OPENNING THE BLACK BOX OF KNOWLEDGE TRANSFER: THE MEDIATIONAL ROLE OF ACCURACY

Gabriel Szulanski

Wharton School, University of Pennsylvania
Department of Management
2033 SH-DH
Philadelphia, PA 19104-6370
Tel: (215) 573-9627
e-mail: szulanski@wharton.upenn.edu

Sidney G. Winter

Wharton School, University of Pennsylvania
Department of Management
2018 SH-DH
Philadelphia, PA 19104-6370
Tel: (215) 898-4140
e-mail: winter@wharton.upenn.edu

Rossella Cappetta

Bocconi University
Department of Organization
Viale Isonzo, 23
20135 Milan, Italy
Tel: (+39) 02 5836-2633
e-mail: rossella.cappetta@uni-bocconi.it

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Abstract

Generative mechanisms underlying stickiness remain largely unspecified in extant research in knowledge transfer. This constrains the interpretation of available findings and the derivation of normative implications from them. This conceptual roadblock is largely a result of the reliance on the signaling metaphor which treats transfers as instantaneous acts of signaling and absorption, obscuring the process whereby knowledge is transferred. Knowledge transfer is treated as a black box. In this paper, we rely on a replication perspective on knowledge transfer to specify a generative mechanism that underlies stickiness. This allows us to open the black box of knowledge transfer. We hypothesize and test the notion that accuracy of the transfer mediates the relationship between stickiness and its predictors. Our analysis relies on a sample of 122 transfers of best practices within eight firms.

Keywords: Knowledge Transfer, Accuracy, Stickiness

1. Introduction

Increasingly, organizations attempt to transfer knowledge to close internal performance gaps, to prevent re-inventing the wheel, to realize synergies, and to shed other avoidable deficits in performance (Dixon, 2000; O'Dell, Grayson, & Essaides, 1998; Pfeffer & Sutton, 2000). Yet this is proving to be quite challenging. Internal knowledge remains stubbornly inert. In a survey of 431 U.S. and European organizations conducted in 1997 by Ernst & Young, only 14% of the respondents judged satisfactory the performance of their organization in transferring existing knowledge internally. The remaining 86% found it lacking (Ruggles, 1998). The transfer of knowledge within the firm appears difficult.

This problem of "internal stickiness" or difficulty to transfer knowledge is a central issue for the management of knowledge assets. Extant research on stickiness has identified a plethora of factors that contribute to the difficulty of transferring knowledge and has offered empirical evidence in support of those claims (Ogawa, 1998; Szulanski, 1996; 2000; von Hippel, 1994). However, it has yet to specify the generative mechanisms that underlie stickiness.

Such a gap in the literature is symptomatic of a deeper shortcoming of prevalent approaches to research on knowledge management. The signaling metaphor (Shannon & Weaver, 1949), a foundation for most of this research, may have outlived its usefulness, as forewarned by decades of criticism (Attewell, 1992; Putnam, Phillips, & Chapman, 1996). A paradigm for communication study (Rogers, 1994), the signaling metaphor had a formative influence on the study of knowledge diffusion and transfer (Attewell, 1992) because it provides a single, easily understandable framework for the movement of knowledge. However, because this metaphor portrays the transfer as an instantaneous and costless act– rather than as a process (Putnam, Phillips, & Chapman, 1996), it blurs the process of transfer and thus the generative mechanisms underlying internal stickiness. This constrains the interpretation of extant findings and the possibility to derive sound practical normative implications. To advance research on stickiness one must model explicitly the process of knowledge transfer.

The replication perspective on internal stickiness that we develop in this paper highlights, like the signaling metaphor, the basic elements of the transfer while also providing a model of the process of transfer. This allows us to specify and test the workings of a generative mechanism that underlie stickiness.

From a replication perspective, knowledge transfer is seen as an iterative process in which source and recipient interact to produce an effective replica of an original example or template. Inaccurate reproduction of the details of the template may delay the achievement of satisfactory results thus prolonging the transfer process. Thus, a replication perspective suggests that barriers cause stickiness by disrupting the replication process primarily by hindering actions designed to produce an accurate replica. Specifically, we advance the hypothesis that accuracy in the replication process mediates the relationship between barriers of transfer and stickiness.

We find empirical support for this claim, especially during the implementation phases of knowledge transfer. Our findings support the notion that accuracy mediates the relationship between stickiness and its predictors. Our analysis relies on primary data collected through a two-step survey of 122 transfers of organizational practices within eight firms.

2. Theory and Hypothesis

2.1 Stickiness and Barriers of the Knowledge Transfer

The signaling metaphor is a dominant influence on research on knowledge transfer. The mathematical theory of communication (Shannon & Weaver, 1949), the theoretical underpinning for the signaling metaphor, has been deemed the most important single stimulus for the development of other models and theories in communication (Serevin with Tankerd, 1988). It served as the “paradigm for communication study, providing single, easily understandable specification of the main components of the communication act: source, message, channel, receiver” (Rogers, 1994: 438), which had a formative influence on the study of knowledge diffusion and transfer (Attewell, 1992).

From a signaling perspective, knowledge transfer is seen as an instantaneous and costless act. Such a view of knowledge transfer is especially evident in early studies of international transfer of technology (cf. Teece, 1977), technology diffusion (cf. Nelson, 1981) and diffusion of practices within organizations (cf. Attewell, 1992; Leonard-Barton, 1995; Rogers, 1983).

From very early on, scholars and practitioners alike noted that the reality of knowledge transfer differed significantly from such costless and instantaneous portrayal. Deviations from this metaphorical view were imputed to the existence of 'social channels' with limited information processing capacity (Arrow, 1974), to the emotions and the experiences of sensemaking individuals (Rogers, 1994), to the peculiarities of the relationship and of the social context in which the transfer is embedded (Hansen, 1999; Kostova, 1999; Szulanski, 1996) and to inevitable distortions in the communication process (Stohl & Redding, 1987).

Another important area where the assumptions behind the signaling metaphor turned problematic concerned the nature of the transferred knowledge (Kogut & Zander, 1992; Nelson & Winter, 1982; Winter, 1987). As Winter and Szulanski (forthcoming) pointed out, a causally ambiguous practice would normally have features that are irrelevant or even detrimental to the effectiveness of the transfer and ones that, though desirable, are impossible to transfer – such as unique human capital. Furthermore, some of its features, may be tacit (Kogut & Zander, 1992; Nonaka, 1994; Polanyi, 1966). Many of the things that are being done right are not obvious and unlikely to be codified; other things are quite obviously being done but are correct in non-obvious ways. These features of the object of transfer add numerous complications to the transfer, widening the gap between the metaphor of signaling and the reality of transfer.

