

**THE PROCESS OF KNOWLEDGE TRANSFER:  
A DIACHRONIC ANALYSIS OF STICKINESS**

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# **THE PROCESS OF KNOWLEDGE TRANSFER: A DIACHRONIC ANALYSIS OF STICKINESS**

## **Abstract**

Even though intra-firm transfers of knowledge are often laborious, time consuming and fraught with difficulty, extant conceptions treat them essentially as a costless and instantaneous exploit. When at all acknowledged, difficulty is an anomaly in the way transfers are modeled rather than a characteristic feature of the transfer itself. One first step towards incorporating difficulty in the analysis of knowledge transfer is to recognize that a transfer is not an act, as typically modeled, but a process. This paper offers a process model of knowledge transfer. The model identifies stages of transfer and factors that are expected to correlate with difficulty at different stages of the transfer. The general expectation is that factors that affect the opportunity to transfer are more likely to predict difficulty during the initiation phase whereas factors that affect the execution of the transfer are more likely to affect subsequent implementation phases. Measures of stickiness are developed for each stage of the transfer so as to explore the salience of different factors at different stages of the process. A cross-sectional analysis of primary data collected through a two-step survey of 122 transfers of organizational practices within eight firms illustrates the use of the model and suggests several issues for further research.

## Introduction

There is a marked increase of interest in the phenomena of organizational learning, on how organizations create, retain and transfer knowledge (Huber 1991; Argote 1999). Perhaps one of the most surprising lessons derived from this attention to knowledge and learning is that mere possession of potentially valuable knowledge assets somewhere within an organization does not necessarily mean that other parts of the organization benefit from that knowledge. Organizations do not necessarily know what they know. To a large extent, this is because internal transfers of knowledge, rather than fluid, are often “sticky” or difficult to achieve (von Hippel 1994; Szulanski 1994).

Yet, even though knowledge transfers are often found laborious, time consuming and difficult, extant research remains anchored on a basic conception of transfers of knowledge as costless and instantaneous exploits (Shannon & Weaver 1949). As a consequence, the difficulty experienced in the process of knowledge transfer has received negligible systematic attention<sup>1</sup>. When at all acknowledged, difficulty is seen as an anomaly rather than as a characteristic feature of the transfer<sup>2</sup>.

One possible way to incorporate difficulty in the analysis of knowledge transfer is to conceive of transfers not as acts, as typically modeled, but as a process. A process view allows for

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<sup>1</sup> This is somewhat surprising, because, in any process, actions that are well timed may succeed, whereas the same actions, undertaken at a less opportune moment, may not. Actions taken to transfer practices within an organization have a higher chance to be effective if they are timely. Lack of attention to timing thus limits the extent to which results reported in earlier studies could inform managerial action or the design of appropriate organizational mechanisms to facilitate transfer.

<sup>2</sup> For example, Teece (1976) associates difficulty with costs, von-Hippel (1994) assumes the existence of the costs of certain kind of knowledge transfers and goes on to explore the consequences see also Zander and Kogut (1995) subsume the time it takes to transfer within the more general question of how long it takes for a company's capabilities to be transferred or imitated, which includes the time companies take to transfer their capabilities.

a closer examination of how difficulty evolves with the transfer and thus could provide insight on the working of different organizational arrangements to transfer knowledge, inform managerial interventions and help design and re-design organizational mechanisms that support knowledge transfer.

To this end, this paper offers a diachronic<sup>3</sup> analysis of stickiness based on a model of the transfer process of organizational knowledge. The model identifies different stages of the transfer and possible predictors of difficulty for each stage. It is generally expected that factors that affect the perception of an opportunity to transfer knowledge are more likely to predict difficulty during the initiation phase whereas factors that affect the execution of the transfer are more likely to predict difficulty during subsequent implementation phases. Cross-sectional analysis of primary data collected through a two-step survey of 122 transfers of best practice within eight firms illustrates the use of the model. More specifically, measures of internal stickiness at each stage of the transfer are used to explore the salience of different predictors at different stages of the transfer. The findings suggest several new issues for further research.

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However, because this research is grounded in the signaling metaphor, stickiness is invariably seen as a departure from a set of ideal conditions rather than an integral feature of the transfer.

<sup>3</sup> The term diachronic is borrowed from linguistics to suggest contrasts between earlier and later moments of an activity. See Barley (1990) for a discussion of the nuances of the differences in the meaning of the terms diachronic and longitudinal.

## **A Diachronic Analysis of Stickiness**

### ***Stickiness.***

**Memory is attention in past tense**

**Daniel Goleman (cited in Gilovich 1991)**

Knowledge transfer is seen as a process (not a one-time act) in which an organization re-creates a complex, causally ambiguous set of routines in new settings and keeps it functioning<sup>4</sup>. Stickiness connotes difficulty experienced in that process (Szulanski 1996; von Hippel 1994).

In a difficult transfer, problems are likely to multiply. Whereas some of the transfer-related problems will be diagnosed easily and resolved routinely by those directly involved with the transfer (e.g., via pre-specified contingency plans), not all problems will. The diagnosis and resolution of some problems may transcend the resourcefulness of the organizational actor(s) who are normally affected by and routinely resolve transfer related problems. This second kind of problems is likely to require ad-hoc treatment in the form of additional deliberation, recourse to non-standard skills, allocation of supplemental resources and escalation of transfer-related decisions to higher hierarchical levels to seek arbitration and resolution. Actors whose attention would not have been normally required, such as senior managers or consultants, are likely to be involved in efforts to identify and resolve this second kind of problems. These actors will get

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<sup>4</sup> This conceptualization of the transfer stands in sharp contrast to theoretical conceptualizations of knowledge transfers as a one-shot, costless and instantaneous act that aims to reproduce precisely a quantum of knowledge that is known perfectly at its source. For example, Nelson talks about the technology diffusing instantaneously and costlessly.

involved on an exceptional basis to expedite the identification of possible solutions and enable and coordinate the implementation of those solutions<sup>5</sup>.

This second kind of problem is more likely to be noticed because it interrupts the assumed flow of the events of the transfer (Zeigarnik 1967). In other words, this kind of problem is more likely to exceed the base rate of eventfulness of a typical transfer and thus it is more likely to be noticed against a background of otherwise ambiguous and inconsistent organizational reality. This kind of problem is more likely to create a distinct moment of difficulty in the transfer (Gilovich 1991) and thus is more likely to contribute to the overall perception of difficulty and to the intensity of efforts exerted to address and resolve problems (cf. March & Simon 1958). The assessment of the degree of difficulty experienced in a transfer is likely to reflect closely the number and intensity of those distinct moments of difficulty. Other things being equal, a transfer is more likely to be perceived as difficult or sticky when efforts to resolve transfer problems become worthy of remark.

### *Predictors of Stickiness.*

The incidence of transfer problems can be predicted to some extent by analyzing properties of the transfer. A useful starting point to classify predictors of stickiness is the signaling metaphor (Shannon & Weaver 1949), which informs most of the actual research in knowledge transfer. This metaphor specifies the basic elements of a transfer: source, channel, message, recipient, and context (see also Rogers 1994:415-418).

