interviews and understand the project; a second six-week trip took place during June and July of 2010 to conduct interviews, observe, and collect archival documents; and a third ten-day trip was undertaken to conduct a final round of interviews and focus groups in March of 2011. This multi-phase approach to data collection allowed for a reiterative analysis and refinement of our ideas and questions over time. The complete data collection effort included over 26 hours of recorded one-on-one interviews or focus groups with over 60 individuals. The interviews were conducted in Spanish either by the first author, or by the other authors through the use of a translator. The interviews were transcribed in Spanish and then translated to English. To avoid discrepancies arising due to translation, the first
author (who is fluent in Spanish) analyzed the data in the original Spanish text and any differences in interpretation were discussed amongst all authors. In addition, a variety of archival sources, including internal communications, public documents, recordings, video, and newspaper articles, were collected. Finally, over two months of non-participant observation was conducted to further triangulate our data. The observations included meetings with producers, trainings, meetings of the development organization’s management, interactions between technicians and producers, the milk collection process, and the production process on the farms. During the non-participant observations, extensive fieldnotes were taken.

In both collecting and analyzing our data, we framed our questions and search for information using embeddedness theory. As stated above, the data were collected in three tranches, which allowed for preliminary analysis following each phase. This analysis was used to refine our questions and focus the data collection process for future phases. The Zukin and DiMaggio (1990) embeddedness framework provided a crucial grounding for our data collection efforts and subsequent analysis. The analysis was carried out using NVIVO, version 9. Our analysis followed the conventions established by Gioia, Corley, and Hamilton (2012). To begin, three co-authors read the transcripts and discussed their perceptions. One co-author used an ‘open-coding’ methodology to code the data. This initial round of data coding produced 53 distinct codes. The authors then discussed each of these codes and arrived at a consensus regarding the organization of the codes (Miles & Huberman, 1994). In some cases codes were broken down into distinct sub-categories, while in other cases categories were combined to produce new codes. The resulting 21 codes represent the ‘first-order concepts’ (Gioia et al., 2012). These first-order concepts
are presented from the interviewees’ point of view and representative quotes are presented in Appendix 1. Each first-order concept was supported by a minimum of seven respondents, with the exception of ‘mirroring’ which was only described by three respondents. However, after discussion we decided to include it because we felt that it did represent an important repositioning tactic, even though it was not always used intentionally by the development organization. The next step of our analysis involved combining first-order concepts into second-order themes which represent the researchers’ analysis of the connections between first-order concepts. After further discussion and consensus, the second-order concepts were then combined to form aggregate dimensions (Gioia et al., 2012). The resulting ‘data-structure,’ including first-order concepts, second-order themes, and aggregate dimensions, is presented in Figure 2. The aggregate dimensions form the components of our causal model, represented in Figure 3.
<table>
<thead>
<tr>
<th>1st Order Concepts</th>
<th>2nd Order Themes</th>
<th>Aggregate Dimensions</th>
</tr>
</thead>
</table>
| • Problem signaling  
• Network alteration  
• Mass communication | Dis-embedding | Repositioning |
| • Envisioning  
• Network orchestration  
• Mirroring | Re-embedding | |
| • View of farm (lifestyle vs. business)  
• Decision making (gut vs. rational)  
• Value (traditional vs. economic) | Cognitive |  |
| • Network ties resist or reinforce change  
• Network ties influence decisions | Social |  |
| • Cultural beliefs about practices  
• Perceived expectations of others | Cultural |  |
| • Level of education of producer  
• Access to human capital on farm | Human Capital | Individual Level |
| • Seriousness and earnestness  
• Desire to progress | Intrinsic |  |
| • Selecting new practices  
• Maintaining new practices | Practice | Repertoire of |
| • Rejecting new practices  
• Maintaining old practices | Practice | |

Figure 2: Data structure
Figure 3: Causal model

Repositioning → Intrinsic → Re-embedded in new context → Adoption of New Knowledge

Human
Findings

Overcoming embeddedness challenges

Our primary research questions focused on understanding how organizations can overcome challenges related to embeddedness within the BOP. Embeddedness constrains and facilitates economic activity, thus creating challenges for introducing new knowledge (Dacin et al., 1999; Lam, 1997). As described above, the development organization in our study faced difficulties in overcoming local embeddedness of producers while transferring knowledge (Kostova, 1999). Prior work has discussed the importance of adapting knowledge to fit within the recipient institutional context (Kostova & Roth, 2002). Our findings, however, illustrate a different approach – that of dis-embedding producers from traditional contexts and re-embedding them into new contexts (Dacin et al., 1999). The organization used a number of specific tactics at the cognitive, structural, and cultural level to facilitate dis- and re-embedding. We also found that the success of these tactics depended on both the human capital as well as the intrinsic motivation of the producer.

Our findings indicated that embeddedness ultimately played a critical role in determining whether or not producers in the BOP would adopt new practices because embeddedness affects both the flow and the evaluation of new knowledge. We found that by dis-embedding producers from their traditional context, and re-embedding them into a more supportive context, the development organization was better able to overcome
embeddedness-related challenges and successfully transfer knowledge. At a cognitive level, producers were traditionally largely unaware of information such as the quality of their milk or the reproductive rates of their cattle. Re-embedding producers within new cognitive frameworks introduced new heuristics regarding farm management, and caused producers to seek out new sources of knowledge (Baron & Ensley, 2006). Dis-embedding producers from traditional networks and re-embedding them within new social structures also provided producers with access to new sources of knowledge (Granovetter, 1973). Finally, new cultural frameworks also affected the flow of information to the producers (Kirk & Papachristos, 2011). As mentioned previously, traditional cultural norms around respecting elders made it difficult for young, college educated technicians to be accepted as experts in communities. Re-embedding producers into a new cultural context opened up opportunities to access new knowledge.

The nature of embeddedness not only had implications for the flow of knowledge, but also how that information would be evaluated (Dacin et al., 1999). For example, producers with traditional cognitive orientations were less likely to perform economic calculations of costs and benefits. Thus, these producers tended to avoid making investments in their farm. They saw investments in resources such as improved feed, minerals, or clean milking technologies as costs that would decrease their daily profitability. Because they did not gather data on productivity rates, reproductive rates, or milk quality, they were unable to calculate the potential benefits. Furthermore, viewing the farm as a lifestyle made such calculations seem unnecessarily complicated and difficult to undertake. On the other hand, when a farmer was re-embedded in a business-
oriented mindset, the calculation of cost and benefit were quite important. Social embeddedness also facilitated the evaluation of information. In traditional social networks, producers often relied on the advice of their peers who were often unfamiliar and suspicious of novel technologies. Thus, these producers were less likely to favorably evaluate novel practices. On the other hand, producers embedded in newly orchestrated networks designed to support new practices were much more likely to find peers that were enthusiastic about new practices. Culture had an impact on the evaluation of information. The traditional culture focused on the symbolic importance of the dairy farm while the new culture placed value on the productivity of the farm. For example, many technicians reported that producers often maximized the number of cattle they owned as it was a symbol of wealth. However, owning 50 cows that produced 3 litres per day was much less efficient from an economic perspective than owning 15 cows that produced 10 litres per day. Thus, culture played an important role in the evaluation of new information and decision making on the farm.

Thus, the development organization’s goal of introducing new practices to producers in the BOP was dramatically influenced by local embeddedness. While prior work has discussed the importance of achieving fit with the local environment (e.g. Kostova & Roth, 2002), our findings indicate that the development organization also focused on dis- and re-embedding producers into new contexts.

Repositioning tactics

As described above, the development organization in our study made specific efforts to change the context in which producers operated. Technicians from the
development organization sought both to dis-embed producers from some features of the environment, while simultaneously re-embedding producers into new contextual arrangements, a process which has received scarce attention in extant research (Dacin et al., 1999). This occurred at the cognitive, social, and cultural levels. We collectively refer to these dis- and re-embedding strategies as repositioning tactics.

Dis-embedding activities. The development organization actively worked to dis-embed producers from the structures which guided their traditional economic activities. These activities were designed to disrupt prior norms and structures and motivate the need for change. At the cognitive level, technicians engaged in what we refer to as ‘problem signaling.’ Problem signaling refers to helping producers identify problems they had not previously considered. Problem signaling directly challenged the producers’ conceptualization of the farm by providing a new perspective on the productivity of the farm. Specifically, the development organization focused on calling the producers’ attention to new problems, such as how much money they forfeit due to suboptimal milk production or reproductive rates. This new information was intended to create dissonance with the producers’ existing cognitive embeddedness (Festinger, 1957). One means of accomplishing this involved instituting record keeping among the producers. Producers became much more aware of exactly how much each cow was producing and how frequently each cow gave birth to a calf. In addition to record keeping at the farm level, the development organization also provided new information to producers through the use of specific exams and analyses. For example, each farm received a ‘reproductive diagnostic’ that graded the herd from 0 to 100% based on information gleaned from
veterinary exams. For the first time, producers considered the overall reproductive health of their herd and saw how it changed over time. Problem signaling caused the producers to consider their farm in new ways, thus dis-embedding them from prior cognitive patterns.

At the structural level, technicians engaged in repositioning tactics by altering existing social networks. In this way producers were dis-embedded from prior social patterns. For example among one group of producers, the most influential and wealthy producer in the area was voted in as the milk collection center president. This election arguably was influenced more by the producer’s prestige in the local community rather than by his motivation or competence to carry out his responsibilities. This producer did not perform the necessary duties of a milk collection center president, particularly in the areas of transparent accounting and quality control. After a brief period, the regional manager of the development organization intervened, first encouraging the milk collection center to hold new elections for a president and then making strong suggestions regarding who might be the best fit for new leadership. The new elections proceeded and the outcome was consistent with the results for which the development organization had lobbied. After the new leadership was installed, the performance of the milk collection center improved dramatically, and became one of the best performing among the eleven centers. The development organization also altered the nature of social embeddedness at the level of the household. The man of the house commonly ran the farm single-handedly. However, the development organization strongly encouraged producers’ wives and children to become involved in the affairs of the farm where they
previously had not been. Where these changes took place the producer received access to additional resources in terms of human capital (children were often more educated than parents) as well as access to a fresh perspective. A final form of altering the social structure occurred when the development organization actively sought to break social ties by removing individuals from networks. Most of the time changes in social structure occurred through a self-selection process; producers who did not wish to participate simply withdrew. In several cases in which producers were disruptive to the development organization’s mission (e.g., by attempting to dissuade other producers from implementing new practices), the development organization’s technicians asked the individuals to no longer participate in the program. Thus, by altering the social structure technicians actively worked to dis-embed producers from existing social norms and relationships.

The development organization also attempted to dis-embed producers from the traditional culture by engaging in mass communication designed to alter cultural norms (Rogers, 2003). The development organization used radio spots to not only remind local producers of pertinent seasonal practices but also in an effort to create awareness among a large number of producers of the potential for more advanced farming techniques. These radio spots were targeted at local producers and encouraged new norms regarding farm management. For example, one radio spot depicted a conversation between Doña Milenia, a wise and successful dairy farmer, and Benito, her neighbor who was interested in learning more from her success. She described the reproductive management techniques she used and the benefits they provided. The spot ended with a jingle
emphasizing the values of improved production and prosperity. Thus, radio spots were one way in which the development organization tried to foster a subculture of business-oriented farm management. As a second example, the development organization also carried out cattle fairs in different locations. The fairs provided an opportunity for producers participating with the development organization to demonstrate the progress they had made on their farms. Competitions were held for the best cows, suppliers of veterinary products presented wares, and information sessions were held regarding new practices. The radio spots and cattle fairs were direct attempts to introduce new information to the larger population of producers and begin to shift norms regarding what it means to be a producer, with the ultimate goal of dis-embedding farmers from their current cultural frames.

Re-embedding activities. In addition to seeking to dis-embed farmers from their cognitive, social, and cultural contexts, the development organization also sought to simultaneously ‘re-embed’ producers in a new context. Re-embedding reinforced new practices and helped solder new linkages at the cognitive, structural, and cultural level to prevent reverting to old habits. Such re-embedding activities helped avoid problems such as under-embeddedness (Uzzi, 1997) or settling back to traditional contexts. Thus, re-embedding formed an important part of the repositioning process and also took place at the cognitive, social, and cultural levels.

At a cognitive level, the development organization sought to re-embed producers’ norms and expectations regarding their farms by introducing them to new possibilities of what their farm could become. We refer to this activity as ‘envisioning.’ In order to
provide opportunities for envisioning, the development organization facilitated the transformation of carefully selected farms to serve as ‘model farms’ to which other producers could refer. The model farms were chosen by the development organization based on the specific producer’s perceived motivation to undertake the program’s initiatives, as well as the geographic centrality of the farm and producers that were important community members. These farms provided a new standard against which farmers could judge their farms. The development organization worked with these specific model-farm producers to make the farms esthetically pleasing with well-kept fences, green fields, and healthy cows. As such, envisioning provided an important complement to problem signaling by providing an alternate vision for what their farm could become if they were to follow recommended practices. Envisioning led to the development and legitimization of new cognitive heuristics and frameworks.