This tension between metaphor and reality stimulated explicit efforts to amend the signaling metaphor by acknowledging the existence of stickiness (Nelson, 1981; Teece, 1977) and of its consequences for innovation related problem solving (von Hippel, 1994). In these efforts, stickiness was defined as the cost associated with technology transfer (Teece, 1977), as the actual speed of technological diffusion, and as the incremental cost of consummating a transfer (von Hippel, 1994).

Based on in-depth fieldwork, Szulanski (1996; 2000) observed that stickiness could also be inferred from the eventfulness of a transfer. He noted that transfer related problems that cannot be handled routinely require additional deliberation, recourse to non-standard skills, allocation of supplemental resources and escalation of transfer-related decisions to higher hierarchical levels for resolution (Galbraith, 1977; Pentland, 1995). These more complex problems are likely to be noticed more broadly because they interrupt the assumed flow of the transfer (Zeigarnik, 1967), exceeding the base rate of eventfulness of a typical transfer, thus becoming noticeable against a background of otherwise ambiguous and inconsistent organizational reality and creating a distinct moment of difficulty in the transfer (Gilovich, 1991) which stimulates efforts to address and resolve transfer related problems (March & Simon, 1958).

Rather than amending the metaphor, several scholars opted instead for constructing alternative metaphors for communication (for review: Boland & Tenkasi, 1995; Putnam, Phillips, & Chapman, 1996). While the details and emphasis on these metaphors vary to some degree from metaphor to metaphor they all treat communication implicitly or explicitly as a iterative process of convergence in which the parties to the communication process converge on a shared meaning (e.g.: Fisher, 1978; Watzlawick, Beavin, & Jackson, 1967; Weick, 1979), thus eliminating the assumption of directionality. Knowledge transfer however remains a directional exchange because the main intent is to recreate knowledge held by the source on the recipient side and the final understanding is rarely very different from the initial one held by the source. Hence, the assumption of directionality is appropriate when conceptualizing knowledge transfer. Correspondingly, students of technology transfer and innovation diffusion preserved the assumption of directionality and opted instead to draw attention to the process of transfer by specifying stages of the process; the most common distinction often made between a phase of initiation and one or several phases of implementation (cf. Szulanski, 2000). While stage models allow a more nuanced exploration of the connection between stickiness and some predictors, such as causal ambiguity or absorptive capacity (c.f., Szulanski, 1996, 2000), they do little to clarify systematically the generative mechanisms that link stickiness

to those contributing factors. Transfers of knowledge, analyzed that way, remain closed 'black boxes' (Van de Ven, 1992).

2.2 Transfer of Knowledge as Replication

The replication metaphor (Kogut & Zander, 1992; Nelson & Winter, 1982) provides a model to open the black box. Spatial replication is a generic process of knowledge utilization. Replicating agents seek to obtain similar results by creating exact or partial replicas of a web of coordinating relationships connecting specific resources so that a different but similar set of resources is coordinated by a very similar web of relationships (Winter, 1995). This process has been variously conceived as horizontal organizational learning (Huber, 1991), knowledge use (Glaser, Abelson, & Garrison, 1983; Leibenstein, 1966), transfer of knowledge and best practices (O'Dell, Grayson, & Essaides, 1998), sharing of common knowledge (Dixon, 2000) and knowledge sharing (Hansen, 1999).

A replication perspective adds an explicit model of the process of transfer to the elements of the transfer specified by the signaling metaphor, thus allowing the articulation of generative mechanisms whereby barriers cause stickiness. The choice of the replication metaphor is inspired by the fundamental observation that complex knowledge must be recreated by the recipient, rather than obtained through a single act of transmission and absorption (Attewell, 1992; Rosenberg, 1982; Zander & Kogut, 1995). Rather than the instantaneous act depicted by the signaling metaphor, knowledge transfer is thus expected to be a protracted iterative process with the goal of replicating the source's performance by recreating the source's practices at the recipient's end.

Several iterations are often necessary to produce an acceptable replica. Iterations are an inevitable consequence of the uncertainty and equivocality that stems from either the complexity of practices (Nelson et al., 1982) or distortions and filtering in the communication process (Stohl & Redding, 1987). The initial replica may be unsatisfactory because crucial details of time and place have been left out from the initial replication attempt thus requiring further iterations to correct oversights (Jensen & Meckling, 1992).

During these iterations, the recipient can draw on information supplied by the source and/or it can, through direct observation, infer relevant replicable aspects of the template. Winter and Szulanski (forthcoming) explain that a working template embodies an “Arrow core” – information that accounts for the performance of the template and that is not used up in the process of replication, i.e., it is non-rivalrous in use. Thus, the source’s agent at the same time acts as gatekeeper to the template and therefore influences how the recipient observes the template. The source can also supply his or her conception of the Arrow core to facilitate the re-creation of the template by the recipient.

The process of spotting and correcting consequential differences between the replica and the original template is typically faster when specific details of the template or the conception of the Arrow core have been reproduced accurately. Otherwise, identifying obstacles to improve results obtained with the replica may require the reconciliation of a larger number of differences in each iteration or a larger number of iterations. Thus, care in the reproduction of the working example or template (Nelson & Winter, 1982) may reduce the time that the recipient needs to achieve satisfactory results.

2.3 The mediational role of accuracy

The eventfulness of a replication effort is increased by anything that interrupts the process to a noticeable extent, increasing the effort and the number of iterations that are necessary to produce an acceptable replica. Inaccuracy in the process of transfer is highly likely to cause such interruptions.

Indeed, early communication studies stress accuracy as a central prerequisite for effective transfer of information. Shannon and Weaver (1949) de-compose the problem of communication into three sub-problems or levels, technical – how accurately can the symbols of the communication be transmitted, semantic – how precisely do the transmitted symbols convey the desired meaning, and effectiveness – how effectively does the received meaning affect the conduct of the recipient in the desired way. Even though

they focus primarily on the technical problem, Shannon and Weaver conclude that effectiveness is most likely when communication is technically accurate and semantically precise[1].

Besides transfers of fully codified information, accuracy is emerging as a central concern for the effective replication of causally ambiguous, i.e., imperfectly understood, organizational practices. In such situations, as Winter and Szulanski (forthcoming) explain, accuracy is desirable because "modifications introduced to adapt the established template may create new problems; problems that will have to be solved in-situ through a costly process of trial and error, since they cannot be solved through reference to the established template" (pp. 18-22). Thus, accurate reproduction of the specific details of the original template shortens the time and effort required to pinpoint and correct differences that may exist between the replica and the original. Intel's "Copy Exactly" philosophy for building semiconductor plants provides a tangible example of such logic. Recognizing that semiconductor production processes have enormously complex and opaque causal structures, Intel requires that every change to the specifications of a semiconductor plant be approved by a central committee, and, when approved, the change must be implemented across all of the fabs built to that specification. Emphasis on precision is such that Intel personnel joke that "even the height of the process technicians must be identical at all fabs" (Iansiti, 1998). Likewise, Rank Xerox, a benchmarking pioneer, allows a business unit to adapt a model process only after it has raised its performance to the same level achieved by the benchmark unit (13/07/1997). Indeed, McDonalds quickly realized that it could only be successful abroad if it stuck to the very same menu and store design that worked in the US. For example, when McDonald's Australia finally restored the standard American menu, its operation moved into the black after eight consecutive losing years. Likewise, only