Several traits of these elements have been found to predict stickiness at different stages of the transfer. One way to relate stickiness to traits of these elements in a somewhat systematic

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<sup>5</sup> For example, Pentland 1994 describes how help desk clerks deal with routine problems directly, but escalate,

manner is to conceive of the transfer as an effort to create a partial or exact replica of a complex and causally ambiguous (Lippman & Rumelt 1982) practice, i.e., a replica of a web of coordinating relationships connecting specific productive resources<sup>6</sup>. Complex and causally ambiguous knowledge could be inert in which case its transfer will require re-construction and adaptation at the receiving end of the transfer (e.g., Attewell 1992; Kogut & Zander 1992). Consequently, resolving problems that arise during such a transfer may involve frequent comparisons of the replica being created with the ‘template’ or benchmark example after which it is modeled (Nelson & Winter 1982). These comparisons entail several exchanges of information between the recipient and the source of knowledge.

The effectiveness of such exchanges depends to some extent on the strength of the tie between them (**Hansen** 1999) which is reflected in the ease of communication and on the “intimacy” of the overall relationship between source and recipient. An arduous (i.e., laborious and distant) relationship might increase the effort needed to resolve transfer related problems.

Besides depending on the strength of pre-existing social ties between source and recipient, the eventfulness of the transfer is likely to reflect also the dispositions and abilities of the source and recipient of knowledge. The motivation of the source may vary with the incentive to compete or collaborate with the recipient and with the effort required to support the transfer. Furthermore, the source may not be perceived as reliable. A capable and trustworthy source is more likely to influence the behavior of the recipient (e.g. see Perloff 1993, ch. 6, for a review, Zander & Kogut 1995).

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i.e., refer upwards, more complex ones.

<sup>6</sup> Though some transfers of practices are large efforts in absolute terms, transfers are assumed to be of narrow enough scope so as to require only incremental adjustment to the other routines of the adopting unit, which therefore maintains an essentially stable identity.

Likewise, the recipient may be more or less motivated to seek or accept knowledge from the outside. Lack of motivation may result in foot dragging, passivity, feigned acceptance, hidden sabotage, or outright rejection in the implementation and use of new knowledge (cf. Hayes & Clark 1985; Katz & Allen 1982, Zaltman, Duncan & Holbek 1973). Recipients may also vary in their absorptive capacity (Cohen & Levinthal 1990:128), i.e., their ability to exploit outside sources of knowledge. Furthermore, to reap the rewards of a transfer, recipients must be able to discard old practices and sustain new ones. Evidence from studies of innovation (e.g. Rogers, 1983:365), planned organizational change (see Glaser, Abelson & Garrison 1983:221-251 for a review) and organizational learning (Argote 1999) suggests that the challenge of abandoning old ways of doing things and of preserving new ones could be significant.

Finally, the organizational context where the transfer is embedded may affect the eventfulness of the transfer. Ultimately, the organizational context affects the willingness and ability of organizational sub-units to complete transfer-related tasks. Its influence occurs through norm- and value- setting (cf. Kostova 1999), through fiat or incentives (Leonard-Barton & Deschamps 1988b) and through counsel and support (Attewell 1992). An organizational context that facilitates the inception and development of transfers is frequently referred to as fertile. Hence a context that hinders the gestation and evolution of transfers is said to be barren. In a barren organizational context, transfer related problems might be more difficult to resolve.

### *A Diachronic Analysis of Stickiness.*

Current understanding of transfer processes provides grounds to specify four distinct stages of a transfer. A distinction is usually made between the initiation and the implementation of a transfer. Within the implementation phase, a further distinction is made often between what



could be described as an initial implementation effort and a subsequent follow-through and evaluation effort to integrate the practice with other practices of the recipient. Follow through efforts typically aim at maintaining and when possible improving the outcome of the transfer after satisfactory results are initially obtained.

More recently, empirical studies have shown that initial implementation of a new practice does involve a two step sequence of first ‘learning before doing’ (Pisano 1996)– either by planning (Argote 1999) or by experimenting in a contrived setting (e.g., a pilot or a laboratory) before knowledge is actually put to use by the recipient – and then ‘learning by doing’ which entails mainly the resolution of unexpected problems that arise when new knowledge is put to use by the recipient (von Hippel & Tyre 1995). The resulting four-phase process is depicted in figure 1 below. Each of the four stages – initiation, implementation, ramp-up and integration – could be difficult, in a different way. The nature of difficulty at each stage and possible predictors are discussed in the next section.

**[FIGURE 1 ABOUT HERE]**

The general expectation is that factors that affect the opportunity to transfer are more likely to predict difficulty during the initiation phase whereas factors that affect the execution of the transfer are more likely to predict difficulty during subsequent implementation phases. In particular, the influence of the attributes of the source could be expected to diminish as the transfer unfolds. That is because the source’s involvement and cooperation is likely to be most needed for the initiation and initial implementation of the transfer. However, once the recipient has obtained satisfactory results on its own it will need progressively fewer interactions with the source. Conversely, attributes of the recipient are likely to become increasingly important as the transfer unfolds. The actual ability of a recipient to implement and retain practices will become

evident only after implementation has begun because that's when those abilities are actually put to test<sup>7</sup>.

### **Initiation Stickiness**

Initiation stickiness is the difficulty to recognize opportunities to transfer and to act upon them to initiate the transfer. An opportunity for a transfer can be said to exist as soon as the seed for that transfer is formed, i.e., as soon as a gap and knowledge to address the gap could be found within the organization. The discovery of a gap may trigger problemistic search (Cyert & March 1963) for suitable solutions. Alternatively, slack search (Cyert & March 1963) may uncover superior practices thus revealing a previously unsuspected gap or creating a new one (cf. Rogers 1983; Zaltman et al. 1973; Glaser et al. 1983).

The eventfulness of the initiation stage depends on how difficult it is to find an opportunity to transfer and to decide whether or not to pursue it. Finding an opportunity means finding both a gap and knowledge to address that gap. This becomes more demanding when existing operations are inadequately understood or when relevant and timely measures of performance as well as internal or external yardsticks are missing. Furthermore, the opportunity may need further scrutiny after being identified because why or how superior results are obtained by the source is seldom fully understood. With the passage of time, the original rationale for a practice and its nuances are reduced to taken for granted beliefs and entrenched habits. Yet, before the transfer could be undertaken, the practice might need to be documented to some extent, e.g., by creating process maps or flowcharts, and its rationale may have to be reconstructed in order to select what needs

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<sup>7</sup> Cool, Dierickx and Szulanski (1997) found empirical support for this argument in the context of the diffusion of analog electronic switching within the Bell System. In the Bell System, easy access to the technology was found to impact the speed of diffusion before the adoption decision was made by the recipient but the traits of the recipient dominated once adoption had begun.

to be transferred. Because of these complications, the initiation of a transfer may require substantial effort to delineate the scope<sup>8</sup> of that transfer, select the timing, assess the costs and establish the mutual obligations of the participants (Ounjian & Carne 1987:198).

Yet, the search for opportunities and the decision to proceed with a transfer occurs under some degree of irreducible uncertainty or causal ambiguity. That is because the source's understanding and ability to explain a practice is often incomplete, the recipient's ability to specify the environment where new knowledge will be applied is also incomplete, and measures of performance used to identify opportunities are often imprecise and subject to chance fluctuation. This makes it more difficult to assess the real merit of an opportunity and act upon it. However, this uncertainty is mitigated if there is evidence that the knowledge to be transferred has proven robust in other environments and also if the source is reputable. When the source unit is not perceived as reliable or when it is not seen as trustworthy or knowledgeable, initiating a transfer from that source will be more difficult and its advice and example are likely to be challenged and resisted, thus increasing the difficulty to initiate the transfer (cf. Walton 1975).