In addition to using envisioning, the development organizations also sought to re-embed producers in new social networks, which we refer to as network orchestration. For example, producers were organized into new groups of approximately fifteen geographically-concentrated farms. Each of the groups contained a model farm, as described above, which served as a central meeting place and allowed for both formal and informal interaction among producers. In some cases, members of the group were well known to one another prior to beginning with the project. However, in many cases, the group members knew each other ‘by last name only’ and became acquainted through the project. For approximately every ten groups of producers, the development organization also established a milk collection center. The milk collection centers served
as overarching hubs where relationships were further formed and strengthened. The milk collection center provided another hub through which producers could meet, discuss common problems, and share potential solutions, thus extending the producers’ networks beyond family and community ties to include more industry-related ties. The orchestration of these networks was a critical means by which the development organization re-embedded producers into a new context for economic action (Granovetter, 1985). Finally, at a cultural level, the development organization engaged in what we term ‘group exemplification’ in which established groups of farmers set an example for the broader community. One technician referred to the small groups of 15 farms each as “mirrors” that would reflect new norms and beliefs (and the importance of corresponding practices) to larger segments of society. These core groups of producers had the ability to influence the local culture regarding what it meant to be a dairy farmer and legitimate certain types of practices such as record keeping or the use of minerals, thus providing a new cultural context in which additional producers could become embedded.

In summary, the development organization engaged in a number of activities intended both to dis-embed producers from one context and re-embed them in a new and distinct context at the cognitive, social, and cultural levels. Dis-embedding activities included problem signaling, network alteration, and mass communication. Embedding activities included traditional appeal, network orchestration, and group exemplification. Each of these activities was designed to reposition the producers in terms of their cognitive, social, and cultural context. Thus, we propose:
Proposition 1: Participation in repositioning activities will lead to a change in how producers are embedded in their cognitive, social, and cultural context.

Human capital

While repositioning activities have the potential to lead to transform how producers are embedded in specific contexts, not all producers are equally susceptible to such changes. Rather, our findings indicate that the likelihood that a change of embeddedness will occur depends on the level of human capital possessed by the producer. Human capital refers to the education, training, and skills possessed by an individual, and human capital has been linked to improved economic and personal outcomes (Becker, 1993; Schultz, 1961). In our study we found that the possession of human capital increased the likelihood that a producer would change the way in which they were embedded at a cognitive, social, and cultural level, while producers with lower levels of human capital were less likely to change. Our findings point to several explanations, including the roles of evaluation, learning, flexibility, and dependence.

Producers possessing higher levels of human capital were more able to evaluate new embeddedness arrangements. For example, as technicians engaged in problem signaling, and then introduced new frameworks and guidelines for conceptualizing farm management, more educated producers were better able to understand the potential advantages of thinking about their farm in a new way. In a similar manner, more educated farmers were more able to evaluate the outcomes associated with engaging in new social networks or embracing new cultural norms. On the other hand, producers with lower levels of human capital were less able to evaluate potential advantages or
disadvantages of distinct types of embeddedness. In a similar fashion, producers with higher levels of human capital were better able to learn, which influenced how easily they could be re-embedded in a new context. For example, cognitive dis- and re-embedding required recognizing problems inherent in traditional heuristics and norms, as well as learning new heuristics and norms for farm management. While producers traditionally thought of the farm as a lifestyle, changing their cognitive embeddedness in a way in which they conceptualized the farm as a business required learning. These producers had to begin to think in terms of economic calculation. Producers with higher levels of human capital were quicker to learn these business-related norms and heuristics for running their farms. Similarly, better educated producers had an easier time building their social networks and adopting new cultural mindsets. Thus, producers with higher levels of human capital were more likely to respond to repositioning activities by changing the context in which they were embedded.

Producers with higher levels of human capital were also more flexible in terms of how they were embedded in their context. Our findings point to at least two sources of this flexibility. First, producers with more human capital had been exposed to a wider variety of contexts. For example, some of the producers were quite familiar with businesses outside of farming and others had relevant experiences in the same or related industries. This exposure to other contexts made producers more flexible in the sense that they were more open and able to understand distinct contexts. A second source of flexibility was the fact that producers with higher levels of human capital were less dependent on their current embeddedness to manage their farms. In other words, they
were actually less embedded to begin with. For example, producers with higher levels of human capital were less dependent on traditional heuristics and biases, less dependent on their social network for advice and support, and less dependent on culture as a guide to actions. Because these producers were less deeply embedded in traditional contexts, they were more flexible in becoming embedded in new environments. Thus, we propose:

*Proposition 2: Human capital positively moderates the relationship between repositioning activities and embedding in a new cognitive, social, and cultural context.*

**Intrinsic motivation**

While human capital was an important moderator of the relationship between repositioning activities and a change in embeddedness, our findings indicated that intrinsic motivation was another important determinant. Intrinsic motivation refers to inherent desire to engage in certain activities (Deci & Ryan, 1985). In our data, respondents often referred to producers who had *intérés*. These producers were serious and earnest with regards to their desire to engage with the new context – in other words, they exhibited high degrees of intrinsic motivation. Intrinsic motivation is a critical concept in our model because it helps explain why some producers with high levels of human capital did not become re-embedded in a new context, while other producers with low levels of human capital ultimately did become embedded in a new context, highlighting how producers act as autonomous agents in regards to the environments in which they choose to become embedded.
A producer named Don Pedro illustrates how intrinsic motivation matters. Don Pedro was a producer in his mid 70’s with highly limited formal education and a small cattle farm on the outskirts of Nagarrote. Pedro and his five sons were initially deeply embedded in the traditional dairy farming context. They rejected technicians from the development organization the first three times they came to visit because they mistrusted outsiders. Eventually they agreed to participate with the develop project and slowly became integrated into an entirely different cognitive, social, and cultural context. They were introduced to new ways of thinking about their farm, made new dairy-related social connections and participated in cattle fairs. Don Pedro took everything very seriously and made dramatic changes to his farm. Ultimately Don Pedro’s farm became one of the best managed among all participating farmers. Multiple interviewees described Don Pedro as someone with ‘interés.’ While his level of human capital was lower than many of the other producers, he was able to compensate in other ways. His *interés* led him to participate actively in the newly orchestrated groups and take advice from technicians quite seriously. At the technician’s request he had his sons keep meticulous records of the farm and began to think of the farm as a business rather than a lifestyle. He actively embraced a new culture of dairy farming, despite an entire life of embeddedness in a distinct tradition. Don Pedro’s intrinsic motivation altered the way in which human capital moderated the relationship between repositioning activities and a change in embeddedness. On the other hand, our findings indicated that some producers with high levels of human capital never moved beyond embeddedness in a traditional context.
Despite their human capital, they were never serious or earnest regarding the new context being presented and preferred to maintain the status quo. Thus, we propose:

**Proposition 3:** Intrinsic motivation moderates the degree to which more human capital will result in a greater probability of a change in embeddedness. Higher levels of intrinsic motivation make a change in embeddedness more likely while lower levels of intrinsic motivation will make a change in embeddedness less likely.

**Discussion**

Development organizations have increasingly employed market-based solutions to address poverty and related needs in BOP markets (Bradley, McMullen, Artz, & Simiyu, 2012; Kistruck, Webb, Sutter, & Ireland, 2011). One commonly utilized market-based solution is the incorporation of local producers into larger developed markets. In doing so, producers shift from subsistence-oriented to more profit-oriented activities. This process generally involves the extensive transfer of new knowledge regarding productive practices (Pietrobelli & Rabellotti, 2006). However, existing forms of embeddedness often create challenges for knowledge transfer into the BOP. The purpose of this study has been to better understand exactly how development organizations can overcome embeddedness challenges. We find that the development organization engaged in a number of repositioning activities designed to dis- and re-embed producers in a context that was more amenable to novel knowledge. However, the effectiveness of these activities depended on the human capital possessed by the producer. Furthermore, the producers’ intrinsic motivation acted as a second order moderator and had a strong
influence on the human capital effect, and ultimately on the extent to which embeddedness changed.

Our study makes a number of important contributions to theory. First, our findings demonstrate how development organizations can overcome challenges related to embeddedness by actively working to dis- and re-embed producers in more facilitative contexts. We build on work which discusses the concept of dis-embeddedness (Dacin et al. 1999; Polanyi, 1944) and use this concept to demonstrate how organizations can actively work to dis- and re-embed individuals in BOP contexts. This insight regarding of dis- and re-embedding complements previous work on the difficulties inherent in knowledge transfer to new institutional contexts (Kostova, 1999; Kostova & Roth, 2002). While extant research has focused on the importance of adapting knowledge to fit with the local context (Kostova & Roth, 2002; Williams, 2007), such adaptations may prove detrimental to performance (Jensen & Szulanski, 2004; Sutter et al., 2013). This study highlights how, rather than adapting knowledge, organizations can work to re-embed recipients in order to facilitate knowledge transfer. This is not to suggest that adaptation of the knowledge is unimportant – the development organization in our study worked hard to adapt the knowledge to fit the needs of the recipients. However, even when knowledge carries large potential benefits, embeddedness may preclude its successful transfer. In such cases, working to dis- and re-embed recipients provides a possible way forward.

Our work also elucidates the mechanisms by which the development organization sought to dis- and re-embed producers at the cognitive, structural, and cultural levels.
Such a fine-grained analysis is important as extant work on the concept of dis- and re-embedding is spare (Dacin 1999 et al., 1999). Furthermore, there have been calls to better understand embeddedness within institutions at multiple levels of analysis (Powell & Colyvas, 2008). This research examines mechanisms for dis- and re-embedding at the cognitive, structural, and cultural levels. One area in which this research could be extended would be to explore the nuances associated with timing and sequencing of various mechanisms at different levels of embeddedness. We observed that in some cases producers became re-embedded at a cognitive level, which then drove them to re-embed themselves at a structural and cultural level. In other cases, they were first re-embedded at a structural level and then became re-embedded at the cognitive and cultural levels. Finally, in some cases, producers were re-embedded at one level, only to be influenced by other levels of embeddedness in such a way that caused them to revert to their initial state of embeddedness. It is possible that the sequencing of mechanisms associated with dis- and re-embedding may either amplify or diminish the importance of factors such as human capital and intrinsic motivation.

Our research also contributes to the discussion of the ‘paradox of embedded agency’ (Seo & Creed, 2002). Recent scholarship has sought to inject agency into the discussion of institutions by focusing on how actors may change institutions, thus altering the ‘rules of the game’ (DiMaggio, 1988; Battilana, Leca, Bauxenbaum, 2009; Seo & Creed, 2002). Our findings highlight how actors also use agency in deciding which game to play – rather than changing the institutions themselves, actors may switch the institutional framework in which they are embedded. This perspective highlights the fact
that institutions are not monolithic, and any given society may have a number of distinct sets of norms, cultures, and rules at any given time. This is especially true in the fragmented and informal environment at the Base of the Pyramid (Mair, et al, 2012). A theoretical focus on understanding why and how actors choose between institutional sets expands our understanding of actors in Base of the Pyramid settings. In particular, our focus on the concept of intrinsic motivation demonstrates that an actor’s agency ultimately influences the institutional environment in which an actor is embedded. While we focus on a case where an outside organization actively encouraged producers to become embedded in new environments, such outside intervention is not necessarily indispensable for a change in embeddedness to occur. Within our sample we heard stories of producers who did not formally participate in the development organization’s program, yet became embedded within the new networks which were formed and altered their mode of production. These producers exercised their agency by actively choosing the set of institutions that would influence their behavior. Thus, agency impacts not only the nature of institutions, but the set of institutions that actors abide.

Finally, our work has important practical implications. We provide a clear illustration of how multiple levels of embeddedness influences actors in BOP markets. While many studies allude to such embeddedness, there are few that actually demonstrate it empirically. In particular, cognitive embeddedness has received relatively less empirical examination in BOP settings. Our findings show how one particular cognitive frame – envisioning the farm as a lifestyle and tradition rather than a business – has important implications for making investments in new routines. This observation helps
shed light on a longstanding debate in development circles. Some have criticized producers living in poverty as ‘backwards’ or ‘stuck in their ways’ because they fail to make investments in new technologies, while others have romanticized the poor and insisted that the only sustainable path for progress is through entirely indigenous innovation with no interference from the developed world. Our observations strike a middle ground in finding that producers living in poverty often fail to make ‘rational’ investments, not because they are backward and ignorant, but because they simply aren’t thinking in cost/benefit terms. An analogy is helpful. Many academics fail to get adequate amounts of exercise and/or eat sufficient servings of vegetables despite the fact that this is the economically rational choice given that it minimizes health care expenditures and increases longevity. This is not because academics are ‘backwards’ and ‘ignorant’ but simply because they do not necessarily make these decisions based solely on economic calculations. In a similar fashion, producers in the BOP use mental frameworks other than economic calculation to make decisions regarding their farms. The understanding of embeddedness may directly impact the design of projects designed to facilitate the transfer of novel routines.