[1] The emphasis on accuracy decreases in later communication studies because communication is seen less as a unidirectional act of signaling and more as a process of converging on a shared meaning which could differ from the original meaning imputed to the message by the source (e.g.: Putnam et al., 1996(Boland & Tenkasi, 1995; Rogers & Kincaid, 1981; Rommetveit, 1974; Weick, 1979). Accuracy, however, has remained a relevant and rather central element for those branches of the communication field that focus primarily on directional exchanges from a source to a recipient, as is the case when technologies or best practices are transferred within organizations.

when the McDonald's units in Germany began to look more like those in the United States did they begin to build volume (Love, 1995). Bradach (1998) found that franchise operators in his sample quickly learned to conform to franchise formats, despite idiosyncratic local pressures, because tinkering with isolated operating procedures of the complex interlocking franchise operating system brought numerous unproductive distractions that culminated in a re-discovery of franchise format. In a similar vein, Knott (1997) shows that franchisors add value by enforcing compliance with prescribed routines implying that adaptations to idiosyncratic needs undertaken by individual franchisees are on average counter-productive.

Accuracy is deemed necessary on the grounds that the combinatorial complexity of a replication effort can potentially explode with small and seemingly inconsequential departures from the specifications of a complex template. As Adler (1990) explains, it is desirable to stick to the original design of a technologically sophisticated practice as much as possible because such practices rely often on poorly mastered process techniques to such an extent that any substantial divergence from the existing, functioning design of the process risks multiplying operational problems beyond manageable levels.

One could thus infer that a common mechanism whereby the barriers to knowledge transfer identified in the literature increase the eventfulness of a transfer consist on the limits they create for the agents to accurately reproduce the features of the original template. Thus, for example, a replication in which the source of knowledge obstructs access to the original example or withholds key information may require more iterations before an acceptable replica can be produced, and the end result is more likely to differ from the original template. Accuracy therefore appears to be an important generative mechanism linking ‘stickiness to its predictors. Consequently, we posit that:

Hp: Barriers to knowledge transfer predict stickiness, and this relationship is mediated by accuracy.

3. Method

3.1 Sample and Research Process

The transfer of best practices (O'Dell, Grayson, & Essaides, 1998) provides a propitious setting to observe transfers of complex knowledge within organizations, in which the main objective is to reproduce superior results already achieved somewhere within the organization. Data were collected through a two-step questionnaire survey. The first step of the survey asked companies to provide a list of transfers for study that included sufficient detail about the parties involved in those transfers (i.e., respondents). More than 60 companies, with varying degrees of experience in the transfer of practices, expressed interest. Of that group, 12 were able to provide such a list. Of the 12, only eight provided entries of sufficient quality to warrant continuation of their involvement in the research. The eight companies were: AMP, AT&T Paradyne, British Petroleum, Burmah Castrol, Chevron Corporation, EDS, Kaiser Permanente, and Rank Xerox.

The second step of the survey was devised to analyze accuracy at specific transfers. The final sample consisted of 271 returned questionnaires, spanning 122 transfers of 38 practices[2], for a response rate of 61%. To obtain a balanced perspective on each transfer, separate questionnaires were sent to the source, the recipient, and a third party to the transfer. The respondents were comprised 110 sources units, 101 recipient units and 60 third parties. Average item non-response was lower than 5%. An average of 7.3 questionnaires were received for each practice studied.

To provide practices for study, companies were directed to search for transfers of important activities or processes that showed evidence of difficulty during the transfer and in the adaptation of the

[2] The sample contained both technical and administrative practices. Examples of technical practices are software development procedures and drawing standards. Examples of administrative practices are upward appraisal and activity-based costing (ABC). Full disclosure of the practices studied is precluded by a guarantee of confidentiality.

practice by the recipient[3]. They were also instructed to rule out practices that could be performed by a single individual and to choose only practices that required the coordinated effort of many.

3.2 Construction of Measures

Multiple-item scales were developed for all constructs to ensure the reliability and validity of the measurement system. Little empirical precedent was available to guide the development of the measures. A broad and thorough literature review informed the generation of the initial constructs and the a priori assignment of items to measure those constructs. In-depth clinical work, consultation with subject experts and feedback obtained when piloting the questionnaire helped refine the choice of constructs, identify the most relevant items for those constructs and select their proper wording given the empirical context. Some items were discarded, but not re-assigned, after the full data set was obtained.[4]

Unless otherwise stated, a balanced five-point Likert-type scale was used to measure most items in the questionnaire: Y! = "Yes!"; y = "yes, but"; o = "no opinion", n = "no, not really", N! = "No!" Following Nunnally's (1978) recommendation, construct scores were computed by adding up the standardized item scores.

Below we detail the operationalization of the central constructs of this paper. Remaining constructs are described in Szulanski (1996).

3.2.1 Accuracy of Transfer

The accuracy of the transfer of practice refers to the care invested in producing a close replica of the template. Thus a measure of accuracy must be sensitive to differences between the replica and the original template, i.e., to modifications introduced to the original template, intentionally or otherwise (Eisenberg & Phillips, 1991; Stohl & Redding, 1987). Communication scholars suggest two types of

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[3] In an effort to increase the variance in the dependent variable, this directive was necessary to counter the inclination of firms to report only successful transfers.

[4] The a priori assignment of items was preserved for all constructs except accuracy. See description below.

modifications. Modifications can either be general, i.e. affecting the comprehensive meaning of the practice. Alternatively, specific modules of the practice can be altered while preserving the overall meaning of the practice.[5]

The measure of accuracy has eight items. We used six items to assess the level of general modifications. We first asked whether compared to the source's practice, the recipient's one is: 1 = "Exactly the same"; 2 = "Essentially the same"; 3 = "Slightly modified", 4 = "Markedly modified", 5 = "Completely different". Then we distinguished between appropriate and inappropriate general modifications. Specifically, we asked whether modifications were introduced to make the practice workable, and to adapt the practice to different environment. We asked whether unnecessary modifications were performed; whether the practice was modified in ways contrary to expert's advice; and whether, altering the practice, further problems have been created.

Finally, we tried to assess specific modifications. At first, we evaluated the incompleteness of the replication by asking whether: 1 = "All modules have been transferred"; 2 = "Only selected, but all the essential modules have been transferred"; 3 = "Only the essential modules have been transferred", 4 = "Only selected modules, some essential some not, have been transferred", 5 = "None of the modules have been transferred". Next, we asked whether original modules of the practice were replaced by existing ones at the recipient.

