

EXPLORING INTERNAL STICKINESS: IMPEDIMENTS TO THE TRANSFER OF BEST PRACTICE WITHIN THE FIRM

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The ability to transfer best practices internally is critical to a firm's ability to build competitive advantage through the appropriation of rents from scarce internal knowledge. Just as a firm's distinctive competencies might be difficult for other firms to imitate, its best practices could be difficult to imitate internally. Yet, little systematic attention has been paid to such internal stickiness. The author analyzes internal stickiness of knowledge transfer and tests the resulting model using canonical correlation analysis of a data set consisting of 271 observations of 122 best-practice transfers in eight companies. Contrary to conventional wisdom that blames primarily motivational factors, the study findings show the major barriers to internal knowledge transfer to be knowledge-related factors such as the recipient's lack of absorptive capacity, causal ambiguity, and an arduous relationship between the source and the recipient.

The identification and transfer of best practices is emerging as one of the most important and widespread practical management issues of the latter half of the 1990s. Armed with meaningful, detailed performance data, firms that use fact-based management methods such as TQM, benchmarking, and process reengineering can regularly compare the performance of their units along operational dimensions. Sparse but unequivocal evidence suggests that such comparisons often reveal surprising performance differences between units, indicating a need to improve knowledge utilization within the firm (e.g., Chew, Bresnahan, and Clark, 1990).¹ Because internal transfers typi-

cally are hindered less by confidentiality and legal obstacles than external transfers, they could be faster and initially less complicated, all other things being equal. For those reasons, in an era when continuous organizational learning and relentless performance improvement are needed to remain competitive, companies must increasingly resort to the internal transfer of capabilities.²

Yet, experience shows that transferring capabilities within a firm is far from easy. General Motors had great difficulty in transferring manufacturing practices between divisions (Kerwin and Woodruff, 1992: 74) and IBM had limited success in transferring reengineered logistics and hardware design processes between business units (*The Economist*, 1993). Although strategic management research has examined impediments to the transfer of best practices (i.e., organizational

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¹ Besides the published references, I have found up to 10:1 gaps in performance in otherwise comparable units, and gaps of 2:1 rather frequently. Personal communication with Robert Camp, a widely known benchmarking specialist at Xerox, confirmed that gaps of 200-300 percent are a typical finding in internal benchmarking efforts.

² Such concern is typically expressed as the need to avoid the duplication of effort or to capture the benefits of the internal 'pockets of excellence' and the 'great ideas' that are implemented on a daily basis (see for example Xerox, 1992: 1-1).

capabilities) between firms because such practices are seen as important drivers of firm performance (e.g., Prahalad and Hamel, 1990; Grant, 1991), impediments to transfer capabilities within firms have received little attention.

This article reports the findings of a systematic empirical investigation of internal stickiness. The study analyzed internal stickiness of knowledge transfer and tested the resulting model by canonical correlation analysis of a data set consisting of 271 observations of 122 best-practice transfers in eight companies. Contrary to conventional wisdom that places primary blame on motivational factors, the major barriers to internal knowledge transfer are shown to be knowledge-related factors such as the recipient's lack of absorptive capacity, causal ambiguity, and an arduous relationship between the source and the recipient.

ANALYZING INTERNAL STICKINESS

Definitions

The *transfer of best practice* inside the firm has a concrete and fairly unambiguous meaning to practitioners. It connotes the firm's replication of an internal practice that is performed in a superior way in some part of the organization and is deemed superior to internal alternate practices and known alternatives outside the company. *Practice* refers to the organization's routine use of knowledge and often has a tacit component, embedded partly in individual skills and partly in collaborative social arrangements (Nelson and Winter, 1982; Kogut and Zander, 1992).

The word 'transfer' is used rather than 'diffusion' to emphasize that the movement of knowledge within the organization is a distinct experience, not a gradual process of dissemination, and depends on the characteristics of everyone involved. Transfers of best practice are thus seen as dyadic exchanges of organizational knowledge between a source and a recipient unit in which the identity of the recipient matters. The exchange of organizational knowledge consists of an exact or partial replication 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. In this sense, transfers of best practice could be conceived as replications of organizational routines (Winter, 1995).