### **Implementation Stickiness**

After it has been decided to transfer knowledge, attention shifts to the exchange of information and resources that occurs between the source and the recipient. Transfer-specific ties are established between members of the source and the recipient and information and resource flows will typically increase and possibly peak at this stage. Efforts are made to preempt problems through careful planning (Pisano 1996), especially to avoid the recurrence of problems that were

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<sup>8</sup>Scope is primarily reflected in the components of the knowledge that are to be transferred. If the recipient is a large and complex organization then scope considerations may also include the choice of parts of the recipient to which new knowledge is to be transferred, and in what sequence.

already experienced in previous transfers of the same knowledge, and to help make the introduction of new knowledge less threatening to the recipient (cf. Rice & Rogers 1980:508-509; Buttolph 1992:464).

The eventfulness of the implementation stage depends on how challenging it is to bridge the communications gap between the source and the recipient and to fill the recipient's technical gap. Bridging the communication gap may require solving problems caused by incompatibilities of language, coding schemes and cultural conventions. Closing the technical gap may disrupt the normal activities of both source and recipient. It may distract the source from its main mission (unless its mission is to support the transfer) – especially when supporting the transfer means generating additional documents, constructing dedicated equipment, lending or donating its own skilled personnel, or training the recipient's personnel. It may also temporarily disrupt the recipient's operations because existing personnel may have to be retrained or reassigned, new personnel may be hired and trained, infrastructure may have to be modified and upgraded and consultants from the source unit or elsewhere may move temporarily to the recipient. Further, when the recipient unit is large, transfer related information might not reach all parts of the recipient thus creating problems of coordination.

Further difficulty may also result from poor coordination between the source and the recipient, especially when either the source or the recipient of knowledge deviate from agreed upon responsibilities. When this occurs, the source or the recipient may do less than it is expected from them or conversely may do more than it is expected leading to situations where the recipient usurps some of the roles of the source or where the source intrudes the domain of the recipient (Leonard-Barton 1990b).

It is for this reason that the true motivation of the source to support the transfer is likely to be discovered at this stage. So will to some extent the predisposition of the recipient which could increase difficulty by ignoring the source's recommendations because it does not understand them, because of hidden resentment or because it wants to preserve pride of ownership and status (Rice & Rogers 1980). The extent of difficulty could be mitigated through planning. However the extent to which implementation activities could be actually planned depends on the depth of understanding of the practice, i.e., on causal ambiguity. Oversights during planning could be compensated through mutual adjustment. The effectiveness of planning, coordination and mutual adjustments is likely to depend on the quality of the relationship between the source and the recipient.

### **Ramp-Up Stickiness**

Once the recipient begins using acquired knowledge – e.g., starts up a new manufacturing facility, rolls over a new manufacturing process, or cuts over to a new system – the main concern becomes identifying and resolving unexpected problems that keep the recipient from matching or exceeding a-priori expectations of post transfer performance. The ramp-up stage is a relatively brief window of opportunity to rectify unexpected problems (Tyre & Orlikowski 1994) where the recipient is likely to begin using new knowledge ineffectively (cf. Baloff 1970; Adler 1990; Galbraith 1990; Chew, Leonard-Barton & Bohn 1991) ramping up gradually towards a satisfactory level of performance, often with external assistance.

The eventfulness of the ramp-up phase depends on the number and seriousness of unexpected problems<sup>9</sup> and the effort actually required to solve those problems. Unexpected problems may surface because a new environment where the transferred knowledge is put to use reacts differently than expected, training of personnel turns out to be insufficient or incomplete, trained personnel leaves the organization or proves unfit for new roles, or the new practices involve significant changes in the language system and in the shared norms and beliefs underlying the correct interpretation of work directives. Likewise, when the transition to the use of new knowledge is gradual rather than sharp, i.e., when a new practice co-exists for a period of time with the practice it was meant to replace, duplication of effort and resource contention is likely. Unexpected problems become more difficult to resolve the later they occur within the ramp-up stage because precarious versions of new practices may become habitualized and will be more difficult to modify. When new knowledge is put to use in broad scope, i.e. simultaneously rather than sequentially, the scope of incidence of unexpected problems will generally be broader.

Thus, difficulty during the ramp-up stage is likely to correspond primarily to the degree of causal ambiguity of the practice because unexpected problems are easier to resolve when cause-effect relationships for the new practice are understood, and when it is possible to forecast results and explain them unequivocally once they are known. The absorptive capacity of the recipient, i.e., the ability to put new knowledge to use, depends on its existing stock of knowledge and skills. Thus the presence of relevant expertise during the ramp-up stage, either from within or lent from external sources, is crucial to contain costs (Chew et al. 1991) and delays (Baloff 1970).

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<sup>9</sup>It is important to note that events that would have a minor effect in a stable organization can seriously disrupt the ramp-up stage.

### **Integration Stickiness**

Once satisfactory results are initially obtained, the use of new knowledge becomes gradually routinized. This progressive routinization is incipient in every recurring social pattern (Berger & Luckman 1966:53). Unless difficulty is encountered in the process, the new practices will blend with the objective, taken-for-granted reality of the organization (Berger & Luckman 1966; Zucker 1977). However, when difficulties are encountered, the new practices may be abandoned and, when feasible, reversal to the former status-quo may occur.

The eventfulness of the integration phase depends on the effort required to remove obstacles and to deal with challenges to the routinization of the new practice. This involves maintaining a delicate and comprehensive truce in intraorganizational conflict (Nelson & Winter 1982:110), i.e. a situation where members of the organization are "content to play their roles . . . [and where] . . . manifest conflict follows largely predictable paths and stays within predictable bounds." This truce may be disturbed by external events such as environmental changes, the arrival of new members<sup>10</sup>, or the appearance of a clearly superior alternative (Goodman, Bazerman & Conlon 1980; Zaltman et al. 1973). Likewise, the truce may be disturbed by internal events such as individual lapses in performance, unmet expectations, unclear rationale for the practice, evidence of dysfunctional consequences of using new knowledge, or sudden change in the scale of activities. Each disturbance to the truce may compound difficulty because each time a contingency is resolved the terms of the truce become more specific and some individuals may resist the more specified version of the truce.

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<sup>10</sup>New personnel, if not adequately socialized, may disrupt routine use of new knowledge. Also, if unassigned, new personnel may provide extra resources for handling outstanding problems. Finally, when a new group of managers takes over, they may create an opportunity to rethink and refocus attention on outstanding problems (Tyre & Orlikowski 1994).

Organizational sub-units may differ in their ability to maintain routine operation. For example, they may differ in the quality of sensing mechanisms that detect incipient threats to the organizational truce and they may differ also in their ability to recalibrate situations once the threat is recognized (Goodman & Dean Jr. 1982). The commitment of the recipient to specific practices will become evident during the institutionalization stage because each time the truce is disturbed the appropriateness of the new practice may be explicitly questioned and reevaluated requiring an affirmative "decision to continue." This decision may exact a social cost to the recipient (cf. Goodman & Dean Jr. 1982:270-271; Berger & Luckman 1966; Nelson & Winter 1982; Tolbert 1987:112). For example, preserving the use of new knowledge may require disciplining or removing disruptive individuals who do not accept the new power distribution or other organizational facts accompanying the new practice.