3.2.2 Stickiness[6]

Stickiness was measured using the set of eight items corresponding to the so-called technical success indicators of a project (Pinto & Mantel, 1990; Randolph & Posner, 1988): on time, on budget, and a

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[5] This distinction is similar to the distinction made by Henderson and Clark (Henderson & Clark, 1990). between architectural knowledge and component knowledge.

[6] This construct is a refined version of the outcome-based measure of stickiness reported in Szulanski (1996). The measures preserves the items but the construct score is calculated using a slightly different procedure which better reflects the underlying meaning of the scale.

satisfied recipient. Deviation in timing was measured as departure from the initial plan in reaching key milestones -- the start of the transfer, the first day the practice became operational at the recipient and achievement of satisfactory performance. For these three items the five possible answers were: 1= "Advanced by more than one month"; 2 = "advanced less than one month"; 3 = "Not rescheduled"; 4 = "Delayed less than one month"; 5 = "Delayed more than one month". In the process of assembling the construct score, we standardized the scores of these items and considered only the scores bigger than 0. Two items measured departure of actual cost from expected cost on the source side and the recipient side. For these two items the five possible answers were 1= "Much (>30%) more than expected", 2 = " Slightly more (<30%) than expected"; 3 = "As expected"; 4 = "Slightly (<30%) less than expected"; 5 = "Much less (>30%) than expected". In the process of assembling the construct score, we standardized the scores of these items and considered only the scores lower than -1. Finally, three items measured recipient's satisfaction. One item measured adjustment in the recipient's expectations after gaining experience with the practice. The possible answers for this question were 1 = "Dramatically upward", 2 = "Slightly upward", 3 = "No change", 4 = "Slightly downward", 5 = "Dramatically downward". Two items measured whether the recipient was satisfied with the quality of the practice and with the quality of the transfer. For these two items, the possible answers were 1 = "Very satisfied"; 2 = " Somewhat satisfied"; 3 = "Neither satisfied nor dissatisfied"; 4 = "Somewhat dissatisfied"; 5 = "Very dissatisfied". To compute the construct score, we first standardized the raw measures and then converted the first three scales to binary indicators such that a true value represented any entry rather than the lowest one. For the last two items we distinguished between above average and below average scores.

3.3 Performance of the measurement model

Table 1 summarizes the performance of the measurement model, including the dependent variable, the predictors and the control variables.

Insert Table 1 about here

Convergent validity (reliability and unidimensionality) was evaluated separately for each construct (Gerbing & Anderson, 1988). Cronbach's alpha was used as a measure of reliability because it provides a lower bound to the reliability of a scale and is the most widely used measure (Nunnally, 1978). All but two scales had alpha greater than .70, thus providing an adequate level of reliability for predictor tests and hypothesized measures of a construct (Nunnally, 1978: 245-246). The two least reliable scales scored only marginally below that standard. Unidimensionality was assessed through factor analysis and computation of the theta coefficient (Armor, 1974; Carmines & Zeller, 1979; Zeller & Carmines, 1980). The unidimensionality of all 11 scales was adequate. Finally, all variables meet reasonable assumptions of normality (see Table 1 for skewness and kurtosis values).

Discriminant validity was evaluated for all construct pairs by examining the observed correlation matrix of the constructs. If the correlation between constructs i and j is 1, (i.e., if constructs i and j are perfectly correlated), the observed correlation should be $(\alpha_i{}^{.5}) * (\alpha_j{}^{.5})$ where α_i and α_j are the reliability coefficients for the constructs. In practical terms, testing for discriminant validity entails computing the upper limit for the confidence interval of the observed correlations and testing whether this limit is smaller than the maximum possible correlation between the scales as computed from their reliability coefficients. Table 2 reports the correlations for all the variables. All construct pairs met the discriminant validity test at $p < .0012$.

Insert Table 2 about here

In the design and administration of the questionnaire, several steps were taken to minimize measurement error (Nunnally, 1978). Formulated only after extensive fieldwork, the questionnaire was pre-tested with all the participating companies, with experienced academics, and with respondents who volunteered to record their reactions while completing it. Finally, the cognitive effort of the respondents was reduced by minimizing the number of scales to be learned and by translating generic terms like "source" or "recipient" into the specifics of a particular transfer.

3.4 Assumptions for the Analysis

Predictors are invariant throughout the transfer.

As a first approximation, predictors are assumed to remain invariant for the duration of the transfer. When such assumption holds true, the timing of the measurement of the independent variables is not critical. This assumption is deemed reasonable because most of the predictors typically change slowly. However there may be exceptions. Some predictors such as the motivation of the source, the motivation of the recipient and the nature of the relationship between the units may be affected by the expected outcome of the transfer. Pre-existing relationships between source and recipient sub-units did exist for al least two years prior to the beginning of the transfer.

Cross-sectional comparison of transfers is warranted.

Leonard-Barton (Leonard-Barton, 1990) argues that it is necessary to measure multi-item constructs at a "defined point" in time if meaningful comparisons are wanted, because the meaning of complex constructs depends on when during a transfer they are measured. As point of reference for her study she selected the "very first use of the technology in a routine production task" as the anchor point. She chose that point because it could be identified with a "satisfactory degree of accuracy". In this study, all questionnaires were completed within a narrow[7] band of 3.5 months, which started 5 months after the first day that knowledge was first put to use by the recipient. Thus, all transfers are at a defined and comparable point in time. Comparison across transfers is thus considered appropriate.

3.5 Analysis

We follow the procedure recommended by Baron and Kenny (1986) to test the mediation hypothesis. Accordingly, three regression models are run: a first model tests whether the predictors affect

[7]Such a band of 3.5 months can be considered narrow, because it means that all transfers were sampled early on in the integration stage which has been documented to last between 1.5 to 2 years. While 3.5 months is not literally a "point in time", it should be close enough to warrant comparison across transfers.

the mediator; a second model tests whether the predictors affect the dependent variable; and a third model to test the relationship between the mediator and the predictor and the effect that including the mediator has on how the predictors affect the dependent variable. The second and the third models enable the comparison of the direct path (excluding the mediator) with the mediated path (including the mediator).

Consequently, in Model 1 we regress accuracy against a set of barriers. In Model 2 we regress stickiness against the same barriers. In Model 3 we regress stickiness against the barriers, including accuracy as an independent variable.

3.6 Results

Table 3 displays the findings for the three models of the mediation analysis. Model 1 shows the relationship between accuracy and the predictors of stickiness.

Insert Table 3 about here

This relation is highly significant and barriers are related to accuracy in the expected direction. Specifically, source motivation, source credibility, recipient absorptive capacity and the quality of the relationship are positively related to accuracy.[8] Causal ambiguity, recipient motivation[9] and retentive capacity are negatively related to accuracy. Knowledge proveness and context are not significant.