Stages in the transfer process

Intrafirm transfer of best practice is seen as an unfolding process consisting of stages in which characteristic factors not only appear in greater or lesser degree but also in a certain order of occurrence. Four stages are identified: initiation, implementation, ramp-up, and integration.³

Initiation

This stage comprises all events that lead to the decision to transfer. A transfer begins when both a need and the knowledge to meet that need coexist within the organization, possibly undiscovered. The discovery of the need may trigger a search for potential solutions, a search that leads to the discovery of superior knowledge. Alternatively, the discovery of superior knowledge may reframe as unsatisfactory a hitherto satisfactory situation (cf. Rogers, 1983; Zaltman, Duncan, and Holbek, 1973; Glaser, Abelson, and Garrison, 1983). In the language of benchmarking, the discovery of superior results will reveal how good is 'best' and who is currently best (Balm, 1992). That discovery may be followed by a more focused inquiry into how those results are obtained. Once the need and a potential solution to that need are identified, their fit—that is, the feasibility of the transfer—is explored. As Teece (1976) found, that process often requires months of information collection and evaluation. The events that lead to the decision to transfer may follow an orderly sequence or one that resembles the working of an organized anarchy (Cohen, March, and Olsen, 1972).

Implementation

The implementation stage begins with the decision to proceed. During this stage, resources flow between the recipient and the source (and maybe a third party). Transfer-specific social ties between the source and the recipient are estab-

³ The stages model presented in this section builds on the insights of the rich empirical traditions of research on innovation diffusion (Rogers, 1983), social change (see Glaser *et al.*, 1983, for a review), technology transfer (e.g., Teece, 1976; Galbraith, 1990), and implementation (e.g., Tyre, 1991; Tyre and Orlitzki, 1994).

lished and the transferred practice is often adapted to suit the anticipated needs of the recipient, to preempt problems experienced in a previous transfer of the same practice, or to help make the introduction of new knowledge less threatening to the recipient (cf. Rice and Rogers, 1980: 508–509; Buttolph, 1992: 464). Implementation-related activities cease or at least diminish after the recipient begins using the transferred knowledge.

Ramp-up

The ramp-up stage begins when the recipient starts using the transferred knowledge, that is, after the first day of use. During this stage, the recipient will be predominantly concerned with identifying and resolving unexpected problems that hamper its ability to match or exceed post-transfer performance expectations. The recipient is likely to use the new knowledge ineffectively at first (cf. Baloff, 1970; Adler, 1990; Galbraith, 1990; Chew, 1991; Chew, Leonard-Barton, and Bohn, 1991), but gradually improves performance, ramping up toward a satisfactory level. The ramp-up stage provides a relatively brief window of opportunity to rectify unexpected problems (Tyre and Orlitzkwi, 1994).

Integration

The integration stage begins after the recipient achieves satisfactory results with the transferred knowledge. Use of the transferred knowledge gradually becomes routinized. This gradual routinization is incipient in every recurring social pattern (Berger and Luckman, 1966: 53). As time passes, a shared history of jointly utilizing the transferred knowledge is built up in the recipient, actions and actors become typified, and types of actions are associated with types of actors. These shared meanings and behaviors facilitate coordination of the activities, making behaviors understandable, predictable (March and Simon, 1958; Nelson and Winter, 1982; Tolbert, 1987) and stable (Berger and Luckman, 1966). In this way, new practices become institutionalized. They progressively lose their novelty and become part of the objective, taken-for-granted reality of the organization (Berger and Luckman, 1966; Zucker, 1977).

Analyzing the difficulty of transferring practices within the firm

The notion of internal stickiness connotes the difficulty of transferring knowledge within the organization.⁴ The point of departure for the analysis of internal stickiness is Arrow's (1969) classificatory notes on the transmission of technical knowledge. Arrow observed that the capacity of a social conduit of knowledge is inherently constrained and hence social conduits are costly to use. Referring to Arrow, Teece (1977: 242) argued that the ease or difficulty of transferring technical knowledge is reflected in the cost of a transfer. More recently, von Hippel (1994) introduced the notion of 'sticky information' to describe information that is difficult to transfer, stickiness being reflected in the incremental cost of transferring the information.