### **An Illustration: Sticky Transfers of Best Practice**

#### ***Setting.***

One of the most prevalent and effective practical manifestations of organizational learning is the so-called transfer of knowledge and best practices within the firm (cf., O'Dell, Grayson & Essaides 1998:224). Upon discovering differences in the performance of similar units, firms multiply attempts to leverage existing knowledge through transfers of best practice.

Transfers of best practice are seen as dyadic exchanges of organizational knowledge between a source and a recipient unit in which the characteristics of the source and the identity of each recipient both matter. The expression *transfer of best practice inside the firm* connotes the replication of a practice that is performed in a superior way somewhere within the organization providing better results than known alternatives within or outside the company. *Practice* refers to



the organization's routine use of knowledge. The word "transfer" is used – instead of "diffusion" – to emphasize that the movement of knowledge within the organization is a distinct experience, not a gradual process of dissemination, and that it depends on the characteristics of everyone involved.

The transfer of best practices provides a propitious setting to observe transfers of knowledge within organizations. The use of the model to analyze internal stickiness in this context is illustrated below.

### ***Sample and Research Process.***

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 which included sufficient detail about the parties involved in those transfers (i.e., of 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 stickiness at specific transfers. The final sample consisted of 271 returned questionnaires, spanning 122 transfers of 38 practices<sup>11</sup>, for a response rate of 61%. To obtain a balanced perspective on each transfer one questionnaire was sent to the source, one to the recipient, and one to a third party to the transfer. In terms of the

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<sup>11</sup> 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

type of respondent, 110 questionnaires were received from sources units, 101 from recipient units and 60 from third parties. Average item non-response was lower than 5%. On average 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, and to prefer those that showed evidence of difficulty during the transfer and in the adaptation of the practice by the recipient<sup>12</sup>. 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<sup>13</sup>.

### ***Construction of Measures.***

The selection of items for the measures of stickiness, the dependent variables, is based on typical<sup>14</sup> events expected at a particular stage of the transfer. These descriptors detect the incidence of *specific behaviors*. The items for the predictors of stickiness, the independent variables, aim to capture *traits* of these basic elements of the transfer. The items constituting all constructs used in the study are described in Appendix-1 (dependent variables) and Appendix-2 (independent variables).

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

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appraisal and activity-based costing (ABC). Full disclosure of the practices studied is precluded by a guarantee of confidentiality.

<sup>12</sup> 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.

<sup>13</sup> This directive was necessary to identify transfers at the inter-organizational level.

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 their proper wording given the empirical context. Some items were discarded, but not re-assigned, after the full data set was obtained. The a-priori assignment of items was preserved for all constructs.

For simplicity in scoring, a balanced five-point Likert-type scale that was relatively straightforward to master was used almost exclusively. Unless otherwise indicated, the scale used was: **Y!** = Yes! ; **y** = yes, but ; **o** = no opinion , **n** = no, not really , **N!** = No! . The construct scores were computed by adding the standardized item scores (cf. Nunnally 1978). Dependent variables were coded so that a larger numerical value represents a higher level of stickiness. Independent variables were coded so that a larger numerical value represents a higher barrier.

**[TABLE 1 ABOUT HERE]**

Table 1 summarizes the performance of the measurement model. Convergent validity (reliability and unidimensionality) was evaluated for each construct (cf. Gerbing & Anderson 1988). Cronbach's alpha was used as a measure of reliability because it provides a lower bound for the reliability of a scale and is the most widely used measure (cf. Nunnally 1978). All but two scales had  $\alpha > .7$ , thus providing an adequate level of reliability for predictor tests and hypothesized measures of a construct (see Nunnally 1978:245-246). The two least reliable scales scored marginally below that standard. The performance of the binary scales of both motivation measures is particularly noteworthy in that both scales qualify marginally for the Guttman

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<sup>14</sup> Either from theory or from empirical evidence.

criterion for scalability (cf. McIver & Carmines 1981). Unidimensionality was assessed through factor analysis and computation of the theta coefficient (Armor 1974; Carmines & Zeller 1979; Zeller & Carmines 1980). The unidimensionality of all 10 scales was adequate.

**[TABLE 2 ABOUT HERE]**

**[TABLE 3 ABOUT HERE]**

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  $\alpha_i$  and  $\alpha_j$  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<sup>15</sup> 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 the independent variables. All construct pairs met the discriminant validity test at  $p < .0012$ .

### ***The Questionnaire.***

In the design and administration of the questionnaire, several steps were taken to mitigate measurement error (cf. 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,

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<sup>15</sup> The upper limit of the confidence interval is given by the expression: UPPER LIMIT =  $\tanh(\tanh^{-1}(\rho) + z_{1/2\alpha} / (N-3)^{0.5})$  where **tanh** is the hyperbolic tangent function,  $\rho$  is the observed correlation coefficient,  $z_{1/2\alpha}$  is the upper 50 $\alpha$  percentage points of the standard normal distribution function and  $N$  is the number of sample points used in the computation of the correlation.

and the mental translation of abstract terms like “source” or “recipient” into the specifics of a particular transfer.

### *Assumptions.*

#### **Validity of the process model.**

Although there are no rigorous statistical tests to assess the validity of process models (cf. Pentland 1995), the behavior described by the model has been found to correspond to observed behavior at the level of abstraction described by the stages in terms of the expected temporal order of concerns (see Szulanski 1995 chapter 4)<sup>16</sup>. Statistical evidence of the distinctiveness of the four phases is provided by the discriminant validity tests for all six stickiness construct pairs.

Besides establishing the validity of decomposing the transfer into four phases. In general, antecedent conditions are thought necessary but generally not sufficient for consequences to occur. However, the reversal of the sequence is considered highly unlikely. It is hard to think of a practice as being institutionalized before it has been implemented, or as being implemented before it is identified.

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<sup>16</sup> A particularly revealing example is provided by how Banc One transfers systems and operating procedures to the banks that it acquires. Banc One focused on the problems of implementation and ramp-up. Neither initiation nor integration were salient problems because the fact that the transfer is going to happen is built-in into their process of affiliation, which includes procedures for establishing what is going to be transferred and who is going to do what. Integration is also not a problem for Banc One because the acquired bank does not have the option to go back to its pre-acquisition systems and operating procedures and thus must rely on Banc One practices and systems for its operation. So the problem of transfer for Banc One is confined to securing an uneventful implementation of the transfer including the ramp-up of the recipient (the acquired bank), after which the transfer is considered complete. The separation between implementation and ramp-up at Banc One is particularly stark because the transition happens over a single week-end. The acquired bank closes on a Friday operating on its own established routines and re-opens on Monday operating as a Banc One bank, with the newly acquired systems and operating procedures fully in place. The process of ramp-up rarely takes more than thirty days with satisfactory performance typically achieved after ten days. For a full description of the Banc One example see Szulanski (1997).

Data was gathered to assess the validity of the model's assumptions about sequence. The respondents were asked to specify the exact dates for each of the milestones of the transfer process.<sup>17</sup> With few exceptions, the dates reported<sup>18</sup> followed the progression one might expect from the specification of the process model. Further evidence for the sequence is provided by the motivation scales. These scales consist of binary items that ask for the occurrence of specific events in an order derived from the process model. A test was conducted to see whether those scales qualify as Guttman scales. This would provide empirical support for the validity of the assumptions about order of events. Both scales, the one for the source and the one for the recipient, did qualify marginally as Guttman scales.<sup>19</sup>

### **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

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<sup>17</sup> The milestones were described as follows:

M1 (87%) Approx. when was it decided to proceed with the transfer of «practice» from «source» to «recipient»?