Model 2 is highly significant and shows significant relationships between stickiness and causal ambiguity (.212, $p < .05$), motivation of the recipient (-.223; $p < .05$) and the easiness of the relationship between source and recipient (-.334; $p < .001$). The introduction of accuracy in Model 3 reduces significantly the magnitude of the relationship between stickiness and most of the barriers. All significant links in Model 1 – causal ambiguity, motivation of the recipient and the easiness of the relationship become insignificant. The reduction in the significance of these links confirms the absorption effect of accuracy, the hypothesized

[8] Source motivation and the quality of the relationship are marginally significant.

mediator. Further, inclusion of accuracy increases adj. R-square modestly from .378 to .399. However, the relationship between stickiness and accuracy is only marginally significant (t-value = -1.496).

The mediation hypothesis receives thus partial support. While accuracy absorbs part of the relationships between stickiness and its predictors, it is only marginally related to stickiness (Baron & Kenny, 1986) providing only modest support for the mediation role of accuracy.

To further establish the nature of the mediation relationship between accuracy and stickiness we repeat the mediation analysis for each stage of the transfer process, initiation, implementation, ramp-up and integration. For this, we replace the outcome based stickiness measure with process based stickiness measure for each stage (cf. Szulanski, 1996; Szulanski, 2000). Table 4 and 5 displays the performance of these additional measures and their correlation with the other variables [10].

Accuracy and Initiation stickiness. Table 6a displays the findings of Model 2 and 3 for initiation stickiness.

Insert Table 6a about here

Model 2a shows that initiation stickiness is linked significantly to the credibility of the source (-.280, p< .001), to the causal ambiguity (.175, p< .05), and to the proveness of the knowledge (-.270, p< .001). These relationships are not weakened when the mediator is considered in Model 3a, even if the inclusion of the accuracy increases the adjusted R-square from .397 to .420. The mediation hypothesis is not supported during the initiation phase.

Implementation stickiness. Table 6b displays the findings of Model 2 and 3 for stickiness in the second phase.

Insert Table 6b about here

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[9] Recipient motivation and retentive capacity are both marginally significant. Motivated recipients tend to introduce unnecessary changes thus decreasing accuracy. Retentive capacity could be interpreted as unlearning barriers which again decrease accuracy. See discussion in Szulanski (2000).

[10] In comparison with the measures in the literature (Szulanski, 1996; Szulanski, 2000), two of the four measures of stickiness have been partially changed, eliminating items too strictly related with the idea of modification included in the accuracy

Model 2b shows that implementation stickiness is linked significantly to the motivation of the source (-.180, p< .05), to the credibility of the source (-.187, p< .05); to the causal ambiguity (.220, p< .05), to the absorptive capacity of the recipient (-.463, p<.001), and to the relationship between source and recipient (-.174, p< .05). The introduction of accuracy in Model 3b produces a significant drop in the size of relationship between all but one barriers and the implementation stickiness. In particular, the links with the motivation of the source and with the relationship between source and recipient become insignificant. And the links with causal ambiguity (.161, p< .05), with the credibility of the source (-.144, p< .05) and with the absorptive capacity of the recipient (-.409, p< .001) become less significant. Further, the inclusion of accuracy in the model increases the adj. R-square from .550 to .641 and the relationship between implementation stickiness and accuracy is highly significant (-.282, p< .001). These results fully meet Baron and Kenny's conditions. The mediation hypothesis is strongly supported during the implementation phase.

Ramp-up stickiness. Table 6c displays the findings of Model 2 and 3 for stickiness in the third phase.

Insert Table 6c about here

Model 2c shows that ramp-up stickiness is linked significantly to the motivation of the source (-.157, p< .05), to the credibility of the source (-.223, p < .05), to the context (-.249, p< .05), to the causal ambiguity (.179, p< .05), to the absorptive capacity of the recipient (-.477, p< .001), and to the retentive capacity of the recipient (.462, p< .001). The introduction of the accuracy in Model 3c produces a significant drop in the size of relationship between all but two barriers and the ramp-up stickiness. In particular, the links with the motivation of the source, with the credibility of the source, and with the causal ambiguity become insignificant. And the links with the absorptive capacity of the recipient (-.272, p< .001) and with the retentive capacity of the recipient (.353, p< .001) become less significant. Only the links with the context (-

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construct. In particular, two items regarding the introduction of modifications are excluded from the Implementation stickiness

.262, p < .001) and with the relationship between source and recipient (.141, p< .05) become more significant. Further, the inclusion of the accuracy increases the adj. R-square from .440 to .596 and the relationship between ramp-up stickiness and accuracy is strongly significant (-.532, p< .001). These results fully meet Baron and Kenny's conditions. The mediation hypothesis is strongly supported during the ramp-up phase.

Integration stickiness. Table 6d displays the findings of Model 2 and 3 for stickiness in the fourth phase.

Insert Table 6d about here

Model 2d shows that integration stickiness is linked significantly to the context (-.206, p< .05), to the causal ambiguity (.168, p< .05), to the motivation of the recipient (.192, p< .05), to the absorptive capacity of the recipient (-.447, p< .001) and to the relationship between source and recipient (.198, p< .05). The introduction of the accuracy in Model 3d produces a drop in the size of relationship between all but three barriers and the integration stickiness. In particular, the link with the causal ambiguity becomes insignificant, and the links with the context (-.189, p< .05), the motivation of the recipient (-.178, p< .05), the absorptive capacity of the recipient (-.335, p< .001), the relationship between source and recipient (-.184, p< .05) become less significant. Further, the inclusion of the accuracy increases the adj. R-square from .647 to .659 and the relationship between integration stickiness and accuracy is significant (-.260, p< .001), even if less significant that in the second and third phases. These results fully meet Baron and Kenny's conditions. The mediation hypothesis is thus supported during the integration phase. Table 7 summarizes the results of the mediation analysis, including results for both for the general analysis and for the analysis of each stage of the transfer.

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measure and two items regarding modifications and alterations are excluded from the Ramp-up stickiness measure.

These results suggest that the modest mediation effect revealed by the initial analysis result from the aggregate effects of the fluctuating importance of accuracy at different phases of the transfer. Accuracy seems to be an important mediator for the implementation phases of the transfer, its importance decreasing slightly for the integration phase and marginally detectable during the initiation phase.

3.7 Robustness of the Results

Further analyses were conducted to explore the stability of the coefficients. Missing data were handled in three different ways. First, regressions were run with missing data deleted case-wise, then with missing data deleted pair-wise and finally by substituting the missing value of the constructs with the mean value of the construct.

Further, the results reported are based on an analysis in which each questionnaire is treated as a discrete data point. In other words, identical questionnaires completed by the source, by the recipient and by the third party pertaining to a same transfer are each treated as a singular data point. Thus, each transfer – the unit of analysis – is sampled three times[11]. This raises the problem of non-independence of data. To confirm the stability and robustness of the findings, additional analyses were conducted. A single observation was created from the three questionnaires for the same transfer with two methods: by discarding all but the best[12] questionnaire for each transfer (highest quality of response) and by averaging the three questionnaires.