Our study has a number of limitations that highlight the need for future research. First, in order to gain a greater depth of understanding, we focused our study on a single development project in one region of Nicaragua. While we believe that many of the theoretical arguments would generalize to other BOP settings, future research could examine these arguments in other environments. In particular, the content of the informal institutions will vary from one setting to another, with implications for the ease of
changing embeddedness. For example, some cultures have a more rigid social hierarchy than others, or employ more coercive means for protecting the status quo. In such societies, changing embeddedness may prove more difficult. One important avenue for future research would be to examine the feasibility of institutional entrepreneurship vis-à-vis the feasibility of actors dis- and re-embedding in a distinct set of institutions. While it may be the case that a more rigid social structure would make both strategies for change difficult, it is possible that different factors influence the difficulty of each one. Future research could examine such possibilities. A related limitation of our study is that while the qualitative methodology allowed us to explore new theoretical relationships, we did not test these relationships quantitatively. While the relationships received broad support from interviewees in our particular sample, future work could engage in quantitative testing of the model we propose.

Finally, while a qualitative methodology allowed for us to explore many nuances in our particular context, it also opened up further possibilities for exploration. For example, our findings indicate that not only did embeddedness at the cognitive, social, and cultural levels have an effect on routine selection and maintenance, but these distinct levels of embeddedness influenced each other. For example, in some cases a change in cognitive embeddedness drove producers to seek out new social and cultural contexts, while in other cases a change in social embeddedness led to cognitive and cultural changes. Similarly, there were cases where a producer changed the nature of their cognitive embeddedness, only to revert to traditional routines after being influenced by their social network. Thus, future studies could explore the interrelationships between
levels of embeddedness, as well as how these interrelationships interact during a change in embeddedness.

Conclusion

This research examines embeddedness and the tactics used by a development organization in its efforts to introduce new practices to producers in BOP markets. Utilizing an exploratory approach grounded in existing embeddedness theory, we find that the development organization’s efforts to introduce new routines involved overcoming various types of cognitive, social, and cultural embeddedness. Our findings further detail how repositioning activities used by the development organization helped dis- and re-embed producers in new context that better facilitated the selection and maintenance of new practices. However, the success of these repositioning activities in re-embedding producers was dependent both on the level of human capital possessed by producers, as well as the intrinsic motivation that they have in engaging with the development organization. This focus on embeddedness highlights how institutional change may be accomplished not only by changing the ‘rules of the game,’ but also by encouraging actors to change the game that they choose to play. We hope that our research stimulates further inquiries into understanding development organizations’ processes in creating market-based solutions in BOP markets and the strategies through which development organizations address challenges related to embeddedness.
Introduction

Base-of-the-Pyramid (BOP) markets, characterized by informal institutional environments and severe poverty, account for much of the world’s population but relatively little economic activity (London, 2009; Prahalad, 2006). In recent years, management scholars have become increasingly interested in how management theories might inform economic development, and in turn, how management theories might be informed by study in a distinct context (Godfrey, 2012; Kistruck, Beamish, Quereshi, & Sutter, 2012). One area of interest is how to incorporate producers living in poverty into larger and more developed markets (Karnani, 2007). Integrating producers into developed markets, however, generally requires a dramatic upgrading of productive practices employed by producers, which requires knowledge transfer (Perez-Aleman, 2011; Pietrobelli & Rabelotti, 2006). Thus, transferring knowledge is an important strategy for creating economic value (Moran & Ghoshal, 1999; Winter & Szulanski, 2001). However, despite the importance of the topic, we know little regarding knowledge transfer in BOP environments.
Extant research provides a foundation for exploring knowledge transfer in the BOP. Knowledge transfer has received extensive attention by scholars (e.g., Argote & Ingram, 2000; Argote, McEvily & Regans, 2003; Moran & Ghoshal, 1999). The literature has identified a number of important ways in which knowledge transfer between a source and a recipient can be structured, such as through interpersonal networks (Granovetter, 1973, 1985; Hansen, 1999), through the transmission of codified materials (Cowan & Foray, 1997; Zander & Kogut, 1995), through templates (Nelson & Winter, 1982; Winter & Szulanski, 2001) and through the use of information technology (Coff, Coff, & Eastvold, 2006; Roberts, 2000). One important line of work compares the relative advantages and disadvantages of different knowledge transfer arrangements (Argote, et al, 2003; Birkinshaw, et al., 2002; Jensen & Szulanski, 2013). Such a comparison is important because though knowledge is non-rivalrous in use, the transfer of knowledge is not costless (Szulanski, 1996; Teece, 1977) and different knowledge transfer arrangements have distinct implications for cost and effectiveness (Haas & Hansen, 2006).

Considering knowledge transfer within BOP settings invites a careful reconsideration of extant theory regarding knowledge transfer. Within such environments, recipients may be quite heterogeneous, thus affecting the knowledge transfer process. Recipient heterogeneity necessitates different knowledge transfer arrangements than when recipients are relatively homogeneous. In addition, recipients in BOP markets act as autonomous agents and independently evaluate new knowledge to make decisions regarding adoption and implementation (Rogers, 2003). However, when
considering the costs of knowledge transfer, current theoretical models generally adopt the perspective of the costs to the overall system (Eisenhardt & Santos, 2002; Haas & Hansen, 2007; Jensen & Szulanski, 2012). Models with such assumptions may not appropriately capture realities within BOP markets where recipients are autonomous. Thus, examining knowledge transfer in BOP settings creates an opportunity to reexamine theory in regards to efficient knowledge transfer from the perspective of the recipient. This study asks the question: what knowledge transfer arrangements are most appropriate under what circumstances in BOP environments? The approach adopted herein specifically considers the impact of recipient heterogeneity and autonomy.

To explore these issues, I conduct a multiple-case study of five development organizations seeking to transfer knowledge into the BOP. Among the five organizations, I look at 25 distinct efforts to transfer project-level knowledge to distinct groups of recipients. My findings show that some knowledge transfer efforts face more ‘exceptions’ among the recipients during implementation (Perrow, 1967). Knowledge transfer efforts with high number of exceptions are those that are heterogeneous from recipient to recipient regarding the required solution (i.e. pest management practices that must be modified for each farmer because of distinct conditions on each farm). On the other hand, knowledge transfer efforts with a low number of exceptions are those that are homogeneous across recipients (i.e. pest management practices are identical across farms regardless of individual conditions).

I classify knowledge transfer arrangements along a continuum from the straightforward exchange of knowledge (e.g. codified documents, trainings) in which the source
and recipient of the knowledge operate relatively independently, to the combination of ideas and knowledge (e.g. experimentation, specialized consulting which combines local knowledge with outside expertise, etc.) in which the source and recipient are highly interdependent. I also describe the costs associated with each knowledge transfer arrangement. The data from the case studies suggest that the development organizations do not simply try to minimize system costs. Rather, the recipients’ preferences dramatically influence the ultimate transfer arrangement. Specifically, the data illustrate how the source and recipient bear different kinds of costs during the knowledge transfer process. Building off of this insight, I find that uncertainty and trust play an important role in determining recipient preferences for knowledge transfer arrangements. Ultimately, successful knowledge transfer arrangements are a negotiated outcome and depend greatly on local context.

This paper makes several important contributions. First, this paper is contributes to a budding research stream regarding the comparative advantages of distinct knowledge transfer mechanisms (e.g. Haas & Hansen, 2007; Jensen & Szulanski, 2012). This paper is unique in its focus on the recipient, and seeks to build theory regarding the most appropriate knowledge transfer arrangement within BOP settings. A related contribution of this study is the focus on the costs of knowledge transfer arrangements. Specifically, I distinguish between costs borne by the source and costs borne by the recipient. This distinction helps explain how incentives vary between knowledge transfer mechanisms and may illuminate prior contradictory findings regarding sources of difficulty during knowledge transfer (Szulanski, 1996; Kostova & Roth, 2002). Finally, from a practical
perspective, this paper provides a framework for helping organizations make decisions regarding the use of knowledge transfer tools.

Theory development

Knowledge transfer in BOP environments

The transfer of knowledge within Base-of-the-Pyramid contexts is an important tool for economic development (Kistruck et al., 2011; Pietrobelli & Rabellotti, 2006). The transfer of established business models may improve the livelihoods of those living in poverty (Christensen, Parsons, Fairbourne, 2010). Knowledge transfer also has the potential to allow rural producers to upgrade their capabilities (Aleman-Perez, 2011; Pietrobelli & Rabellotti, 2006). For example, development organizations have worked in a number of industries such as apiculture, cacao, dairy, and horticulture, in improving the productive practices of small, rural producers living in developing countries (e.g. www.technoserve.org). Transferring new practices has the potential to improve the quality and quantity of production, allowing small producers to compete in more competitive and lucrative markets (Pietrobelli & Rabellotti, 2006).

Despite the potential value, knowledge transfer is not costless (Szulanski, 1996; Teece, 1977; Von Hippel, 1994). Instead, knowledge has been described as ‘sticky’ as a number of factors inhibit its successful transfer, such as source or recipient characteristics such as motivation, or knowledge characteristics such as causal ambiguity or complexity (Szulanski, 1996). Knowledge transfer within BOP markets is especially challenging due to the prevalence of informal institutional environments (London & Hart, 2004), lacking
infrastructure (Kessides, 1993), and low levels of human capital (Birdsall & Londoño, 1997).

In considering knowledge transfer in BOP environments, two characteristics have particularly important theoretical implications – recipient heterogeneity and recipient autonomy. Recipient heterogeneity refers to the fact that organizations seeking to transfer knowledge into the BOP may at times face local idiosyncrasies among recipients that require costly adaptation (Kistruck et al., 2011). In order to account for heterogeneity across intended recipients, this paper adopts the perspective of the ‘problem-set.’ Prior research has focused on ‘problems’ which may be solved through the acquisition of knowledge (e.g. Nickerson & Zenger, 2004). Building off of the problem solving perspective, this paper moves up one level of aggregation to examine ‘problem-sets’ to denote the fact that organizations seeking to transfer knowledge are focused on simultaneously solving the problems of multiple recipients through knowledge transfer. Each recipient represents a ‘problem’ and the aggregation of problems represents a ‘problem-set.’ While the underlying ‘problem’ is similar for each recipient, variance across the problem-set may require individual adaptations. Thus, the focus on problem-set helps make explicit the extent to which there is heterogeneity among intended recipients.

Recipient autonomy is also a defining characteristic of knowledge transfer by development organizations in the BOP (Rogers, 2003). Much of the work on knowledge transfer builds on the assumption of hierarchical organization and the use of fiat (Williamson, 1991). Indeed, the knowledge-based-view of the firm explains the existence
of organizations in terms of the relative advantage of hierarchy over markets for managing knowledge (Eisenhardt & Santos, 2002; Kogut & Zander, 1992). Thus, while recipient motivation is acknowledged in work on knowledge transfer (e.g. Gupta & Govindarajan, 2000; Szulanski, 1996), the underlying assumption is that the benefits of knowledge transfer accrue at the organizational level (Grant, 1996; Kogut & Zander, 1996). In contrast, within BOP settings, recipients are autonomous actors. This has two important implications for knowledge transfer. First, the source of the knowledge cannot exercise fiat during the transfer process. Thus, motivational concerns are potentially more salient in BOP contexts than in contexts where knowledge recipients are internal to the organization. Second, recipients must be examined independently in terms of knowledge transfer efficiency and effectiveness. In other words, even if a given knowledge transfer arrangement could prove efficient from a systemic perspective, unless it results in gains at the recipient-level, it is unlikely to be successful. Thus, in theorizing regarding knowledge transfer within BOP contexts, recipient autonomy must be explicitly considered. In summary, knowledge transfer within BOP environments is an important topic needing further scholarly attention.

Knowledge transfer arrangements

Considering the role of recipient heterogeneity and autonomy in BOP environments as well as the importance of knowledge transfer for economic development, begs the question, which knowledge transfer arrangements are most important under what circumstances? A recent stream of work has begun to examine the trade-offs and benefits associated with distinct knowledge transfer arrangements (Haas & Hansen, 2007; Jensen
& Szulanski, 2013). This work finds that not all knowledge transfer arrangements are equal; rather different arrangements entail different costs and benefits. Haas and Hansen (2007) explore codified versus network sources of knowledge and find that codified knowledge sources save time but do not improve quality, while personal advice improved quality but did not save time. Jensen & Szulanski (2012) focus on the distinct stages of knowledge transfer and match transfer mechanisms with the appropriate transfer stage. Sutter, Kistruck, and Morris (2013) find that templates are valuable for improving performance, but when adaptation is required, social interaction with practice experts leads to improved performance. This stream of literature indicates that not all knowledge transfer mechanisms are equivalent – certain circumstances may favor some mechanisms over another.

While this literature has made significant contributions, important gaps remain. Specifically, extant research has not yet developed a comprehensive theoretical map for guiding the choice of knowledge transfer arrangements in BOP environments. Yet solving these issues is important, both theoretically and practically. From a theoretical perspective, understanding trade-offs inherent in distinct knowledge transfer arrangements will help sharpen our understanding of each knowledge transfer tool in isolation. Such a theory would also build on recent work (Jensen & Szulanski, 2012; Haas & Hansen, 2007) seeking to bridge distinct streams of literature which tend to focus on a single knowledge transfer mechanism in isolation. Finally, by focusing on BOP environments, the roles of recipient heterogeneity and autonomy would be brought to the theoretical forefront. From a practical perspective, a theory of appropriate knowledge
transfer arrangements could guide organizations in designing their approaches to knowledge replication. Thus, the goal of this paper is to develop a comparative framework for matching appropriate knowledge transfer arrangements with recipient characteristics in BOP environments.