M2 (79%) Approx. when did «practice» become operational in «recipient»?

M3 (70%) Approx. when was «recipient» first able to perform «practice» entirely on its own? (i.e. without any assistance from «source», corporate or external consultants)

M4 (72%) Approx. when was «practice» first introduced to «company»?

M5 (86%) Approx. when did you learn about the existence of «practice»?

M = Milestone. Item response rate given in parenthesis.

M1 precedes M2 96.4% of cases. M2 precedes M3 95.6% of cases. M4 or M5 precedes M1 in 98.2% of cases.

<sup>18</sup> To reconstruct the dates, respondents were asked to refer back to discussions, reports, visits, presentations, meetings, and to their personal calendar.

<sup>19</sup> The Guttman coefficient of reproducibility (CR) – computed according to Goodenough-Edwards (a more conservative) criterion for counting errors – is .84 for the source motivation scale and is .8 for the recipient motivation scale. Todd's coefficient of scalability (CS) is .72 for the source motivation scale and .63 for the

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 at least two years prior to the beginning of the transfer.

**Cross-sectional comparison of transfers is warranted.**

Leonard-Barton (1990a:259) 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 precision”. In this study, all questionnaires were completed within a narrow band of 3.5 months, which started 5 months after the first day that knowledge was first put to use by the recipient<sup>20</sup>. Thus, all transfers in the study not only reached the institutionalization stage but are at a defined and comparable point in time. Comparison across transfers is thus considered appropriate.

***Analysis.***

The analysis purports to illustrate the relationships between predictors ( $\beta_1$ - $\beta_9$ ) and stickiness at each stage. Several controls were included to account for unobserved heterogeneity. Spontaneity ( $\beta_{c1}$ ) is a single item variable that controls for whether or not the transfer was hierarchically imposed rather than spontaneous<sup>21</sup>. The model is specified in the equations below.

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recipient motivation scale. A scale with CR  $\geq$  .9 and CS  $>$  .6 can be considered an adequate Guttman scale (see McIver & Carmines 1981, pp.40-55).

<sup>20</sup>The average duration of the ramp-up process was 1.5 months with surprisingly little variation. Thus all transfers were sampled early on in the integration stage. Because the integration stage has been documented to last 1.5 to 2 years, a band of 3.5 months could be considered narrow.

<sup>21</sup> The transfer of «practice» from «source» to «recipient» was: (circle one option) 1. mandated by top management 2. strongly encouraged 3. favored 4. optional 5. entirely spontaneous

### ***Results.***

#### **[TABLE 4 ABOUT HERE]**

Table 4 displays the findings from the regression analyses run separately on each measure of stickiness (equations I, II, III and IV). The four equations have significant explanatory power (adj. Rsq.  $\geq$  .4) for each of the process based descriptors of internal stickiness.

#### **[FIGURE 2 ABOUT HERE]**

Overall, the pattern of results is consistent with the general expectation that factors that affect the opportunity to transfer are more likely to predict difficulty during the initiation phase whereas factors that affect the execution of the transfer are more likely to predict difficulty during subsequent implementation phases. Traits of the source unit such as Motivation and Perceived Reliability are significant in the first three stages of the transfer. The traits of the recipient unit, most notably Absorptive Capacity, become significant once implementation has begun. Causal Ambiguity is significant at all stages of the transfer. In terms of relative importance, it would appear that causal ambiguity and the lack of absorptive capacity of the recipient are the most important predictors of stickiness.

### ***Robustness of the Results.***

Further analysis was conducted to explore the stability of the coefficients. Missing data were handled in four different ways. First, regressions were run with missing data deleted pairwise and then by substituting the missing value of the constructs with the mean value of the construct. Then, to maximally utilize the information contained in the data set, the missing indicators were replaced by the means for that indicator and the constructs were re-computed.



This was done once by substituting independent variables only and then again by substituting both the dependent and the independent variables. Results remain stable also when company dummy variables are included in the four regression equations.

The results reported are based on an analysis in which each questionnaire is treated as a discrete data point. In other words, questionnaires furnished 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<sup>22</sup>. This raises the problem of non-independence of data. To confirm the stability and robustness of the findings, four additional analyses were conducted. First, dummy variables were introduced to control for the affiliation of the respondent, i.e., source, recipient or third party. Second, a single observation was created from the three questionnaires for the same transfer, first by averaging all questionnaires, then by averaging only those with high quality of responses, and finally by discarding all but the best<sup>23</sup> questionnaire for each transfer (highest quality of response). In all these analyses, the models remain highly significant with adj. R-square  $\geq .27$ , samples sizes ranging from 77 to 98 observations. The analyses revealed that for three of the four equations: Initiation Stickiness, Ramp-Up Stickiness and Integration Stickiness, all coefficients are stable.

For the equation of Implementation Stickiness, it was found that the coefficient for unproven knowledge became insignificant when perspective-dummy variables were introduced, when questionnaires were averaged and when only the best one was retained. The coefficient for perceived reliability became significant in the expected direction when perspective-dummies were

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<sup>22</sup> Unless one or more questionnaires for that sample have not been returned.

<sup>23</sup> The questionnaires were selected based on the completeness of the responses, on the overall quality of answers to questions about quantitative data such as dates or costs, and based on the care demonstrated by the respondent when answering open ended questions.

introduced. In sum, with the exception of that single coefficient in the Implementation Stickiness equation, results are otherwise stable indicating the absence of major specification errors.

## **Discussion and Conclusion**

Even though intra-firm transfers of knowledge are often laborious, time consuming and fraught with difficulty, extant conceptions continue to treat them as a costless and instantaneous exploit. For example Nelson (cf. 1981:1049) notes that early studies of technological innovation assume that ". . . new technology instantly diffuses across total capital" (cf. Nelson 1981:1049). Hansen (1996) reviews a large body of macro organizational research which emphasizes the benefits of resource sharing while neglecting to analyze how knowledge sharing actually takes place. Attewell (1992) forcefully critiques the use of the signaling metaphor (Shannon & Weaver 1949) to study the transfer of complex knowledge within organizations because such complex knowledge is to a large extent inert and thus knowledge transfer should be thought more as a process of reconstruction than a mere act of transmission and reception.

A conception of transfer as an instantaneous and costless act essentially negates the possibility of difficulty. Thus, when at all acknowledged, difficulty is an anomaly in the way transfers are modeled rather than a characteristic feature of the transfer. The process approach to study transfer is often distinguished from a results, event or variance approach. The later focuses on describing and explaining results. Looking only at results however obscures the decision processes involved and the nature of implementation problems.

The process model proposed and illustrated in this paper provides, hopefully, a constructive way to incorporate difficulty in the analysis of knowledge transfer. By distinguishing

between Initiation Stickiness, Implementation Stickiness, Ramp-Up Stickiness and Integration Stickiness, the model provides one possible way to examine empirically the evolution of difficulty.

The empirical evidence illustrates such a diachronic analysis of sticky transfers of best practice within the firm. The sample is drawn from a set of firms – reputed pioneers in best practices transfer as well as relative neophytes – that are aware of their own transfer activities and interested in studying them enough to be willing and able to commit to supply high quality responses. Sample selection bias occurs at the level of the transfers studied because despite a keen effort to the contrary most firms reported only transfers that reached the integration stage. The sample does not contain examples of transfers aborted during previous stages. Another limitation of the evidence is that its cross-sectional nature precludes strong causal inferences.