The results with the general measure of stickiness (see Table 3) fluctuate slightly with different methods to handle observations, and with the inclusion of dummies and with different restricted samples. In particular, in these further analyses we found that the significance of the coefficient of accuracy decreases and also its effect of absorption become less evident.

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[11] Unless one or more questionnaires for that sample have not been returned.
[12] The questionnaires were selected based on the completeness and on the accuracy of the responses.

The results of the analysis with the four differentiated measures of stickiness (see Table 4a, 4b. 4c, and 4d) remain completely stable when the different methods to handle missing value, the company dummies, and perspective dummies are included in the four regression equations. Further, with the restricted samples created by discarding all but the best questionnaire for each transfer and by averaging the three questionnaires the models remain highly significant with R-square >= .47, samples sizes ranging from 89 to 112 observations. The analyses revealed that the coefficients are stable, particularly the coefficient of accuracy. The only exception is the coefficient of accuracy in Model 3a (Table 6a). This coefficient which is insignificant in the analysis that uses the full sample of observations becomes mildly significant when the analysis is conducted with a sample consisting only of the best questionnaire for each transfer.

4. Discussion and Conclusion

While extant research on stickiness has identified a plethora of factors that contribute to the difficulty to transfer knowledge and has offered empirical evidence in support of those claims, it is yet to specify the generative mechanisms that underlie stickiness. The replication perspective on internal stickiness that we develop in this paper allows us to specify and test the workings of a generative mechanism that underlie stickiness. A replication perspective suggests that barriers cause stickiness by disrupting the replication process primarily by hindering actions that would produce a more accurate replica. Specifically, we advance the hypothesis that accuracy in the replication process mediates the relationship between barriers of transfer and stickiness. We find empirical support for this claim, especially during the implementation phases of knowledge transfer. Our findings support the notion that accuracy mediates the relationship between stickiness and its predictors.

Our results expose the role of accuracy as a generative process of stickiness. Such perspective in turn opens the possibility for specifying a unifying logic connecting between barriers and stickiness. For example, this suggests possible hypotheses to guide an investigation of how the motivation of the source of

knowledge could affect the eventfulness of a transfer. The source may impact accuracy by hindering access to the template or by withholding important details that preclude the possibility of creating an accurate enough replica at the first attempt. Similarly, causal ambiguity may impact accuracy by increasing the scope of template characteristics that must be considered for reproduction thus increasing the effort necessary for a successful transfer, because some of these characteristics will turn out to be immaterial to the functioning of the replica but that cannot be known in advance.

The mediation effect of accuracy seems to be particularly important during the implementation phases of the transfer. And it is during those moments that the replica is actually being produced. While some mediation is detected also during the initiation phase it is highly probably that other mechanisms affect the initial and final moments of the transfer. For example, during the initiation of the transfer, processes of search and competition for attention may upstage accuracy seeking (Cyert & March, 1963; Hansen, 1999; Simon, 1957). Likewise, during the institutionalization phase, accuracy requirements may be relaxed as adaptation efforts are made to fine tune the replica to its environment, thus taking the resulting replica away from the original template.

A limitation of the evidence is that its cross-sectional nature precludes strong casual inferences. Data collected through a cross sectional survey could be valuable for a diachronic analysis because longitudinal archival data is virtually non-existent and most extant longitudinal examinations of the process of transfer span, at best, a handful of transfers and, almost invariably, a single firm. Furthermore, observations taken through a fixed-interval periodic survey may not be comparable because the specific meaning of complex measures is sensitive to the stage of the transfer in which those measurements are taken. Thus such a survey may miss important dynamics when transfers are not synchronized, when the interval of sampling is long relative to the pace of events in the transfer and when respondent's participation in the transfers is fluid. Analysis of a cross-sectional survey is not subject to these other concerns.

Overall, our results allow us to elaborate the contingency approach to the management of knowledge management transfer suggested in Szulanski (2000). Indeed, different managerial interventions may be more appropriate to different stages of the transfer. Our analysis suggests that interventions geared to increase accuracy could be particularly beneficial during the implementation phases of the transfer, especially during initial implementation and during ramp-up. Thus for example, stressing the use of training materials during the implementation could help improve accuracy thus reducing stickiness, while hiring new personnel during those phases of the transfer may increase the inflow of extraneous information from the outside thus reducing accuracy and increasing stickiness.

The metaphor of replication provides a powerful yet simple model to specify some of the mechanisms that underlie stickiness. It applies to all those instances of knowledge utilization where knowledge reuse is preferable to de novo learning. This metaphor has allowed us to make progress past the inherent limitations of the signaling metaphor to specify and test a specific mechanism, accuracy, underlying stickiness.

Progress in understanding the still substantial mysteries of knowledge transfer is being increasingly impaired by a treatment of the transfer as if it were a black box. We believe that opening that proverbial black box is a promising avenue to achieve further progress and we hope that we have shown one possible way to meet the challenges to moving in that direction. Of course, not all transfers are born equal and therefore the importance of accuracy or other intervening mechanisms may vary from transfer to transfer. However, we have uncovered a seemingly important example of these mechanisms and measured its impact in the transfer of best practices. Future research in this direction may bring a more nuanced understanding of stickiness and increase our ability to leverage what we know by helping us unsticking sticky transfers.

Table 1: Measurement Model

Construct	Description	Cronbach α	Items	Valid N	Avg. Inter item Corr.	Skewness	Kurtosis
1 Source's motivation	Motivation of the source unit to support the transfer	.93	13	271	.5	-.16	-1.34
2 Credibility of source	Degree to which the source of the best practice is perceived as reliable	.64	8	210	.19	-.29	-.28
3 Context	Degree to which the organizational context supports the development of transfers	.77	14	247	.2	-.09	-.03
4 Causal ambiguity	Depth of knowledge	.86	8	250	.45	.19	-.74
5 Knowledge proveness	Degree of conjecture on the utility of the transferred knowledge	.67	3	251	.4	-.67	-.27
6 Recipient's motivation	Motivation of the recipient unit to support the transfer	.93	14	271	.48	-.31	-1.27
7 Recipient's absorptive capacity	Ability of the recipient unit to identify, value and apply new knowledge	.83	9	252	.36	-.22	-.65
8 Recipient's retentive capacity	Ability of the recipient unit to support the routinize the use of new knowledge	.81	6	249	.43	-.12	-.04
9 Relationship	Ease of communication and intimacy of the relationship	.71	3	237	.46	-.30	-.61
10 Accuracy	Degree of similarity between the replica and the template.	.79	8	203	.32	-.08	-.30
11 Stickiness	Degree of difficulties experienced in the transfer of knowledge	.73	8	140	.24	.62	-.78

* These scales are composed of binary items. Both scales qualify marginally as Guttman scales