**Methodology**

This paper used a multiple case-study inductive design (Eisenhardt, 1989; Eisenhardt & Graeber, 2007). A multiple case-study design allows for theory generation and elaboration (Barnard, 2006; Eisenhardt, 1989). Multiple cases use a replication logic which allows researchers to develop theory and then confirm or disconfirm inferences as new cases are examined (Yin, 2009). This methodology was particularly advantageous for this study for two reasons. First, there is a need to build theory regarding comparative knowledge transfer mechanisms for replication in the BOP. Current theory is relatively silent regarding comparative advantages and disadvantages of different knowledge transfer mechanisms. Furthermore, the extant literature on relative advantages and disadvantages of distinct transfer mechanisms examines individual knowledge transfer events (Haas & Hansen, 2007; Jensen & Szulanski, 2013). However, in this study I examine a different level of analysis by exploring transfer across problem-sets rather than individual problems. Because there is little prior research to guide quantitative testing, case studies are an appropriate methodology for theory building (Eisenhardt, 1989). Second, a qualitative case-study approach allowed for a rich examination of the both the phenomenon and the context. Given the nuance and complexity of the knowledge transfer process, as well as the context, a case study methodology was appropriate as it allowed
for a deeper understanding of the phenomenon. Specifically, I used a multiple-case study with replication logic in which multiple similar cases are used to refine and sharpen new theory (Eisenhardt & Graebner, 2007).

Cases were selected from organizations seeking to replicate knowledge in a BOP context. Nicaragua was chosen as the study site and all of the cases were located in northwest Nicaragua. Geographic co-location of the cases was important for several reasons. First, it reduced the number of extraneous factors that could potentially influence the knowledge transfer process. This was especially important given the replication design of the case study. Second, it allowed for an in-depth understanding of a single context, rather than a shallower understanding of multiple contexts. Finally, from a logistical perspective, co-location of case sites allowed the researcher greater access to data. Because of poor infrastructure and a lack of maps, street names, etc., simply navigating the terrain was difficult. By co-locating the cases, the researcher gained a first-hand knowledge of the area and could use this knowledge to access multiple case sites.

Nicaragua was a fruitful context to study knowledge replication in the BOP for several reasons. First, Nicaragua is among the poorest nations of Latin America, with a per capita GNI of approximately $1500 and a poverty rate of approximately 42% (World Bank, 2013). Nicaragua suffered a long and devastating civil war ending in the 1990’s and the country has since struggled to regain its footing. Second, knowledge transfer efforts are prevalent in rural Nicaragua. Nicaragua has an economy that is highly dependent on agriculture and many of the residents are small-scale farmers that engage in subsistence activities. A number of governmental and non-governmental organizations
focus on transferring knowledge to agricultural producers in an effort to improve productivity. In addition, a number of development organizations seek to transfer knowledge regarding small business operation, health, nutrition, and community organization. Multiple challenges to knowledge transfer exist in BOP markets and these challenges are highly evident in Nicaragua. These challenges include low levels of human capital (Birdsall & Lodono, 1997), inadequate infrastructure (Kessides, 1993), weak formal institutions (North, 1990), and informal institutions which do not necessarily support the adoption of new technology (Sutter, Webb, Kistruck, 2013). In this environment, development organizations struggle to find effective and efficient means for knowledge transfer. Despite these challenges, knowledge transfer remains a key strategy for rural economic development in Nicaragua. Thus, rural Nicaragua provided a context in which to study the replication of knowledge across a BOP environment.

I selected five specific development organizations engaged in a total of 25 distinct knowledge transfer efforts. These organizations were chosen using a case replication logic (Eisenhardt & Graebner, 2007). Each organization was similar, allowing for extension and sharpening of theory as each case was examined. These organizations were all engaged in transferring knowledge to recipients in the BOP. Each organization was staffed by Nicaraguans with extensive experience in their area of expertise (i.e. agriculture, credit, health, etc.). Each organization was also interested in reaching a large number of recipients and doing so in a cost-efficient manner. I refer to the five organizations with the pseudonyms Milk-tech, Veggie-tech, Ag-tech, Family-tech, and Credit-tech. A description of each organization is provided in Table 8.
<table>
<thead>
<tr>
<th>Organization and Description</th>
<th>Knowledge Transfer Efforts Studied – in parentheses, the degree of exceptions from low (1) to high (5)</th>
<th>Transfer mechanism used for each transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family-Tech – Development organization with a focus on improving the well-being of families. They promoted health, welfare, patio gardens, and small businesses</td>
<td>Pests – understanding different kinds of pests, where they come from and how to prevent them (4)</td>
<td>Workshop</td>
</tr>
<tr>
<td></td>
<td>Organic fertilizer – how to make fertilizer out of rice husks and cow manure (1)</td>
<td>Demonstration</td>
</tr>
<tr>
<td></td>
<td>Planting in tires – unique planting techniques (3)</td>
<td>Social interaction</td>
</tr>
<tr>
<td></td>
<td>Cooperative Administration (2)</td>
<td>Trainings</td>
</tr>
<tr>
<td></td>
<td>Family Garden – planting a vegetable garden at home (4)</td>
<td>Trainings, demonstrations, experiments</td>
</tr>
<tr>
<td>Veggie-Tech – development organization focused on improving horticulture productivity for small-scale producers</td>
<td>New veggies (mini-squash, broccoli, asparagus) (3)</td>
<td>Demonstrations</td>
</tr>
<tr>
<td></td>
<td>Plant with seedlings (1) use of greenhouse and planting with seedlings rather than seeds</td>
<td>Experiment</td>
</tr>
<tr>
<td></td>
<td>Developing a work plan (4) – individualized plan for each farm regarding crop choice and management</td>
<td>Farmer Field School</td>
</tr>
<tr>
<td></td>
<td>Pest management – building barriers, yellow plastic traps, and spraying (3)</td>
<td>Farmer Field School</td>
</tr>
<tr>
<td></td>
<td>Drop irrigation and plastic ground covering (1)</td>
<td>Farmer Field School</td>
</tr>
<tr>
<td>Cow-Tech – Development</td>
<td>Accounting/records (1) – provided a standardized</td>
<td>Training</td>
</tr>
</tbody>
</table>

Table 8: Organizations and key knowledge transfer efforts (Continued)
<table>
<thead>
<tr>
<th>Table 8 Continued</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>organization focused on improving productivity of small-scale dairy farmers</strong></td>
</tr>
<tr>
<td>accounting method for farmers</td>
</tr>
<tr>
<td>Electric fences (1) – a pre-designed, low-cost electric fence system that could</td>
</tr>
<tr>
<td>be installed rapidly</td>
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<tr>
<td>Demonstrations</td>
</tr>
<tr>
<td>Reproductive Management (4) – diagnosis of reproductive issues and plan for</td>
</tr>
<tr>
<td>management</td>
</tr>
<tr>
<td>Training and expert visits</td>
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<tr>
<td>Hygienic milking (1) – a series of steps such as hand-washing designed to improve</td>
</tr>
<tr>
<td>milk quality</td>
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<tr>
<td>Demonstrations, Training,</td>
</tr>
<tr>
<td>Summer feed (3) – introduction of new grasses, silage, etc. to improve summer</td>
</tr>
<tr>
<td>feed for cattle</td>
</tr>
<tr>
<td>Training, expert visits</td>
</tr>
<tr>
<td>**Credit-Tech – Development organization focused on providing credit, health</td>
</tr>
<tr>
<td>services, and business training. Works with community-banks in which credit</td>
</tr>
<tr>
<td>recipients guarantee one another’s loans.</td>
</tr>
<tr>
<td>Organization and policies (1) – replication of community bank model</td>
</tr>
<tr>
<td>Manual, demonstration</td>
</tr>
<tr>
<td>Health care (1) – encouraging all women to engage in a standardized preventative</td>
</tr>
<tr>
<td>care regimen</td>
</tr>
<tr>
<td>Training</td>
</tr>
<tr>
<td>Group problems (4) – resolving disputes among women regarding repayment of credit</td>
</tr>
<tr>
<td>Experience, social interaction</td>
</tr>
<tr>
<td>Business training (5) – improve the functioning of the small businesses owned by</td>
</tr>
<tr>
<td>women</td>
</tr>
<tr>
<td>Training</td>
</tr>
<tr>
<td>Selecting members (2) – choosing to include new participants in community banks</td>
</tr>
<tr>
<td>Expert interaction</td>
</tr>
</tbody>
</table>

(Continued)
Table 8: Organizations and key knowledge transfer efforts

<table>
<thead>
<tr>
<th>Organization</th>
<th>Knowledge Transfer Efforts</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ag-Tech – Development organization focused on providing</td>
<td>Seed variety selection (5) – finding appropriate varieties of seed for varied climates and preferences</td>
<td>Experimentation</td>
</tr>
<tr>
<td></td>
<td>Soil and water conservation (4) – encouraging farmers to use terraced farming, drip irrigation, and other soil and water preserving techniques</td>
<td>Training</td>
</tr>
<tr>
<td></td>
<td>Fertilization (1) – producing organic fertilizer for gardens</td>
<td>Demonstration</td>
</tr>
<tr>
<td></td>
<td>Farm diversification (4) – planting a variety of new crops instead of engaging in mono-culture</td>
<td>Visits</td>
</tr>
<tr>
<td></td>
<td>Seed varieties – validation (5) – testing new preferences for seeds</td>
<td>Field experimentation</td>
</tr>
</tbody>
</table>

Table 8 Continued
Data Sources

Data for the case studies came from three sources: (1) semi-structured interviews with individuals working for development organizations and with intended knowledge recipients, (2) archival data including codified knowledge transfer materials, organizational plans, and third-party documents such as news articles, and (3) observation of knowledge transfer efforts. A total of 52 interviews were conducted. Interviews were conducted in entirely in Spanish. Each interview was recorded and transcribed. Interviews were semi-structured in nature; an interview guide was used, but the structure of the interview was flexible enough to pursue emergent themes (Bernard, 2006; Loftland, Snow, Anderson, & Loftland, 2006). The data were collected during a 5 month field study between December 2012 and May 2013. Interviews took place at the development organizations’ regional offices, at their field sites, and at recipients’ homes and farms. Archival data was collected for each organization and used to help compile case histories. All archival data was in Spanish and was analyzed in the original language. Observations of knowledge transfer efforts included trainings, demonstrations, farmer field school meetings, and individual meetings between agents from the development organizations and intended recipients. During the observations that took place in the field, the researcher used a motorcycle to follow the agent from the development organization (technician) as they went to out to small villages and rural areas to engage with recipients. During observations extensive notes were taken and a
follow-up interview was conducted with both recipients and the technician to enhance understanding of what had occurred. Data collection efforts are summarized in Table 9.
<table>
<thead>
<tr>
<th></th>
<th>Semi-Structured Interviews</th>
<th>Observation</th>
<th>Archival Documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veggie-Tech</td>
<td>4 managers and technicians 10 farmers</td>
<td>1 farmer field school meeting</td>
<td>Technical guides</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 collection center/plant nursery site visits</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 farm visits</td>
<td></td>
</tr>
<tr>
<td>Cow-Tech</td>
<td>3 managers* 2 farmers*</td>
<td>2 collection center Site Visits*</td>
<td>Training materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15 farm visits*</td>
<td>Project Plans</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Technical documents</td>
</tr>
<tr>
<td>Family-Tech</td>
<td>4 managers and technicians 11 recipients</td>
<td>1 training meeting and demonstration</td>
<td>Training materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11 home visits</td>
<td>Project Plans</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 collection center/cooperative site visit</td>
<td></td>
</tr>
<tr>
<td>Credit-Tech</td>
<td>6 managers and loan officers 2 recipients</td>
<td>6 regional office visits</td>
<td>Training guide</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8 community bank meetings</td>
<td>Descriptive statistics on loan officer productivity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 recruitment meetings</td>
<td></td>
</tr>
<tr>
<td>Ag-Tech</td>
<td>5 managers 1 local government official</td>
<td>1 regional headquarters and experimentation center site visit</td>
<td>Technical guides</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 regional office site visit</td>
<td>Project Plans</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Video</td>
</tr>
</tbody>
</table>

Table 9: Data sources
Analysis

All interviews were recorded and transcribed. The transcripts were coded using NVIVO 9. Specifically, I focused on codes relating to characteristics of the knowledge, characteristics of the source, characteristics of the recipient, and the transfer process (Argote, et al., 2003). During an initial open-coding of the document a total of 63 distinct codes were produced (Loftland, et al., 2006). Data from archival sources were also categorized by knowledge transfer effort. Field notes were reviewed and organized according to knowledge transfer effort. The data from interviews, archival sources, and field notes from observations were then combined to generate case histories. These case histories were used for both within-case and across-case analysis (Eisenhardt & Graebner, 2007). Within-case analysis was conducted first. Each case was considered on its own and used to generate unique insights regarding choices of knowledge transfer mechanisms, costs, and outcomes for individual development organizations. The replication logic of the multiple case study design then allowed for across-case comparison. Across-case analysis was used to compare the patterns generated from individual cases and to look for inconsistencies. These patterns and inconsistencies helped to develop and sharpen theory. I used these patterns to explore the knowledge transfer mechanisms chosen by development organizations and build theory regarding the best fit between the transfer mechanism and the problems that the development organizations were trying to solve, as well as to understand moderating factors influencing these relationships.
Findings

The data were used to develop a contingency model for predicting the most efficient choice of knowledge transfer mechanism (see Figure 4). In this section I detail the findings from the case studies and develop specific propositions regarding matching problem-sets with knowledge transfer mechanisms, as well as the role of uncertainty and trust.