In general, 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.

Therefore, the findings presented in this paper merit consideration as a suggestive illustration of areas for further research. Overall, the pattern of results is consistent with expectations and supports the claim that the relative importance of predictors changes as the transfer unfolds. Thus scrutiny of transfer processes seems warranted to improve the

understanding of the working of organizational mechanisms to support knowledge transfer and to inform managerial intervention.

Furthermore, two stable but unexpected findings are intriguing. One of them is the counter-intuitive finding that a motivated recipient could intensify, rather than mitigate, the difficulty encountered during the ramp-up stage (see equation III). This finding is consistent with studies of the diffusion of innovations where highly motivated adopters have been found to exacerbate problems of implementation by voluntarily dismissing outside help before due time, expanding seemingly straightforward modifications into major projects, making unnecessary modifications to preserve pride of ownership and status or because of hidden resentment (cf. Rice & Rogers 1980; Tyre & Orlikowski 1994) and switching to new practices at a sub-optimal moment because of unchecked enthusiasm (cf. Baloff 1970). This counter-intuitive finding suggests the intriguing hypothesis that a highly motivated recipient could be a double-edge sword in that it will, as conventional wisdom suggests, help initiate a transfer but it might complicate its implementation.

The other stable but unexpected result is the negative coefficient on the lack of retentive capacity during ramp-up (see equation III). This construct, which was expected to be significant during the institutionalization of a new practice, i.e., during the integration stage, turned out to be significant only during the ramp-up stage and with opposite sign. This finding may therefore be an indication of the presence of unlearning barriers (see Szulanski 1996). Because questionnaires were administered a relatively short time after practices were put to use by the recipient, those practices are unlikely to have been fully institutionalized by the time measurement occurred (cf. Lawless 1987; Tyre & Orlikowski 1994). Thus, to the extent that this construct measures, as intended, the degree of institutionalization of a practice, a high score of institutionalization early in

the integration stage must represent, to some extent, institutionalization of *pre-existing* knowledge. The more institutionalized pre-existing knowledge is, the higher the effort required to dismantle it, i.e., the higher the unlearning barrier (Hedberg 1981; cf. also Hamel 1991). Such efforts to de-institutionalize or “forget” prior knowledge are not likely to begin in earnest until new knowledge is first put to use, i.e., during the start-up stage, and will probably wane by the time satisfactory results are obtained using new knowledge. Thus the unlearning interpretation is also consistent with the fact that the coefficient is significant only during the ramp-up stage. This finding implies that there may be a natural pace for organizational knowledge transfers to occur. If the pace of transfers is too fast, changes may never get fully implemented. However, if the pace is too slow, practices will become institutionalized and thus it will be more difficult to replace them.

A more general question of interest to students of organizational learning is how do organizations learn to transfer knowledge or, in other words, how do organizations learn to learn? The process view of knowledge transfer developed and illustrated in this paper suggests an answer to this question. Organizations learn to transfer knowledge by making those transfers less eventful. People have a tendency to remember interrupted tasks better than they do remember those that have been completed (Zeigarnik 1967). Interruptions of a transfer of knowledge occur when transfer-related problems impede further progress with the transfer. The transfer is interrupted at that point and the lessons learned from solving those problems are likely to be remembered better and more likely to be applied the next time a transfer is attempted. Thus an organization learns to cope with stickiness by drawing on the lessons from previous experience with knowledge transfer. A dramatic account of this organizational learning process is offered by a systems analyst at Banc One Systems Corporation,

At first, when a particular bank needed to be converted, all individual departments did it when they wanted. Applications were more independent, we didn't have so much interdependence. When the conversion management group was formed, they started coordinating across application areas. Conversions were done "in-sync". It was the first time I met other analysts, and that we started to work together, going to another bank. We began holding biweekly status meetings. In this way we became aware of the interdependencies. Thus we resolved interrelations during the conversion and not after. We became aware of how the system worked together, with a huge benefit to the conversion group. Every time we would run into a problem like that we would generate a task list. Then the problem became a check point and a task.

An organization that becomes more adept at transferring knowledge is likely to become better at preempting or resolving transfer-related problems next time that a transfer occurs. Dramatic reductions in the eventfulness of transfers could occur if problems that cause difficulty are identified, solved and catalogued. The process model offers a framework to classify transfer-related problems and the lessons from solving them. More generally, process thinking offers the possibility and the accompanying excitement of learning to manage organizational learning, that is to plan knowledge transfers more effectively and when necessary to "unstick" sticky transfers.

## Appendix 1 - Process based measures of stickiness

Each sentence in the description of the scales below is the full text of the question as it appears in the questionnaire.

Unless otherwise indicated, answers were scored by using the default scale (Y! Y o N N!).

Key for the default scale: Y! = Yes! ; Y = yes, but ; o = no opinion , N = no, not really , N! = No!

The overall score for each scale was computed by adding the standardized scores obtained from each question.

### ***Stickiness-process-based measure: initiation stage. ( $\alpha = .74$ , Items = 8), default scale***

Ranking the performance of «company»'s units on their results on «practice» was straightforward. Within «company», there existed consensus that «source» has obtained the best results with «practice». Compared to external benchmarks, «source» has obtained best-in-class results with «practice». «source» could easily explain how it obtained superior results with «practice». «source» could easily point to the key components of «practice». «source» was reluctant to share crucial knowledge and information relative to «practice». Distributing responsibility for the transfer between «source» and «recipient» generated much conflict. The transfer of «practice» from «source» to «recipient» was amply justified.

### ***Stickiness-process-based measure: implementation stage. ( $\alpha = .83$ , Items = 13), default scale***

«recipient» recognized «source»'s expertise on «practice». The transfer of «practice» from «source» to «recipient» disrupted «source» normal operations. «recipient» could not free personnel from regular operations so that it could be properly trained. Communication of transfer related information broke down within «recipient». «recipient» was able to recognize inadequacies in «source»'s offerings. «recipient» knew what questions to ask «source». «recipient» knew how to recognize its requirements for «practice». «recipient» performed unnecessary modifications to the «practice». «recipient» modified the «practice» in ways contrary to expert's advice. «source» turned out to be less knowledgeable of the «practice» than it appeared before the transfer was decided. Much of what «recipient» should have done during the transfer was eventually completed by «source». «source» understood «recipient»'s unique situation. All aspects of the transfer of «practice» from «source» to «recipient» were carefully planned.

### ***Stickiness-process-based measure: ramp-up stage. ( $\alpha = .77$ , Items = 9), default scale***

Initially «recipient» "spoon fed" the «practice» with carefully selected personnel and raw material until it got up to speed. At first «recipient» measured performance more often than usual, sometimes reacting too briskly to transient declines in performance. Some people left «recipient» after having been trained for their new role in the «practice», forcing «recipient» to hire hastily a replacement and train it "on the fly". Some people turned out to be poorly qualified to perform their new role in the «practice», forcing «recipient» to hire hastily a replacement and train it "on the fly". The «practice» had unsatisfactory side effects which «recipient» had to correct. By altering the «practice», «recipient» created further problems which had to be solved. «recipient»'s environment turned out to be different from that of «source» forcing «recipient» to make unforeseen changes to «practice». Outside experts (from «source», other units, or external consultants) could answer questions and solve problems about their specialty but did not have an overall perspective on the «practice». Teams put together to help «recipient» to get up to speed with the «practice» disbanded because their members had to attend to other pressing tasks.