Cost, eventfulness and internal stickiness

Cost could be a poor descriptor of difficulty, however. First, deciding exactly which portion of the cost of a transfer actually reflects difficulty—the increment—is a matter of conjecture without a base case—the cost of the same transfer without such difficulty. Systematically constructed base cases are rare, and past experience in transferring knowledge might be inadequate as a base case if prior transfers are not equivalent to the one under scrutiny. Moreover, experience is likely to be distorted by faulty memory, *ex post* embellishment of past events, and noncomparable transfer cost accounting. Second, cost might fail to discriminate between problems that are equally costly but qualitatively very different. Some problems are resolved routinely or by prespecified contingency plans with relatively little effort from all but the most directly involved participants. Other problems involve participants whose attention is not normally required, such as senior managers, to expedite the identification of possible solutions and explicitly coordinate their implementation. This second type of problem is

⁴ In the strategy literature, the adjective 'sticky' has been used as a synonym for 'inert' (Porter, 1994), or 'difficult to imitate' (Foss, Knudsen, and Montgomery, 1995). Macroeconomists use the term 'sticky price' to mean 'slow to adjust.' In the lingo of Wall Street, 'sticky' means 'difficult to sell.'

likely to engage, and thus be noticed by, a broader range of participants. This second type of problem is also likely to be remembered as being relatively more difficult to resolve, at least by those who could not cope with them without assistance.

Hence, problems that participants cannot handle on a routine basis are likely to evoke the greatest overall perception of difficulty. Whether or not problems are objectively difficult to resolve matters little because perceptual processes, not objective properties, affect organizational behavior (cf. Hellriegel and Slocum, 1974). The perceived difficulty of a problem for the individual is what determines his or her reaction to it. Therefore, transfers that involve the most nonroutine problems will be perceived as the most difficult, other things being equal. This suggests that the notion of eventfulness, the extent to which problematic situations experienced during a transfer are worthy of remark, is conceptually related to the notion of difficulty. Eventfulness has a universal base case: a transfer that is not at all difficult is unremarkable, is uneventful. The implication is that an organization equipped with effective routines to handle all aspects of a transfer is unlikely to consider that transfer sticky.

Eventfulness could be translated into an outcome-based descriptor of stickiness. If an organization has effective routines to handle all aspects of a knowledge transfer, it should be able to specify milestones, budgets, and expectations for the transfer process rather accurately. To the extent that the transfer turns out to be sticky, requiring *ad hoc* solutions, some of those milestones are likely to be missed, budgeted cost will be exceeded, and some of the participants' expectations about the transfer will not be fully met. As in the case of cost, the outcome-based descriptor requires the specification of a transfer-specific base case in the form of *ex ante* expectations.

A transfer-specific base case is not necessary, however, if the descriptor of stickiness is based on the process rather than the outcome of the process. Combining the notion of eventfulness with the stages model presented in the preceding section provides four different descriptors of stickiness, one for each stage of the transfer. The process model suggests that the problems encountered as the transfer unfolds will vary according to the stage of the transfer. During

the initiation stage, problems will stem from efforts to identify needs, identify knowledge that meets those needs, and assess the feasibility of the transfer. During the implementation stage, problems will reflect efforts to bridge the communication gap between the source and the recipient or to adapt the practice to the recipient's needs. During the ramp-up stage, problems will reflect the struggle to achieve satisfactory performance. Finally, during the integration stage, problems will reflect efforts to achieve and preserve routine use of the new knowledge in the recipient. The more these problems require participants to develop *ad hoc* solutions—that is, the more remarkable the problems are—the higher will be the perceived eventfulness of the transfer.