Figure 4: Causal model
The Problem-Set and Exceptions

The analysis of the cases and the 25 distinct transfer efforts demonstrated that not all problem-sets were equivalent. Some problem-sets were highly homogeneous, while other problem-sets were highly heterogeneous. I refer to this difference as the number of exceptions contained by the problem-set. The number of exceptions refers to how often a given solution must be modified in order to solve problems within the overall set (Perrow, 1967, 1970). As an illustration, the need for organic fertilizer is a problem-set with few exceptions. Organic fertilizer is nearly universally beneficial and can be produced with a highly standardized process. Farmers simply combine cow manure with organic material (such as rice husks or vegetation), mix thoroughly, add some water, and cover with black plastic for a predetermined period of time. There are few exceptions to this solution and the same solution can be implemented with few modifications from farm to farm. Integrated pest management, on the other hand, is a problem-set with many exceptions. The practices vary based on the crops being grown as different plants have different susceptibilities. Furthermore, pest management depends on the proximity of other plants being cultivated on neighboring farms. Pest management depends on the mineral content of the soil, the micro-climate, and the particular infestations that manifest themselves from year to year. Thus, the particular solution to pest management will vary dramatically from farm to farm. Thus, pest management is a problem-set with a high number of exceptions.

My data indicated that exceptions to problem-sets may flow from at least two sources. First, differences in the environment may cause exceptions across the problem-
set. For example, a technician from Family-Tech describes environmental differences in different areas, which necessitate distinct approaches to watering crops:

*The water system is different there – the water is closer and here it’s a bit deeper. There they harvest the water in wells and tanks so they can water during the summer and here that doesn’t work because of the type of soil we have, and the terrain. Here it is flat, while over there they have mountains and hills. Here we can access water through wells at 10, 20, or 30 meters, while there they can’t – it’s too deep. So they have to harvest and store rainwater. If we tried to do that here it would just evaporate because it’s too hot.*

A second source of exceptions within problem-sets may arise due to the heterogeneity of resources available for implementing new solutions (Maritan & Brush, 2004; Sutter, et al., 2013). For example, human capital varied dramatically between recipients, and low levels of education could have a dramatic impact on the ability to assimilate complex knowledge. Financial and physical resources also had an important impact on the ability to implement solutions as designed. Thus, the development organizations often had to adapt solutions based on the resources available to different recipients.

*Knowledge Transfer Mechanisms*

The development organization used a variety of mechanisms to share knowledge with producers in the BOP. These mechanisms included using codified materials,
trainings, demonstrations, farmer exchanges, individual visits from technicians, experimentation, and farmer field schools (for further description, please see Table 10. Codified materials were used by the development organizations. For example, Milktech developed a series of posters to detail new practices, Ag-tech developed a series of pamphlets, technical guides, and even calendars to detail the benefits of distinct genetic strains of crops or detail animal husbandry techniques, and Credit-tech used posters to detail meeting agendas. However, technicians from the development organizations also explained that codified materials had drawbacks as recipients were often uncomfortable reading. Trainings and demonstrations provided ‘theory’ and ‘practice’ to recipients in a group setting. Individual visits from technicians allowed for personalized advice and instruction. In experimentation, producers were guided by technicians in designing and executing simple controlled experiments to test new practices. Farmer field schools (FFS) were the most complex transfer mechanism represented in the data and were used by Veggie-tech and Ag-tech. Farmer field schools involved group cultivation of a shared plot of land, facilitated by a technician. The group typically met once per week (though individuals from the group would work the plot during the week) and discussed questions, concerns, and new practices. The group would then work the land together, implementing the new knowledge and often setting-up small, controlled experiments.
<table>
<thead>
<tr>
<th><strong>Transfer Mechanism</strong></th>
<th><strong>Description</strong></th>
<th><strong>Combination</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Codified materials</td>
<td>Materials such as pamphlets, posters, radio ads, etc.</td>
<td>Exchange</td>
</tr>
<tr>
<td>Trainings</td>
<td>Standardized instruction provided by technician to group of recipients</td>
<td></td>
</tr>
<tr>
<td>Demonstrations</td>
<td>Standardized display of practices to be transferred. The recipients often participate in carrying out the demonstration and there is some opportunity for questions and discussion</td>
<td></td>
</tr>
<tr>
<td>Social interaction</td>
<td>Coordinated visits between recipients. Sometimes, recipients from a given area were all invited to a single location to see a more advanced recipient (field day) and sometimes one small group of recipients (10 – 15) were taken to visit more advanced recipients in a more distant location (experience exchange)</td>
<td></td>
</tr>
<tr>
<td>Expert visits</td>
<td>Technicians individually visited recipients to provide individualized feedback and customized advice</td>
<td></td>
</tr>
<tr>
<td>Experimentation</td>
<td>Technicians helped recipients design and carry-out experiments based on new knowledge</td>
<td></td>
</tr>
<tr>
<td>Farmer Field Schools</td>
<td>Technicians work with groups of farmers on a plot of land to grow crops. Together the farmer and technicians plan, make decisions, carry-out experiments, care for crops, and harvest</td>
<td></td>
</tr>
</tbody>
</table>

**Table 10: Knowledge transfer mechanisms**
These knowledge transfer mechanisms varied to the extent to which they allowed for customization and in regards to their cost. Customization was accomplished when knowledge from recipients and from the source were combined. For example, a technician from Veggie-tech described the difference between farmer field schools and other mechanisms. The farmer field schools provide a much richer opportunity for the combination of ideas between recipient and source:

The truth is, in the field school we want to change the methodology because normally we arrive, we’re the teacher and supposedly, in parenthesis, we teach. But as a facilitator, I learn too and I have to consider very heavily the experience of the producer. So, in the other trainings, we come out of the university believing that we can come to the producer and teach the producer. We do know the theory, and we have read. But the practical part, they have. And many times during trainings we don’t take this into account. In the trainings, in that way of teaching, we think we know everything. In the farmer field schools, I’ve learned things and I’ve learned that I have to take into account the experience that the producer has. That’s why we do experiments with different things, because we consider what they tell us.

Thus, these various mechanisms may be conceptualized along a continuum ranging from exchange to combination (Moran & Ghoshal, 1999; Schumpeter, 1934). Exchange refers to a transfer of resources from one party to another (Schumpeter, 1934).
While exchange is typically used in reference to tangible goods, I use exchange here to denote the transfer of knowledge from one party to another without any fundamental change to the knowledge itself. Exchange does not involve any modification of the knowledge, but rather precisely replicates the knowledge in a new location (Jensen & Szulanski, 2007). Exchange takes advantage of existing knowledge and exploits this knowledge in new settings (March, 1991). Codified materials, trainings, and demonstrations are examples of exchange-based knowledge transfer mechanisms.

Combination refers to the many ways in resources can be grouped together and pressed into service (Moran & Ghoshal, 1999). In this paper, I use the term combination to denote knowledge that is combined together to form something that is fundamentally distinct (Nahapiet & Ghoshal, 1998). Prior research has shown that not all combination is necessarily equally valuable – mixing incorrect knowledge can reduce the value of useful knowledge (Sutter et al., 2013). On the other hand, combining principled knowledge of new practices with deep local knowledge may result in highly beneficial new combinations (Baden-Fuller & Winter, 2005; Sutter et al., 2013). Individual technician visits, experimentation, and farmer field schools provide examples of combinatory knowledge transfer mechanisms.

Exchange and recombination provide a useful conceptual framework for understanding knowledge transfer for at least three reasons. First, exchange and combination highlight the role of both the knowledge source and recipient and underscore the ways in which the two actors may interact. The concept of resource combination emphasizes the fact that each actor carries particular resources which may be blended in
distinct ways, while the notion of exchange calls attention to the fact that each party must be in agreement for a transfer to occur. A second reason for using the exchange/combination continuum is that this perspective allows for a discriminating assessment of costs. Exchange and combination each carry particular costs, and conceptualizing knowledge transfer along this continuum provides a framework for evaluating these costs. Finally, exchange and combination highlight the process of economic development (Moran & Ghoshal, 1999). Exchange and combination bring both creative destruction, as well as economic growth (Schumpeter, 1934). This emphasis on destruction and growth is valuable because it draws attention to the ultimate intended outcome of the knowledge transfer process.

My findings demonstrate that knowledge transfer mechanisms vary not only to the extent to which they embody exchange or combination, but also to their costs. While costs are certainly critical in any environment, they are especially salient in BOP markets where there is an enormous need to scale poverty reduction efforts with only limited resources (Prahalad, 2006). The development organizations in my sample were acutely aware of the costs involved in transferring knowledge. For example, a manager from Ag-tech describes the costs inherent in different knowledge transfer mechanisms:

Another methodology that is very expensive, are the farmer field schools.

The farmer field schools is one of the most effective extension methods.

But it’s expensive because we try to select a farm, a producer, and have that producer plant a certain crop. Generally each week a specialist visits...but it’s expensive because you have to get the people together, and
moving people from one place to another is expensive. There’s the transport, the food, the didactic material, etc. But there are a lot of field schools in beans, in corn, in tomatoes and in other crops in this zone…We have to do technical assistance visits to groups because each technician has about 150 producers, so they can’t visit them one by one – it would be too expensive. So they have meetings, they have them organized in groups, let’s say in groups of 20 that live close and they know that every two weeks the technician will arrive and discuss the problems their crops have, and the solutions…we also have these fliers, and this is an easy way to reach producers, but they don’t like to read, or they don’t like the information because they like to do things the traditional way.

Within the cases, two distinct kinds of costs became apparent: the direct cost of knowledge transfer and the indirect costs of misfit. The direct costs include items such as the costs of physical reproduction of documents, developing trainings, preparation, transportation, purchasing required inputs, time required for learning, etc. The second category of costs consists of costs incurred by inappropriately applying knowledge to a problem within the problem-set. I refer to this type of cost as misfit. For example, one development organization focused on a problem-set relating to summer feed for cattle. The organization used a template to facilitate the exchange of knowledge. One of the practices within the template was the use of sugarcane. Many farmers followed the template and planted sugarcane. While this worked well in many locations, other
locations were too dry and the sugarcane died. The farmers bore the costs of misfit as they had implemented knowledge which was inappropriate for their area.

Exchange-based and combinatory knowledge transfer mechanisms vary as to their costs. Exchange-based mechanisms are more efficient in regards to direct costs. The cost-savings are primarily a result of the economies of scale inherent in exchange-based mechanisms. For example, codified materials, trainings, and demonstrations can all be used to reach large numbers of recipients relatively easily. These group-based knowledge transfer efforts reduce the costs inherent in preparation, time, and transportation. However, because the same solution is provided to multiple recipients, the possibility exists for high-levels of misfit costs. On the other hand, combinatory transfer mechanisms entail much higher direct costs, as illustrated in the quote above. They are much more time-consuming and generally involve much smaller and more customized interactions with participants. However, because the new combinations of knowledge are tailored to the specific needs of the recipient, the potential for misfit costs is much lower.

*Efficient Matching of Problem-Sets and Knowledge Sharing Mechanisms*

Given the differences across problem-sets (number of exceptions) and knowledge transfer mechanisms (exchange to combination) it is possible to construct a contingency framework of efficient knowledge transfer. The criteria for evaluating the ‘success’ of the match is the overall efficiency and effectiveness of the knowledge transfer mechanism for solving the solutions of a given problem-set. Because the development organizations were concerned with both the effectiveness of knowledge transfer and the costs, I evaluate success as efficient knowledge transfer.
Using knowledge transfer efficiency as the predominant criterion, problem-set characteristics can be matched with appropriate knowledge transfer mechanisms. In the case of a problem-set with a low number of exceptions, knowledge may be shared through either exchange or combination. In the case of a problem-set with few exceptions, the misfit costs are relatively low – the development organization needs to transfer a single solution which can be used to solve the problems across the entire set. In general, exchange-based transfer mechanisms have low direct costs. While they have the potential for high misfit costs, the low number of exceptions mitigates this concern.

Combinatory transfer mechanisms have low misfit costs, but have much higher direct costs. Combinatory transfer requires additional time for combination and learning to occur. Such direct costs may not be justified, given that customization of the solution is not required across the problem set. Thus, at when there are few exceptions within the problem set, exchange mechanisms are more efficient than combinatory mechanisms, as illustrated in Figure 5.