### ***Stickiness-process-based measure: integration stage. ( $\alpha = .79$ , Items = 12), default scale unless indicated***

«recipient» has not yet solved all problems caused by the introduction of the «practice», because energy and resources were siphoned off by daily work pressures. Some of the "temporary workarounds" devised to help «recipient» get up to speed became habitual. For the «practice» today, the roles are well defined. «recipient» personnel are content to play their roles in «practice». The appropriateness of performing the «practice» in «recipient» has been explicitly questioned after its introduction. «recipient» has reconsidered its decision to adopt the «practice». «recipient»'s expectations created during the introduction of the «practice» have been met. Individual values favor performing the «practice». It is clear why «recipient» needs the «practice». The justification for performing the «practice» at «recipient» makes sense. The activities accompanying the «practice» are difficult. The activities accompanying the «practice» are: *(circle one option)* 1. OBVIOUSLY FUNCTIONAL 2. SOMEWHAT AGAINST THE GRAIN OF EXISTING WORK PRACTICES 3. ARBITRARY WITHOUT A BASIS IN REALITY.

## Appendix 2 Measures of predictors of stickiness

1) The description of the scales follows the same convention used in Appendix 1 for dependent variables.

### ***Causal Ambiguity*** ( $\alpha = .86$ , *Items = 6*), *default scale*

The limits of the «practice» are fully specified; With the «practice», we know why a given action results in a given outcome; When a problem surfaced with the «practice», the precise reasons for failure could not be articulated even after the event; There is a precise list of the skills, resources and prerequisites necessary for successfully performing the «practice»; It is well known how the components of that list interact to produce «practice»'s output; Operating procedures for the «practice» are available; Useful manuals for the «practice» are available; Existing work manuals and operating procedures describe precisely what people working in the «practice» actually do.

### ***Unproven Knowledge*** ( $\alpha = .67$ , *Items = 3*), *default scale unless indicated*

We had solid proof that «practice» was really helpful; «practice» contributes significantly to the competitive advantage of «company»; For the success of «company», the «practice» is: 1. CRITICAL 2. VERY IMPORTANT 3. FAIRLY IMPORTANT 4. FAIRLY UNIMPORTANT 5. NOT IMPORTANT AT ALL

### ***Source Lacks Motivation*** ( $\alpha = .93$ , *Items = 13*), *binary scales*

*Source saw benefit in:* measuring its own performance; understanding its own practices; sharing this understanding with other units; sharing the limits of this understanding with other units; assessing the feasibility of the transfer; communicating with «recipient»; planning the transfer; documenting «practice» for transfer; implementing «recipient»'s support systems; training «recipient»'s personnel; helping «recipient» troubleshoot; helping resolve recipient's unexpected problems; lending skilled personnel

### ***Source is not Perceived as Reliable*** ( $\alpha = .64$ , *Items = 8*), *default scale unless indicated*

«source» and «recipient» have similar Key Success Factors; «source»: 1. INVENTED THE «PRACTICE» 2. WAS THE FIRST UNIT TO HAVE EXPERIENCE 3. RECEIVED PRACTICE FROM OTHER UNIT, «source» was able to accommodate the needs of «recipient» into «practice»; «source» had an hidden agenda; The superior results of the «source» were visible; remained stable; «source» possessed the necessary resources to support the transfer; «source» has a history of successful transfers.

### ***Recipient Lacks Motivation*** ( $\alpha = .93$ , *Items = 14*), *binary items*

*Recipient saw benefit in:* measuring its own performance; comparing it with the performance of other units; understanding its own practices; absorbing «source»'s understanding; analyzing the feasibility of adopting «practice»; communicating its needs to «source»; planning the transfer; implementing the systems and facilities for «practice», assigning personnel full time to the transfer; assigning personnel to be trained in «practice»; understanding the implications of the transfer; troubleshooting «practice»; insuring that its people knew their jobs; insuring that its people consented to keep doing their jobs.

### ***Recipient Lacks Absorptive Capacity*** ( $\alpha = .83$ , *Items = 9*), *default scale*

Members of «recipient» have a common language to deal with the «practice»; «recipient» had a vision of what it was trying to achieve through the transfer; «recipient» had information on the state-of-the-art of the «practice»; «recipient» had a clear division of roles and responsibilities to implement the «practice»; «recipient» had the necessary skills to implement the «practice»; «recipient» had the technical competence to absorb the «practice»; «recipient» had the managerial competence to absorb the «practice»; It is well known who can best exploit new information about the «practice» within «recipient»; It is well known who can help solve problems associated with the «practice».

### ***Recipient Lacks Retentive Capacity*** ( $\alpha = .81$ , *Items = 6*), *default scale*

«recipient» periodically retrains existing personnel on the «practice»; «recipient» has mechanisms to detect malfunctions of the «practice»; «recipient» regularly measures performance and corrects problems as soon as these happen; «recipient»'s personnel can predict how they will be rewarded for good performance in the «practice»; «recipient»'s personnel are provided with numerous opportunities to commit freely and publicly to perform their role; At «recipient» there is a clear focal point for the «practice».

### ***Barren Organizational Context*** ( $\alpha = .77$ , *Items = 14*), *default scale*

Existing performance measures of the «practice» are detailed enough to be meaningful; Performance measures of the «practice» are taken frequently enough to be timely; Performance measures of the «practice» from different units are easily comparable; «company» enforces company-wide standard policies with respect to the «practice»; At «company» there is constant pressure to improve performance; It is easy to justify time spent visiting other units; To visit another unit, it is easy to justify travel expenses; At «company», improving performance by copying and adapting practices from other units is as legitimate as improving performance from own creativity, At «company», a unit that exposes those needs that it is unable to meet on its own loses status; At «company», a unit that exposes unresolved problems loses status; At «company», despite structural differences units can always learn from one another; Normally a best-in-class practice is most likely to be found outside «company»; At «company», managers seem to prefer to use external sources of help and support even though they are more expensive and less useful, At «company», corporate pride and values encourage managers not to look outside for help or to share with the outside

### ***Arduous Relationship*** ( $\alpha = .71$ , *Items = 3*)

Communication between «source» and «recipient» is 1. VERY EASY 2. FAIRLY EASY 3. FAIRLY DEMANDING 4. VERY DEMANDING; Collaboration between «source» and «recipient» 1. IS SOUGHT ACTIVELY 2. IS WELL RECEIVED 3. PREFERABLY AVOIDED 4. ONLY IF NO OTHER CHOICE; Collaboration between «source» and «recipient» (same scale as previous question).