Table 2: Correlations Between Accuracy, Stickiness and Barriers of the Knowledge Transfer (Casewise)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1 Source's motivation	1.00										
2 Credibility of source	.48	1.00									
3 Context	.46	.55	1.00								
4 Causal ambiguity	-.39	-.48	-.54	1.00							
5 Knowledge proveness	.30	.33	.47	-.45	1.00						
6 Recipient's motivation	.39	.43	.38	-.29	.08	1.00					
7 Recipient's absorptive capacity	.03	.40	.46	-.23	.03	.50	1.00				
8 Recipient's retentive capacity	-.04	.34	.47	-.34	.21	.22	.68	1.00			
9 Relationship	.29	.53	.60	-.40	.34	.51	.38	.39	1.00		
10 Accuracy	.42	.62	.54	-.61	.44	.30	.24	.21	.54	1.00	
11 Stickiness	-.18	-.47	-.41	.43	-.21	-.49	-.44	-.28	-.53	-.49	1.00

Table 3: Mediation analysis for Accuracy and Stickiness

Dependent variable	Accuracy	Stickiness	Stickiness
	Model 1	Model 2	Model 3
Predictors			
Source's motivation	.144 (1.863)	.199 (1.788)	.180 (1.630)
Credibility of source	.260* (3.308)	-.154 (-1.371)	-.115 (-.967)
Context	.040 (.518)	-.011 (-.086)	.021 (.159)
Causal ambiguity	-.335** (-4.342)	.212* (2.044)	.186 (1.635)
Knowledge proveness	-.012 (-.160)	-.040 (-.412)	-.007 (-.070)
Recipient's motivation	-.113 (-1.435)	-.223* (-2.021)	-.211 (-1.823)
Recipient's absorptive capacity	.254* (3.00)	-.188 (-1.374)	-.232 (-1.680)
Recipient's retentive capacity	-.141 (-1.746)	.198 (1.570)	.148 (1.160)
Relationship	.122 (1.621)	-.334** (-3.067)	-.216 (-1.792)
Mediator			
Accuracy			-.188 (-1.496)
R-square	.448	.435	.464
Adj. R-square	.414	.378	.399
F	12.992	7.544	7.114
Valid N	154	98	93

Notes to Table
t-values in parentheses
** Significant at 1% level, * Significant at 5% level.

Table 4: Measurement Model for the Process Measures for Stickiness

Construct	Description	Cronbach α	Items	Valid N	Avg. Inter item Corr.	Skewness	Kurtosis
1 Initiation Stickiness	Difficulties experienced prior to the decision to transfer	.74	8	241	.27	.75	.26
2 Implementation stickiness**	Difficulties experienced between the decision to transfer and start of actual use	.80	11	240	.27	.39	-.26
3 Ramp-up stickiness**	Unexpected problems from the start of actual use until satisfactory perf obtains	.69	7	236	.25	-.00	-1.03
4 Integration stickiness	Difficulties experienced after satisfactory performance is achieved	.79	12	224	.25	.31	-.72

* These scales are composed of binary items. Both scales qualify marginally as Guttman scales

** These measures contain each two fewer items than the measures for the same item reported in Szulanski (1996; 2000). Two items regarding the introduction of modifications are excluded from the Implementation stickiness measure and two items regarding modifications and alterations are excluded from the Ramp-up stickiness measure.

Table 5: Correlations Between Accuracy, Initiation Stickiness, Implementation Stickiness, Ramp-up Stickiness, Integration Stickiness, and Barriers of the Knowledge Transfer (Casewise)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Initiation Stickiness	1.00													
2 Implementation stickiness	.56	1.00												
3 Ramp-up stickiness	.37	.56	1.00											
4 Integration stickiness	.23	.57	.49	1.00										
5 Source's motivation	-.31	-.30	-.40	-.21	1.00									
6 Credibility of source	-.54	-.51	-.43	-.32	.46	1.00								
7 Context	-.31	-.40	-.38	-.55	.32	.37	1.00							
8 Causal ambiguity	.55	.49	.34	.33	-.24	-.41	-.39	1.00						
9 Knowledge proveness	-.50	-.38	-.20	-.17	.28	.43	.39	-.56	1.00					
10 Recipient's motivation	-.31	-.30	-.22	-.49	.36	.35	.37	-.17	.13	1.00				
11 Recipient's absorptive capacity	-.22	-.53	-.28	-.62	-.08	.23	.38	-.07	.04	.38	1.00			
12 Recipient's retentive capacity	-.21	-.31	.12	-.42	-.08	.17	.33	-.18	.18	.26	.59	1.00		
13 Relationship	-.33	-.40	-.19	-.50	.26	.37	.49	-.30	.37	.33	.29	.29	1.00	
14 Accuracy	-.39	-.68	-.67	-.52	.38	.54	.38	-.54	.35	.25	.31	.12	.39	1.00

Table 6a: Regression for Initiation Stickiness

Dependent variable	Initiation Stickiness	Initiation Stickiness
	Model 2a	Model 3a
Barriers		
Source's motivation	-.047 (-.635)	-.044 (-.569)
Credibility of source	-.280** (-3.646)	-.317** (-3.895)
Context	.035 (.462)	.046 (.592)
Causal ambiguity	.175* (2.392)	.236* (2.886)
Knowledge proveness	-.270** (-3.888)	-.254** (-3.475)
Recipient's motivation	-.113 (-1.503)	-.117 (-1.480)
Recipient's absorptive capacity	-.099 (-1.183)	-.120 (-1.369)
Recipient's retentive capacity	.020 (.255)	.022 (.270)
Relationship	-.041 (-.597)	-.037 (-.496)
Mediator		
Accuracy		.088 (1.063)
R-square	.429	.459
Adj. R-square	.397	.420
F	13.216	12.030
Valid N	168	153

Notes to Table
t-values in parentheses
** Significant at 1% level, * Significant at 5% level.

Table 6b: Regression for Implementation Stickiness

Dependent variable	Implementation Stickiness	Implementation Stickiness
	Model 2b	Model 3b
Barriers		
Source's motivation	-.180* (-2.661)	-.114 (-1.774)
Credibility of source	-.187* (-2.606)	-.144* (-2.100)
Context	.041 (.610)	.058 (.928)
Causal ambiguity	.220* (3.344)	.161* (2.467)
Knowledge proveness	-.075 (-1.211)	-.070 (-1.187)
Recipient's motivation	.084 (1.263)	.029 (.473)
Recipient's absorptive capacity	-.463** (-6.044)	-.409** (-5.635)
Recipient's retentive capacity	.038 (.524)	-.010 (-.147)
Relationship	-.174* (-2.810)	-.069 (-1.119)
Residual (stage 1)	.206** (3.845)	.183** (3.678)
Mediator		
Accuracy		-.282** (-4.107)
R-square	.579	.668
Adj. R-square	.550	.641
F	20.336	24.688
Valid N	159	147

Notes to Table
t-values in parentheses
** Significant at 1% level, * Significant at 5% level.