Figure 5: Problem-set characteristics, knowledge transfer mechanisms, and cost
The transfer of hygienic milking practices provides an illustration of a problem-set with a low number of exceptions. Milk-tech introduced hygienic milking practices for dairy farmers that were designed to improve milk quality. They consist of a number of specific behaviors such as washing hands prior to milking the cow, washing the cows udder, storing milk in an aluminum (rather than plastic) container, filtering milk as it is poured into a container, etc. The problem set consisted of unclean milk across nearly 2000 farms. The hygienic milking practices represented a solution that could be implemented with very few exceptions. The development organization used codified materials, training sessions, and demonstrations to transfer this technology. Each of these transfer mechanisms is geared toward knowledge exchange rather than combination. The organization could instead have ‘re-invented’ clean milking practices on each farm by using combinatory transfer mechanisms such as experimentation or individualized consultation. However, this methodology would be quite expensive as it would require much more of the development organizations time with each farm. Such a level of customization was unnecessary given the low number of exceptions inherent in the problem-set.

As the number of exceptions for a problem-set increases, eventually an inflection point is reached (see Figure 5). At this point, the heterogeneity among the problems within the problem-set drives up misfit costs until they outweigh the cost-savings derived from using an exchange mechanism. While combinatory knowledge transfer mechanisms require more time for both combination and learning, they produce more customized
solutions. While the direct costs of combinatory transfer mechanisms are high, they produce more customized solutions which minimize misfit costs. Thus, when the number of exceptions within a problem-set is high, combinatory mechanisms for knowledge transfer have lower total costs and lead to more efficient knowledge transfer.

The reproductive management of cattle is an example of a problem-set with a high number of exceptions. Milk-tech had the goal of improving reproductive outcomes of cattle. While some practices could be universally beneficial, such as improving the quality and quantity of feed and water, other practices were heavily dependent on local realities. For example, different cattle had different reproductive concerns. In some cases cows needed specific minerals and supplements to improve reproduction. In other cases the farmers needed to invest in a new bull or artificial insemination techniques. Furthermore, the best genetic mix for calves varied depending on the conditions on the farm. Thus, rather than a single solution appropriate for the entire problem-set, customized farm-by-farm solutions were required. The development organization took the time to conduct farm by farm reproductive diagnostics and sent technicians to consult with each farm. The technicians worked with farmers to design customized solutions to reproductive issues. While the direct costs of these combinatory techniques were high, the resulting solutions were lower in misfit and the total transfer costs.

In summary, the most efficient knowledge transfer mechanism is dependent on the number of exceptions within the problem-set. Thus, I propose:

*Proposition 1a: When the problem-set contains few exceptions, exchange mechanisms are more efficient than combinatory mechanisms for accomplishing knowledge transfer.*
Proposition 1b: When the problem-set contains many exceptions, combinatory mechanisms are more efficient than exchange mechanisms for accomplishing knowledge transfer.

Recipient Uncertainty and Transfer Mechanism Choice

While the contingency approach developed above focuses on efficient matching of knowledge transfer mechanisms and problem-set characteristics, my data shows that development organizations did not always use these criteria to determine transfer mechanism choice. Rather, there is evidence of systematic overinvestment in knowledge transfer mechanisms by development organizations (see Figure 6). Of the 25 knowledge transfer efforts studied, 13 could be considered to ‘inappropriately’ use combinatory transfer mechanisms when a more exchange-based approach would have sufficed. Extensive conversations with recipients, technicians, and managers, as well as observation and archival documents provided evidence that such overinvestment was due in large part to uncertainty on the part of the recipient regarding the new knowledge.
Figure 6: Map of specific knowledge transfer efforts according to recombination and exceptions

- Family-Tech
- Veggie-Tech
- Cow-Tech
- Credit-Tech
- Ag-Tech
The data demonstrate that many intended recipients within our sample experienced great uncertainty regarding the technologies to be transferred. Specifically, they experienced response uncertainty in that they were unsure what outcomes their particular actions would generate (Shenkar, Aranya & Almor, 1995). These recipients were introduced to new ideas from various NGOs, from neighbors, and from businesses, and many expressed uncertainty regarding which technologies would actually work. Failure was a real possibility; several respondents shared stories of learning and investing in a particular technology, only to have it fail. Thus, despite reassurances from development organizations, recipients perceived uncertainty regarding new technologies. For example, a farmer who participated in a farmer field school with Veggie-Tech describes his initial reaction to new technologies that were introduced:

Farmer: They did an experiment with the mounds, one row as a witness [and one as control] and we tried out the plastic ground-covering on lettuce and it came out great.

Interviewer: Were you more convinced after seeing?

Farmer: Yes, it’s that for the producer to be convinced, it has to be – how can I explain it? – practical, not theoretical. You have to demonstrate in the field, and then, show how to do it.
Interviewer: What happens if you aren’t shown?

Farmer: It’s like castles in the air. It’s like you might be good at imagining things, and you can imagine a beautiful house, but it’s not the same as seeing it. You can say that on a manzana (2.5 acres) I planted cabbage and harvested 18 thousand or 17 thousand, but I have to see it, the quality, the weight the size, what products you used.

As explained by this farmer, new knowledge could simply be ‘castles in the air’ rather than functional knowledge that will improve yields. In Base of the Pyramid environments, where resource scarcity is a severe constraint, uncertainty regarding new practices often leads to inaction. Intended recipients are simply unwilling to risk investing in something that could prove inappropriate for their farm.

Uncertainty has important implications for knowledge transfer effectiveness because of the division of costs in transfer. Within my cases, the development organizations bore the direct costs of knowledge transfer while the recipient bore the indirect costs of misfit. For exchange-based transfer mechanisms, the direct costs are low as the development organizations can generate significant economies of scale by providing the same solution to multiple recipients. For example, development organizations distributed posters, held group training meetings or workshops, and used radio ads in an effort to transfer a single solution across the problem set. The cost per producer for such efforts was relatively low. Combinatory mechanisms, on the other
hand, have much higher transfer costs. In the case of combinatory transfer mechanisms, the development organizations relied on mechanisms such as one-on-one engagement between technicians and recipients, experimentation, or farmer field schools, which were costly in terms of time, fuel, salaries, etc. Some efforts, such as farmer field schools, attempted to generate some economies of scale by meeting with multiple recipients at the same time. However, these methods also created significant costs as the development organization had to organize recipients in groups, dedicate time to a weekly meeting, provide inputs for experimentation, and follow-up with the group over a period of months or even years. Thus, the development organization bore the brunt of the direct costs would therefore prefer to use exchange-based transfer mechanisms when possible.

From the perspective of costs borne by the recipient, the opposite trend emerges. Within these case studies, the recipients did not bear the direct costs of knowledge transfer. Rather, recipients primarily bore the indirect costs of misfit. When using combinatory transfer mechanisms, the potential for misfit was greatly reduced, as knowledge was customized for each producer.

![Diagram](image.png)

Figure 7: Problem set characteristics, knowledge sharing mechanisms, and costs to recipients
Thus, the costs shift dramatically depending on the perspective being considered. Figure 7 depicts the total costs of each mechanism borne by the recipients. As portrayed in Figure 7, the total costs borne by the recipient are always lower when combinatory mechanisms are used. Thus, when there is uncertainty regarding a particular technology (i.e. there is uncertainty regarding the costs of misfit which will be borne by the producer), the producer will be more likely to prefer combinatory mechanisms where misfit is less likely to occur. Given the autonomy of the recipients in production decisions, a mismatch of preference of transfer mechanism and the mechanism used could lead to a failure of the transfer. Thus, I propose:

Proposition 2: As recipient uncertainty regarding technologies increases, effective knowledge transfer will require increasingly combinatory knowledge transfer mechanisms.

Overcoming uncertainty through trust

As described above, uncertainty regarding specific practices creates a dilemma for development organizations engaged in choosing knowledge transfer mechanisms. When the number of exceptions are low across the problem-set, efficient knowledge transfer could be accomplished through exchange knowledge transfer mechanisms. However, such cost-effective knowledge mechanisms may not result in actual knowledge transfer, as intended recipients fail to adopt new practices in the face of uncertainty. Thus, in order to successfully transfer knowledge, the development organization must bear higher transfer costs than would otherwise be necessary. This frequently resulted in ‘over-investment’ in knowledge transfer, as depicted in Figure 6. However, in a number of
cases, development organizations were able to overcome these challenges through trust. When recipients trusted that the knowledge being transferred was useful and would not result in high-levels of misfit, they were more likely to adopt the technology, even when exchange transfer methods were used.

Development organizations used various methods to leverage trust. One common tactic was to work with the same recipients over time. For example, in one location Veggie-tech had worked with the same recipient group of farmers for over a decade. Early, positive experiences by the recipients led to increased willingness to receive further knowledge. Even when working with new recipients, the development organizations sought to build trust quickly. One approach was to develop individual relationships between technicians and recipients. As these technicians became trusted friends, they were more likely to convince recipients to adopt new technology, even in the face of uncertainty. For example, farmers working with Veggie-tech described their relationship with the technician assigned to their group:

*She (technician) leaves everything written down and we pay attention. Even if someone else says, ‘this is good to do’ but she (technician) didn’t tell us...it’s that this is a field school and she is the teacher and we do what she says, so even if something were wonderful and others are using it, if she doesn’t say, then we don’t use it.*

In this case, the recipients overcame uncertainty regarding new techniques by only following advice from a trusted technician. In this way they were able to avoid potentially harmful outcomes from inappropriate knowledge. Development organizations also they sought to build competence-based trust in the organization itself. For example, Credit-tech sought to actively build the trust between clients and the organization. Thus,
when any official representative of Credit-tech sought to transfer knowledge, clients were more willing to adopt this knowledge, even in the face of uncertainty.

While developing trust between the development organization and recipients was effective, it also took time. A different approach to fostering trust involved leveraging trust that existed between recipients to encourage knowledge transfer. In these cases, a recipient that had already adopted the technology would explain the benefits to a potential recipient considering adoption (Rogers, 1967). Development organizations sought to do this in a number of ways. For example, Milk-tech established model farms which would serve as examples to other farmers. Not only were these farms templates that could serve as a reference point for knowledge transfer, but they also helped in persuading other farmers to adopt the new knowledge (Jensen & Szulanski, 2007). The farmers operating the model farm would share their experiences with other farmers in an effort to convince them to try the new practices. The similarity in experiences and background helped create trust that then worked to encourage recipients to adopt new knowledge, even in the face of uncertainty. All of the development organizations in the study also helped train ‘promoters’ that were from local communities and had ties with the local populations. These promoters would leverage their social ties to encourage others to adopt new practices.

While trust could encourage adoption, thus overcoming challenges related to uncertainty, it was not a panacea. When the number of exceptions across a given problem-set was high, trust could exacerbate problems of misfit by encouraging recipients to adopt inappropriate knowledge. For example, one farmer had taken out loans
at the suggestion of a technician in order to obtain the capital necessary for applying new knowledge. However, the knowledge was not appropriate for his farm and he was unable to pay the bank loans back. Instead of improving farm conditions, he found himself in danger of losing his farm.

In summary, trust had an important impact on the relationship between uncertainty and action. In cases where the number of exceptions was low but uncertainty was high, trust could act as a catalyst for knowledge transfer even when development organization’s used exchange-based knowledge transfer. On the other hand, trust could also prove detrimental when the number of exceptions were high. Finally, a lack of trust could impede knowledge transfer in the face of uncertainty. Thus, I propose:

*Proposition 3: Trust moderates the degree to which uncertainty will decrease the adoption of knowledge when exchange-based knowledge transfer mechanisms are used. Specifically, an increased level of trust will reduce the dampening effect of uncertainty on knowledge adoption, while a decreased level of trust will increase the dampening effect of uncertainty on knowledge adoption.*

**Discussion**

Over the past two decades, knowledge has risen to become a prominent topic in management research (Argote & Ingram, 2000; Grant, 1996; Szulanski, 1996). One important area of focus involves leveraging existing knowledge in new locations (Nelson & Winter, 1982; Winter & Szulanski, 2001). Knowledge transfer is valuable because it allows existing knowledge to be exploited in new areas without depleting the original knowledge stock (Arrow, 1962; March, 1991). Such transfer is particularly valuable in
BOP markets, where new knowledge has the potential to vastly improve productivity, with important implications for poverty alleviation (Perez-Aleman, 2011; Pietrobelli & Rabellotti, 2006). Extant research has explored the transfer process and identified a number of knowledge transfer arrangements. However, less is known regarding the relative advantages of one knowledge transfer mechanism over another (Haas & Hansen, 2007; Jensen & Szulanski, 2012). Furthermore, the BOP provides a distinct context in which recipient heterogeneity and autonomy play a prominent role. The purpose of this paper is to fill this gap by exploring the comparative advantages or disadvantages of distinct knowledge transfer mechanisms for replicating knowledge in BOP environments.

This paper seeks to make three principle theoretical contributions. First, I contribute to literature on knowledge transfer by developing a contingency framework for comparing between knowledge transfer arrangements in BOP environments. With a few notable exceptions (Haas & Hansen, 2007; Jensen & Szulanski, 2012) the current literature generally focuses on a single knowledge transfer mechanism (e.g. social networks, templates, codified material, etc.) and does not consider choices between transfer mechanisms. This study seeks to fill this gap by establishing a foundation for comparing between knowledge arrangements in BOP environments.