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**Table 1: Measurement Model**

<b>Construct</b>	<b>Description</b>	<b>Cronbach <math>\alpha</math></b>	<b>Items</b>	<b>Valid N</b>	<b>Avg. Inter- item Corr.</b>
Stickiness-initiation	Difficulties experienced prior to the decision to transfer	.74	8	241	.27
Stickiness-implementation	Difficulties experienced between the decision to transfer and start of actual use	.83	13	240	.28
Stickiness-ramp-up	Unexpected problems from the start of actual use until satisfactory perf obtains	.77	9	236	.28
Stickiness-integration	Difficulties experienced after satisfactory performance is achieved	.79	12	224	.25
Causal ambiguity	Depth of knowledge	.86	8	250	.45
Unproven knowledge	Degree of conjecture on the utility of the transferred knowledge	.67	3	251	.4
Source lacks motivation*	Motivation of the source unit to support the transfer	.93	13	271	.5
Source not perceived as reliable	Degree to which the donor of the best practice is <u>perceived</u> as reliable	.64	8	210	.19
Recipient lacks motivation*	Motivation of the recipient unit to support the transfer	.93	14	271	.48
Recipient lacks absorptive capacity	Ability of the recipient unit to identify, value and apply new knowledge	.83	9	252	.36
Recipient lacks retentive capacity	Ability of the recipient unit to support the routinize the use of new knowledge	.81	6	249	.43
Barren organizational context	Degree to which the organizational context supports the development of transfers	.77	14	247	.2
Arduous relationship	Ease of communication and intimacy of the relationship	.71	3	237	.46

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

**Table 2: Correlations Between the Dependent Variables.**

Pearson Product-Moment Correlations (missing data deleted pairwise)

	1	2	3
1.Initiation Stickiness			
2.Implementation Stickiness	0.53 n=222		
3.Ramp-up Stickiness	0.42 n=216	0.64 n=222	
4.Integration Stickiness	0.30 n=203	0.49 n=211	0.45 n=211

Shaded correlations are significant at  $p < .05$ .

**Table 3: Correlations Between the Independent Variables.**

Pearson Product-Moment Correlations (missing data deleted pairwise:  $N_{max}=271$ ,  $N_{min}=196$ ,  $N_{avg}=235$ )

	1	2	3	4	5	6	7	8
1.Source lacks motivation								
2.Source not perceived as reliable	0.46							
3.Recipient lacks motivation	0.48	0.34						
4.Recipient lacks absorptive capacity	0.07	0.27	0.39					
5.Recipient lacks retentive capacity	-0.11	0.09	0.18	0.62				
6.Causal ambiguity	0.32	0.47	0.21	0.23	0.25			
7.Unproven knowledge	0.27	0.33	0.17	0.16	0.08	0.43		
8.Barren organizational context	0.25	0.28	0.30	0.44	0.46	0.35	0.25	
9.Arduous relationship	0.21	0.32	0.29	0.24	0.15	0.28	0.31	0.35

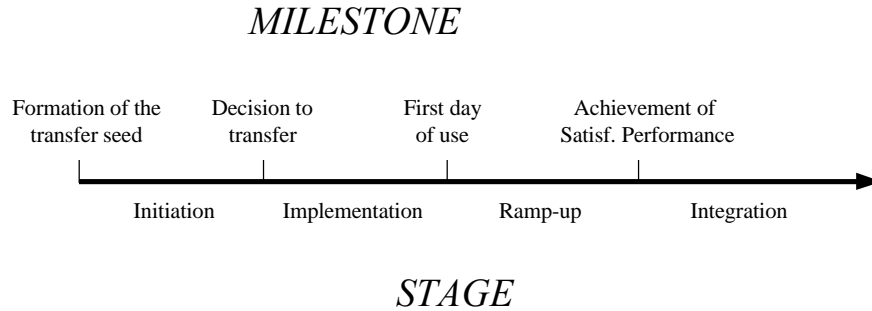
Shaded correlations are significant at  $p < .05$ .

**Table 4: Regressions of internal stickiness for each stage.**

Variable	Standardized beta coefficients (t – value)			
	Stickiness Initiating	Stickiness Implementing	Stickiness Ramp Up	Stickiness Integrating
	(I)	(II)	(III)	(IV)
Causal Ambiguity	0.20** (2.74)	0.23** (3.32)	0.24** (3.39)	0.16* (2.50)
Unproven Knowledge	0.27** (-3.89)	0.11+ (-1.72)	-0.09 (1.23)	-0.09 (1.43)
Source lacks Motivation	0.07 (-0.92)	0.17* (-2.33)	0.16* (-2.21)	0.06 (-0.97)
Source not perceived as Reliable	0.27** (-3.59)	0.17* (-2.25)	0.24** (-3.23)	-0.05 (0.76)
Recipient lacks Motivation	0.10 (-1.35)	-0.07 (0.95)	-0.14* (2.05)	0.19** (-3.07)
Recipient lacks Absorptive Cap.	0.11 (-1.37)	0.47** (-5.87)	0.49** (-6.08)	0.45** (-6.07)
Recipient lacks Retentive Cap.	-0.01 (0.10)	-0.03 (0.46)	-0.43** (5.73)	0.01 (-0.20)
Barren Organizational Context	-0.04 (0.55)	-0.06 (0.81)	0.21** (-2.86)	0.21** (-3.18)
Arduous Relationship	0.05 (-0.70)	0.16* (-2.38)	0.07 (-1.12)	0.19** (-3.17)
Spontaneity	-0.16* (-2.53)	-0.10+ (-1.71)	0.00 (-0.06)	0.00 (-0.03)
Residual (I)		0.17** (3.04)	0.11+ (1.90)	-0.10* (-1.99)
Residual (II)			0.30** (5.22)	0.21** (4.17)
Residual (III)				0.16** (3.18)
R <sup>2</sup>	0.46	0.54	0.56	0.68
Adj.-R <sup>2</sup>	<b>0.42</b>	<b>0.51</b>	<b>0.52</b>	<b>0.64</b>
F	15.88	14.6	15.88	20.62
N	166	150	158	142

+p<.10; \*p<.05; \*\*p<.01; shading, p<.05

**Figure 1: the process of knowledge transfer**



**Figure 2: Model**

STICKINESS

$\beta_i =$  PREDICTORS OF STICKINESS     $\beta_{ci} =$  CONTROLS

$$\begin{aligned}
 & \beta_1 * \text{Knowledge}_{\text{Causal Ambiguity}} \\
 & + \beta_2 * \text{Knowledge}_{\text{Unprovenness}} \\
 & + \beta_3 * \text{Source}_{\text{Lack Motivation}} \\
 & + \beta_4 * \text{Source}_{\text{Lack Perceived Reliability}} \\
 & + \beta_5 * \text{Recipient}_{\text{Lack Motivation}} \\
 & + \beta_6 * \text{Recipient}_{\text{Lack Absorptive Capacity}} \\
 & + \beta_7 * \text{Recipient}_{\text{Lack Retentive Capacity}} \\
 & + \beta_8 * \text{Context}_{\text{Barren}} \\
 & + \beta_9 * \text{Relationship}_{\text{Arduous}} \\
 & + \beta_{c1} * \text{Spontaneity} \\
 & + \beta_{c2} * \text{Residual Equation (I)} \quad (\text{equations II, III, IV only}) \\
 & + \beta_{c3} * \text{Residual Equation (II)} \quad (\text{equations III, IV only}) \\
 & + \beta_{c4} * \text{Residual Equation (III)} \quad (\text{equation IV only})
 \end{aligned}$$

(I) Stickiness<sub>Initiation</sub> =

(II) Stickiness<sub>Implementation</sub> =

(III) Stickiness<sub>RampUp</sub> =

(IV) Stickiness<sub>Integration</sub> =

**Figure 3: relative weight of predictors**  
 numbers indicate rank order of significant beta coefficients

	Initiation Stickiness	Implementation Stickiness	Ramp-Up Stickiness	Integration Stickiness
Causal Ambiguity	3	2	3	4
Unproven Knowledge	2			
Source lacks Motivation		3	5	
Source not perceived as reliable	1	3	3	
Recipient lacks Motivation			6'	3
Recipient lacks Absorptive Cap.		1	1	1
Recipient lacks Retentive Cap.			2'	
Barren Organizational Context			4	2
Arduous Relationship		4		3

! : opposite sign