Table 6c: Regression for Ramp-up Stickiness

Dependent variable	Ramp-up Stickiness	Ramp-up Stickiness
	Model 2c	Model 3c
Barriers		
Source's motivation	-.157* (-2.056)	-.117 (-1.694)
Credibility of source	-.223* (-2.813)	-.094 (-1.302)
Context	-.249* (-3.102)	-.262** (-3.693)
Causal ambiguity	.179* (2.386)	-.043 (-.595)
Knowledge proveness	.064 (.821)	.017 (.245)
Recipient's motivation	.140 (1.871)	.038 (.571)
Recipient's absorptive capacity	-.477** (-5.478)	-.272** (-3.485)
Recipient's retentive capacity	.462** (5.661)	.353** (4.943)
Relationship	-.020 (-.283)	.141* (2.097)
Residual (stage 1)	.100 (1.618)	.157* (2.887)
Residual (stage 2)	.224** (3.646)	.099 (1.830)
Mediator		
Accuracy		-.532** (-7.074)
R-square	.482	.631
Adj. R-square	.440	.596
F	11.665	17.991
Valid N	150	139

Notes to Table
t-values in parentheses
** Significant at 1% level, * Significant at 5% level.

Table 6d: Regression for Integration Stickiness

Dependent variable	Integration Stickiness Model 2d	Integration Stickiness Model 3d
Barriers		
Source's motivation	-.061 (-.975)	-.018 (-.270)
Credibility of source	.050 (.764)	.096 (1.393)
Context	-.206* (-3.112)	-.189* (-2.782)
Causal ambiguity	.168* (2.690)	.112 (1.540)
Knowledge proveness	.103 (1.614)	.130 (1.941)
Recipient's motivation	-.192* (-3.151)	-.178* (-2.836)
Recipient's absorptive capacity	-.447** (-6.138)	-.335** (-4.334)
Recipient's retentive capacity	-.015 (-.224)	-.065 (-.951)
Relationship	-.198** (-3.426)	-.184* (-2.892)
Residual (stage 1)	-.129* (-2.548)	-.152* (-2.860)
Residual (stage 2)	.190** (3.778)	.120* (2.315)
Residual (stage 3)	.192** (3.796)	.200** (3.781)
Mediator		
Accuracy		-.260** (-3.472)
R-square	.678	.693
Adj. R-square	.647	.659
F	22.627	20.307
Valid N	142	131

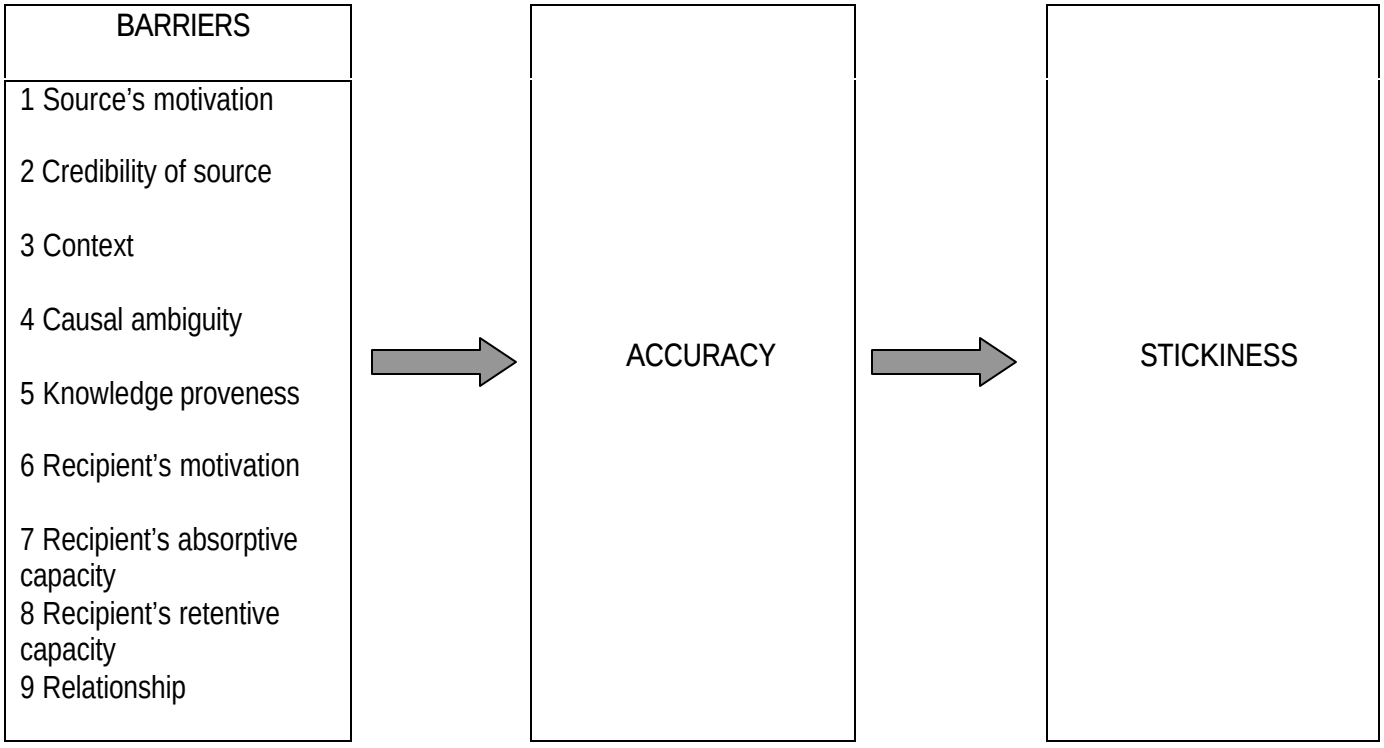
Notes to Table
t-values in parentheses
** Significant at 1% level, * Significant at 5% level.

Table 7: Summary of the Relationships between Accuracy and the four typologies of Stickiness

Dependent variable	Stickiness	Initiation Stickiness	Implementation Stickiness	Ramp-up Stickiness	Integration Stickiness
Link between Accuracy and Stickiness	MODERATE LINK (t-value = 1.496)	WEAK LINK (t-value = 1.063)	STRONG LINK (t-value = -4.107)	STRONG LINK (t-value = -7.074)	MODERATELY STRONG LINK (t-value = -3.472)
Absorptive effect of Accuracy	STRONG ABSORPTIVE EFFECT (all p-values but two increase)	NO ABSORPTIVE EFFECT	STRONG ABSORPTIVE EFFECT (all p-values but one increase)	STRONG ABSORPTIVE EFFECT (all p-values but two increase)	MODERATE ABSORPTIVE EFFECT (all p-values but three increase)

.

Figure 1: The conceptual framework



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