Second, I focus explicitly on the role of recipient heterogeneity during knowledge transfer. Recipient heterogeneity during knowledge transfer has been relatively underexplored in the literature (Maritan & Brush, 2004), but has profound implications for knowledge transfer. By focusing on the ‘problem-set’ this study seeks to highlight how recipient heterogeneity is both a major driver of cost and a major contingency
variable in determining the appropriate knowledge transfer arrangement. In this way, this study builds on prior work in contingency theory (Perrow, 1967; Thompson, 1967; Woodward, 1965). The general intuition of this literature is that as routineness of a given task decreases, a more interdependent structure is necessary (Birkinshaw, et al., 2002; Donaldson, 2001; Thompson 1967). In terms of knowledge transfer, interdependency allows for the combination of new ideas between both the source and recipient, thus facilitating solutions to non-routine features of a given task (Perrow, 1967; Thompson, 1967). Thus, this study complements existing work by demonstrating that recipient heterogeneity creates ‘exceptions’ which influence efficient knowledge transfer arrangement choice.

The final major contribution of this study is the focus on recipient autonomy in BOP environments. In particular, I call attention to costs inherent in knowledge transfer. While costs are a critical aspect of knowledge transfer (Szulanski, 1996; Teece, 1976), they are often ignored in the literature. Not only does this paper highlight the relative costs of distinct transfer arrangements, but it also distinguishes between the costs borne by the source and the costs borne by the recipient. This allows for a more fine-grained understanding of the incentives inherent in knowledge transfer. The major implication of this insight is that efficient knowledge transfer requires a focus on the recipient’s perspective. This stands in contrast to extant work, which predominantly considers the advantages of knowledge management at the perspective of the overall system (Eisenhardt & Santos, 2002; Grant, 1996; Kogut & Zander, 1996). Reconsidering
knowledge transfer from the recipient perspective dramatically alters the underlying theory.

The focus on recipient costs has several other implications. Prior work in communications has discussed different costs borne by senders and receivers of email (Van Zandt, 2001) and how the different incentives cause problems such as information overload, which ultimately reduces successful knowledge transfer. In a similar fashion, this study highlights how different kinds of costs influence the success of distinct knowledge transfer mechanisms. This observation could help elucidate prior conflicting findings regarding motivation and knowledge transfer. For example, some research has discussed motivation as a primary impediment to knowledge transfer (Kostova & Roth, 2002; Rogers, 2003) while other research focused instead on knowledge characteristics as the primary impediment (Kogut & Zander, 1992; Szulanski, 1996). Understanding the differences in the types of costs, as well as who bears the costs, may enrich our understanding of the interplay between motivational and knowledge-based hindrances to knowledge transfer.

This study also makes a number of important contributions to practice. The framework developed here can be used to guide practitioners while designing projects dedicated to knowledge transfer. Furthermore, this framework will guide practitioners towards thinking about issues related to costs borne by their organizations as well as intended knowledge recipients. Such investigation is important in light of prior conflicting results regarding the effectiveness and efficiency of knowledge transfer mechanisms in BOP environments. For example, Godtland, Sadoulet, Janvry, Murgai,
and Ortiz (2004) find farmer field schools to be an effective means of knowledge transfer. On the other hand Feder, Murgai, and Quizon (2004) find farmer field schools to be unsustainably expensive. By distinguishing between times when farmer field schools are the optimum transfer method and times when less costly approaches might be appropriate, this study can help guide effective planning by practices.

This study has a number of limitations which create opportunities for future research. First, this paper uses a case-study methodology with the goal of theory development (Eisenhardt, 1989; Yin, 1994). The case-study methodology allows for a deep exploration of the context and is appropriate for iterating between extant theory and reality while developing new theory (Eisenhardt, 1989). However, a case-study methodology also has disadvantages. For example, case studies are not appropriate for testing theory, as the sample size is typically quite small. Future work could use a quantitative methodology to test the relationships proposed here.

Another limitation of this study is the fact that it takes place within a single country in a developing economy context. Thus, there are likely limits to the generalizability which should be examined. In terms of the underlying theory, several salient attributes of the context may affect generalizability. First, I examine project-level knowledge transfer to autonomous recipient units. Thus, the recipients have a high-degree of discretion in choosing whether or not to adopt new knowledge. Within a single organization, such discretion may be lessened due to fiat (Williamson, 1991). However, work from a behavioral perspective emphasizes the autonomy and conflicting goals within firms (Cyert & March, 1963). Furthermore, prior work on knowledge transfer has
emphasized the autonomy of recipient units in deciding whether or not to institutionalize new practices, even when these practices have been dictated through fiat (Kostova & Roth, 2002). Thus, while this study may represent an extreme case of autonomy, many of the theoretical issues regarding cost and motivation are likely relevant within organizational boundaries as well.

A second critical contextual characteristic of the context that may influence generalizability is related to the informal institutional environment. In the Nicaraguan context, the majority of the intended recipients had limited formal education, limited access to knowledge supporting infrastructure such as libraries, internet, or even television, and limited ability to draw on outside expertise through social networks. Thus, the role of uncertainty regarding new technology likely loomed especially large. In more developed economies, knowledge recipients would likely have greater absorptive capacity due to a greater amount of prior experience and education, increased access to knowledge supporting infrastructure, and increased access to other sources of knowledge through social networks. Thus, it is possible that the role of uncertainty regarding new knowledge is less in more developed economies. However, extant research emphasizes the role of causal ambiguity and uncertainty in knowledge transfer (Lippman & Rumelt, 1982; Szulanski, 1996). When knowledge is complex or causally ambiguous, the role of uncertainty in influencing the motivation to transfer is likely similar in developed economies. Thus, while the Nicaraguan context may represent an extreme example, the same theoretical relationships would likely exist in more developed contexts. However, further research is needed to more explicitly test this theory for generalizability.
A final limitation is that it considers each knowledge transfer in isolation. In other words, the theoretical framework developed in this study compares the benefits of one knowledge transfer mechanism directly with another. However, organizations may use combinations of knowledge transfer mechanisms. Distinct combinations of knowledge transfer mechanisms may at some times complement each other and at other times act as substitutes. Future research could examine ways in which knowledge transfer mechanisms may substitute or complement one another.

Conclusion

This study examines knowledge transfer in a BOP environment and asks the question, under what circumstances are different knowledge transfer arrangements most efficient? Using a case-study methodology, this paper explores knowledge transfer efforts to recipients in Base of the Pyramid markets. I develop a framework for comparing knowledge transfer mechanisms. Knowledge transfer mechanisms are classified as being on a continuum ranging from exchange-based transfer mechanisms to combinatory mechanisms, with different cost implications. The problem-set, consisting of multiple similar problems, also vary along a continuum from a low to high number of exceptions. Problem-set characteristics are then matched with knowledge transfer mechanisms, with knowledge transfer efficiency as the primary criterion. I also show how uncertainty and trust moderate the effectiveness of different knowledge transfer arrangements. This paper contributes to the literature by creating a framework for directly comparing distinct knowledge transfer mechanisms, considering recipient heterogeneity, and considering
how the autonomy of recipients influences the most efficient knowledge transfer arrangement.
References


Appendix A: Abbreviated adaptation measure

Please mark which best describes how you have carried out each practice over the last year.

<table>
<thead>
<tr>
<th>Practice</th>
<th>I do this exactly as the poster shows</th>
<th>I do this in a different way</th>
<th>I don’t do this</th>
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<tbody>
<tr>
<td><strong>Reproductive management</strong></td>
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<td>Watering <strong>troughs</strong> in all of the pastures</td>
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<td>Injections of minerals, AD3E, y selenium</td>
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<tr>
<td><strong>Management of newly born calves</strong></td>
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<tr>
<td>Build a shed for the calves</td>
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<td>Stop milking the cow 2 months before she gives birth</td>
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<td><strong>Use of minerals</strong></td>
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<td>Mix 100 lbs of salt with 50 lbs of minerals</td>
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<td>Offer this every day, all that they can eat</td>
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<td><strong>Establishing sugar cane</strong></td>
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<td>Make trenches 20 cm deep and 1.5 m apart</td>
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<tr>
<td>Apply 300 lbs of fertilizer per acre and plant 60 cm cane stems that are 7 months old</td>
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<td><strong>Hygienic milking</strong></td>
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<td>Use a milking shed</td>
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<td>Wash the shed before and after milking</td>
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<td><strong>Protein banks</strong></td>
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<tr>
<td>Prepare the earth and apply 300 lbs of fertilizer</td>
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<tr>
<td>Leave the seeds soaking one day before planting</td>
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</table>
Appendix B: Illustrative Quotes

<table>
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<tr>
<th>Dis-embedding</th>
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<tr>
<td><strong>Problem signaling</strong></td>
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<td><strong>Network alteration</strong></td>
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| **Network alteration**  | An intern describes how the development organization actively altered social networks:  Let’s say the group had come to an agreement and in the night someone came to undo it all so that the next day everything had fallen apart. The technician comes to do whatever they had agreed upon and finds that no one is doing anything. So the technician begins to investigate who it really was that wasn’t in agreement and they talk to this person and ask if they really want to be involved. If they don’t want to be involved, they will be excluded so they don’t affect everyone else, that’s what the technician has to do, exclude them from the group. |

| **Network alteration**  | An employee of a milk collection center describes the impact of altering social networks to include the woman of the home:  ‘Who is going to vaccinate the cows?’ ‘I will vaccinate them,’ and she ties them up and she gives them their vaccine. So the man is relieved of a bit of his work and she is incorporated into the farm and the scheme of the work changes so it includes the woman. Now, the man makes decisions and the woman says, ‘Wait husband, we’re better like this, |
let’s not leave (the project), let’s stay.’ So there’s a back up. And if the friend says, ‘Let’s leave’ the woman is the companion in the home that hammers, ‘Stay, stay, stay’ and it provides a bit of weight so that the man will stay.

### Mass communication

**Transcript of a radio spot:**

Benito: ‘Wow, that’s a ton of cows Mrs. Millenium!’
Doña Milenia: ‘It’s that last year, I gave salt and minerals to all of my cows and almost all got pregnant and I have this mountain of calves’
Benito: ‘I throw in a good bull, but only a few got pregnant…’
Doña Milenia: ‘It’s not just the bull, Benito. You have to de-worm the cows, give them fresh water, salts and minerals, good grass, and shade in the pasture’
Benito: ‘Oh, ‘You have to treat them right…”
Doña Milenia: ‘Of course. Skinny cows don’t get pregnant, so make sure they don’t lose weight in summer, and take care of them when they give birth so they don’t get infections and so the placenta doesn’t stay inside!’
Song: ‘So that together we produce and prosper!’

A farmer describes how cattle fairs introduce novel information to participants:

With this support we’ve been going to cattle fairs and in the fairs we’ve received even more expanded knowledge, so we can keep improving.

### Re-embedding

**The general manager discusses how new experiences can inspire a new vision for a farm:**

Maybe a lot of people say about the producer that the first thing he thinks about is money and if you just show him that the technology is going to give him more money, then he will adopt it for that reason. It’s not true. Very few do it, it doesn’t work that way. The producers’ way of making decisions is not like that… I tell my technicians that the model farms shouldn’t just be sustainable, they should be pretty. So the people notice that, that the patios are pretty, that the electric fences are nice and straight, nicely in good form...seeing pretty things motivates them. And the perception that enters through his eyes, how nice that green pasture looks, how nicely the farm is organized, how nice, how nice that bull is.
<table>
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<tr>
<th>A farmer describes his impressions from a visit to another farm and how they wanted to imitate what he saw:</th>
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<tr>
<td>They took me to see Rio Blanco, to learn from experiences of other producers there. There were many things that we didn’t have them here and I came back telling my father and brother, that the producers there were working in a beautiful way with <em>madero negro, leucaena</em>, the rotation of the pastures and this helped us follow the producers because they were more advanced…we saw they were working so well and so we’ve come along as well with the grace of God. So, for example, I went and had many experiences in Rio Blanco and I came home very excited because of the things I saw there, how they worked.</td>
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<tr>
<th>Network orchestration</th>
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<td><em>A technician describes the importance of orchestrating new networks:</em></td>
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<td>Also, we should recognize something…we brought together producers that never had been organized in any way, right? It was a fact among the groups that many people had never participated in anything, and they recognized that only united they could reach their goals. So this was one of the accomplishments that we realized, forming them in groups and letting them see that they all have the same goal of moving forward, continuing and reaching a goal.</td>
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<tr>
<th>An intern to the development organization describes how the development organization brought people together:</th>
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<td>For Valle San Antonio, the development organization was a lot of help because they were so isolated there. There was practically no contact between them and los Zarzales, but the development organization linked the people together and this grew until there was a conexion between the two villages and this created social relations between them and now they share a milk transport route and all of those things.</td>
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<tr>
<th>Mirroring</th>
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<td><em>A manager describes how new norms have spread throughout the region:</em></td>
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<td>What the cattle eat in the pastures is the improved grasses and this has enormous benefits. Many producers that weren’t beneficiaries of the project, but have neighbors who were, have opted to take this technology and use it on their farm. For example, when we starting using mineral powder the business that sold these products said that their sales went up enormously because so many producers went to buy more minerals. So some of the neighbors that weren’t in the project found out and started using the minerals. I believe that it’s had a positive impact on the whole region.</td>
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<tr>
<th>A technician describes how the newly formed groups spread the information to the rest of the community:</th>
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<td>Also, another advantage of working in a group is that they were a mirror for the community, so that the other producers that couldn’t participate because of limitations, this helped that some producers that weren’t beneficiaries...</td>
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</table>
also today practice what we taught to the beneficiaries. So it helped that the group was like a mirror.

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<tr>
<th>Cognitive Embeddedness</th>
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<tr>
<td>View of farm</td>
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<tr>
<td>A producer discusses how other producers don’t think of their farm as a business</td>
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<td>People don’t see things like a business. The problem is, they have the bad idea that what you want is quantity and not quality. And that’s an error. What we look for is quality and not quantity – fewer cows, but better cows. Better, and this is difficult.</td>
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<tr>
<td>Decision making</td>
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<tr>
<td>A producer describes how many other producers are unwilling to invest in the farm:</td>
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<td>There are people for who it’s tough to buy a vitamin. Sometimes it’s because of a lack of resources, but a lot of people believe that they are going to spend money when really they are investing because they are going to earn more. They don’t see it as an investment, they see it as an expense. They don’t see it as earning money and this is earning. Taking care of your cattle is profitable.</td>
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<tr>
<td>Value</td>
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because of her loyalty,’ I tell him. ‘Do you think loyalty pays?’ he says. ‘Because of loyalty you’re going to lose your cow, because nobody is going to want to buy that cow.’ And it was very difficult to sell her; I had to put another cow that was attractive to sell with her. And this is what happens to the producer, he’s influenced by his feelings for the cow, this cow that doesn’t even have teeth.”

The general manager of the development organization describes how farmers think of their farms as a lifestyle:
We try to get them to see how the farms are progressing. How their neighbors are really improving. Some people don’t like the technicians to go to their farms to tell them what to do, you know they come with a price. But people who are really interested in the model farm they go there and they see they make much…? They don’t know much about it but they do it. They don’t feel right if anybody goes to the farm and…but it’s natural. I don’t like anybody to come to my house and say change this or change that because I feel that so good. It’s a lifestyle. They were born like a farmer, they live like a farmer, they will die like a farmer. If you take this guy to the city he will die.

Social Embeddedness

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<tr>
<th>Network ties resist or reinforce change</th>
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<tr>
<td>A intern with the development organization describes challenges associated with network embeddedness.</td>
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<tr>
<td>In the whole world it happens, but here I’ve seen it more where jealousy ends fighting, death, and everything. Fights over production, if you produce more than someone else, he makes your life impossible. He breaks your fences, he burns your pastures. Where I was doing my internship this was in style – burning pastures. They burned them.</td>
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<th>Neighbors influence decisions</th>
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<tr>
<td>A milk collection center employee describes how new networks can reinforce change:</td>
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<td>Here, people get together that have never seen each other before. And why haven’t they met each other? Because they live 20 kilometers apart. Some to the east or west and some to the north or south. They’ve never seen each other and they get to know each other and form new friendships and exchange experiences. This really helps them, it motivates them to get better, to keep going. Because you find someone and meet them and you’re similar to them and have the same preferences. And you say, ‘I’m going to talk to William’ and I feel good with him, and this friendship strengthens the producers, so this is an important part.</td>
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| Producers in San Antonio describes how he was willing to participate in the development project because his family also participated: |
| I had faith because we were going to be in a group. And I said it’s easy to fool one person, but to fool a whole group is |
hard, so there was more trust. More trust because I said if the river takes me away, I won’t be the only one taken. So I got in with some brother-in-laws, brothers of my wife, and they chose me as part of the group.

An employee of a milk collection center describes how network linkages from traditional networks can exert pressure to prevent other producers from participating in new networks:
They say, ‘You’re crazy! Why are you running around with these crazies? No, No! Look at me. I’m calm, and I’m still selling my milk there (to the cheese producer) and no one’s after me, and I don’t go around vaccinating and I don’t go around looking, and I’m not wasting time like in meetings, and I’m doing fine’ he says. This happens, and some go back to where they started and others say, ‘No, I’m doing better!’

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<th>Cultural Embeddedness</th>
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| **Cultural beliefs about practices** | Technician describes the durability of cultural practices:  
So it’s like my companions said earlier – it’s difficult to change the culture of the producer because the mentality came, unfortunately from 10 years of war. Remember that we also have to work with the culture of yesteryear, of the great grandfathers and the way that they milked. |
| | Regional manager describes the challenge of cultural beliefs:  
I’ll tell you that the most difficult thing has been the culture. They haven’t wanted to undo the way they’ve worked all their life. So they have done many things traditionally because their fathers taught them, but these things don’t make any sense technically. So we teach them new techniques. |
| **Perceived expectations of others** | A technician talks about the difficulty of going against the dominant culture:  
So we think if the project would have lasted a bit longer, I believe that the percentage of producers who keep records would have been much greater than what we left right now because we’re fighting against a myth. We’re fighting against the myth of doing what their ancestors did.”  
Two producers describe how hygienic milking, which includes hand-washing, went against their culture for milking cows:  
The most difficult practice was hygienic milking because, our ancestors and forefathers milked like, like all of the poor people, right? Because we say the poor people; the other way (hygienic milking practices) we saw only on the farms of the rich.” |

## Human Capital

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<th>Level of education</th>
<th>An intern for the development organization describes the importance of education. In my case where I was, the families that had, let’s say, more study, more education they were better able to improve. Almost all of the model farms were owned by people with education and they were more likely to abide (the new routines)…they were a bit better prepared, they had more conversations, not just within the community but with other people.</th>
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<td>A regional manager for the development organization describes the challenges associated with a lack of education: Because there are people, or in other words many of our producers, that don’t have any level of education. So what they do is try to produce milk however they can, sell it, and get by day at a time but without much vision of getting ahead, without much motivation to grow. So that’s been one of more difficult things that I’ve seen.</td>
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<th>Access to human capital on farm</th>
<th>A technician describes how the children of the producers could contribute to the farm: This was a project that trained the youngest to the oldest in dairy farming! We encouraged the farmers to send their children to school from the time that they were young so that the children are interested in increasing the number of cows, because there is a benefit for them. There are differences among the farms, on some farms the children have more education than their parents and the children pay more attention.</th>
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<td>Cooperative employee and producer describes involving the children in record keeping: There wasn’t a custom of keeping a record of the calves. You have to keep records to know what you have sold, and what you have reused on the farm and what you have invested and what you have spent on family necessities; this habit didn’t exist, there was no record. And it’s a bit tough to do because the producers don’t read much, they don’t write much, and it’s hard for them to be on top of their record in their notebook. It’s tough for them to keep track of it. But the children are helping. The children help with this record. You have to teach the father the importance, but the child keeps the record.</td>
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## Intrinsic Motivation

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<th>Seriousness and earnestness</th>
<th>A producer describes the importance of being willing to give it all he has: Some followed, right, and others just stayed put. They received the help, but nothing more. They lacked the will to work, and that’s the reality. They had little intérê, little interest in moving ahead. Because I, as I said to my sons,</th>
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since this has come, God willing, we are going to give it all that we have.

A technician describes the difference between two producers:
The best producer I had was here in Poneloya, it was Don Jose…he supported me in the field, he was a good helper, and he had experience. When we gave him sugar cane, he said, ‘Is there more?’ because he knew (that it was valuable). The worst producer I had was on the same highway, and it was a question of willingness, because he wasn’t a bad person. He did everything, but when we gave him the seed, he didn’t show interés, he gave it to someone else who wasn’t even in the group. And the sugarcane he planted on the side of the highway and when it filled with water it was lost and he said the problem was the highway, but it was really a question of his will. One of the producers had it and the other had nothing and they were in the same zone on the same highway, two people whose behavior was completely different.

Desire to progress

A producer describes the qualities he looked for in potential group members:
To be a member of the group you need to have interés, and have your farm and property, and like the idea of prospering. There are people that were given things and they never came, they never even saw the milk collection center, and they are members of the cooperative, so there are people that were given things and they never joined, they didn’t want to learn anything. But a lot of people with cattle did get interested and we looked for people with interés, that liked this and when we called them they would participate.

An intern describes a producer that wasn’t interested in progressing:
One had desires to do better, and the other now, despite that he had more resources. I think (names a producer), that we lost him because he was purely political and the environment in his home is political. All he does is criticize. Sincerely, I’m not sure how he got into the project.

Adoption of New Practices

Select new practices

A regional manager describes how a vision of the farm influences decision making:
The truth is nothing is difficult. Look, for example, if you invest in a filter that costs you a cordoba for each 40 liters of filtered milk, that’s what they see. They are used to milk without washing the udder, without washing their hands, and so there is no cost. But if you engage in clean milking, you have to wash the milk pail with detergent, with Clorox, wash your hands, the milker can only milk and the other goes tying up the legs, so you need another worker and this costs more. So anytime you have to pull a cordoba out of the pocket, it’s a problem because they don’t see it.
as an investment, they see it as an expense. But it’s profitable, and now many don’t see it as expense, but as an investment that they are making. Because before, they had never done palpations on their cows and so they didn’t know they had reproductive problems and that they were never going to give birth and they were maintaining a cow with vitamins and feed and the cow was never going to produce anything. And now they are getting rid of cows that are no good and giving better management to their cattle. Cows that used to give birth every two years, now they are giving birth every year.

A producer describes how a changed vision leads to different practices:
Well, the majority of knowledge we’ve have learned has been in the management of the farm because in general those without knowledge have managed the farm in the traditional way, right? And now with these new trainings they’ve changed our vision of how we manage our properties. Before we didn’t worry about bettering the grasses, or bettering the water of our animals. Today we’ve learned that for good management of the animal it needs to drink good water and eat good grasses to stay well. So we’ve been implementing all of this knowledge…

Maintain new practices
A leader of a cooperative describes how they work to maintain new practices:
Well, now we know that to change the mentality of the producer there are many that are working together…each route has two members that support and work to sensitize the group. For example, tomorrow there are meetings, in the morning with Sabana Grande on the southern route and in the afternoon we’ll go to the other route, at 9am and 1pm. We go to the small, medium, and large producer because we have to keep pounding on them until it’s a habit for them and they no longer forget…so this is the method that we use, this communication among the producers. Through the people that collect the milk we maintain contact, this contact and movement. Because they see the producer daily and so any information or meeting, they are the channel. And they have meetings among themselves, among the producers.

Producer in Nagarrote describes how she won’t stop using hygienic milking practices:
It was very difficult because the people didn’t want to do hygienic milking because they said, ‘this is a waste of time, washing the cow’s udder, who cares?, this is a waste of time’ and the employees didn’t want to do it, but when they begin to do it, they say, ‘Are you doing hygienic milking?’ Now it’s the custom and when my husband came, he didn’t understand what hygienic milking was, so I sent him to the training and he came back and he implemented it, and now, for nothing in the world would we stop it.
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<th>Rejection of New Practices</th>
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<td><strong>Reject new practices</strong></td>
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<td>Intern for the development organization describes why producers reject practices:</td>
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<td>They've been doing things the same for 70 years and if someone comes and says, ‘change this’ it is really difficult for them, even if they see it will make the future production better, they don’t do it…let’s say if we take the technology of clean milking, they believed that it was a cost, but in reality it was an investment and the problem was their willingness. So they would say their method was better, even after seeing the results and they believed that their old method was better because it was easier for them.</td>
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Technician describes a case where a producer rejected the practice of planting new grass varieties: |
We gave a producer seed and he did nothing. I said, ‘Are you waiting until next year?’ He shows me the sack of seed, the whole sack sitting there without being opened. And I say, ‘What are doing? You’ve already lost all of May, and all of June, and all of July!’ And I say, ‘When are you going to plant it? With this, you’re doing nothing.’ And he says, ‘Look, I promise I’ll have it planted next time you come by.’ And I say, ‘What next time?’ |

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<th>Maintain traditional routines</th>
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<td>Producer describes another producer that refused to implement new practices, even in the face of extreme loss:</td>
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<td>There were some people that couldn’t do things because of economic concerns, but others no, it was just that they didn’t change. My grandfather did something two hundred years ago, and I continue doing it the same…they don’t change because they don’t see the problem. It’s like the guy whose cows have died. He never improved his grasses, he never plants a sufficient amount of grass even though he has enough area, but he doesn’t plant improved grasses that will give his cows better food. He keeps planting a little area with grasses that don’t give enough for his cows. He doesn’t use de-wormers, and he doesn’t believe in them. Last year 5 of his animals died. Now another three are thin, almost dead already. I’ve been visiting him to try to change his traditional management, but he is a person that resists. He’ll say yes, but then nothing else.</td>
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An intern describes how producers maintain traditional practices: |
They didn’t change anything, and I can say even my own family didn’t change anything, but they keep doing the same thing, with low production, practically broke. And that’s how you are going to find many producers, almost broke. And you give them the opportunity to change, you are offering them an opportunity and they don’t take advantage of it.