ORIGINS OF INTERNAL STICKINESS

Prior research suggests that four sets of factors are likely to influence the difficulty of knowledge transfer: characteristics of the knowledge transferred, of the source, of the recipient, and of the context in which the transfer takes place (e.g., Leonard-Barton, 1990; Teece, 1977; Rogers, 1983). Some researchers place an almost exclusive emphasis on the attributes of the knowledge transferred (e.g., Zander and Kogut, 1995; Winter, 1987). Others stress the characteristics of the situation in which the transfer occurs (e.g., Arrow, 1969). However, all four sets of factors can be used together in an eclectic model that allows their relative influence to be measured. Descriptions of the primary variables within each set of factors follow.

Characteristics of the knowledge transferred

Causal ambiguity

Modeling a capability as a production function, Lippman and Rumelt (1982) argued that difficulty in the replication of a capability is most likely to emanate from ambiguity about what the factors of production are and how they interact during production. When the precise reasons for success or failure in replicating a capability in a new setting cannot be determined even *ex post*, causal ambiguity is present and it is impossible to pro-

duce an unambiguous list of the factors of production, much less measure their marginal contribution (Rumelt, 1984: 562).

Key to their argument is the notion of *irreducible* uncertainty. Polanyi (1962: 49) suggested that the undefinable portion of knowledge is embodied in highly tacit human skills. Tacitness could also be a property of collectively held knowledge (Winter, 1987; Kogut and Zander, 1992) and it is often singled out as a central attribute of knowledge with respect to its transferability (Spender, 1993; Nonaka, 1994; Grant, 1996). Causal ambiguity could also result from imperfectly understood idiosyncratic features of the new context in which knowledge is put to use (Tyre and von Hippel, forthcoming; Winter, 1995).

Unprovenness

Knowledge with a proven record of past usefulness is less difficult to transfer. Such a record hints of robustness and helps in the process of selecting knowledge for transfer. Without such a record, it is more difficult to induce potential recipients to engage in the transfer (Rogers, 1983) and to legitimize controversial integration efforts (Goodman, Bazerman, and Conlon, 1980; Nelson and Winter, 1982).

Characteristics of the source of knowledge

Lack of motivation

A knowledge source may be reluctant to share crucial knowledge for fear of losing ownership, a position of privilege, superiority; it may resent not being adequately rewarded for sharing hard-won success; or it may be unwilling to devote time and resources to support the transfer.

Not perceived as reliable

An expert and trustworthy source is more likely than others to influence the behavior of a recipient (e.g., see Perloff, 1993, ch. 6, for a review). When the source unit is not perceived as reliable, 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 (cf. Walton, 1975).

Characteristics of the recipient of knowledge

Lack of motivation

The reluctance of some recipients to accept knowledge from the outside (the 'not invented here' or NIH syndrome) is well documented (e.g., Hayes and Clark, 1985; Katz and Allen, 1982). 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. Zaltman, Duncan, and Holbek, 1973).

Lack of absorptive capacity

Recipients might be unable to exploit outside sources of knowledge; that is, they may lack absorptive capacity (Cohen and Levinthal, 1990: 128). Such capacity is largely a function of their preexisting stock of knowledge (Dierickx and Cool, 1989) and it becomes manifest in their ability to value, assimilate and apply new knowledge successfully to commercial ends.

Lack of retentive capacity

A transfer of knowledge is effective only when the knowledge transferred is retained (Glaser *et al.*, 1983; Druckman and Bjork, 1991). Evidence from studies of innovation (e.g., Rogers, 1983: 365; Nord and Tucker, 1987: 9) and planned organizational change (Goodman and Dean, 1982: 228; Yin, 1979; see Glaser *et al.*, 1983: 221–251 for a review) suggests that persistence cannot be taken for granted. The ability of a recipient to institutionalize the utilization of new knowledge reflects its 'retentive' capacity. In the absence of such ability, initial difficulties during the integration of received knowledge may become an excuse for discontinuing its use and, when feasible, reverting to the previous status quo (Zaltman *et al.*, 1973).

Characteristics of the context

Barren organizational context

Intrafirm exchanges of knowledge are embedded in an organizational context, the characteristics of which may affect their gestation and evolution. Like a plant, a transfer that unfolds fully in one

context may grow poorly in another or stagnate in a third. An organizational context that facilitates the development of transfers is said to be fertile. Conversely, a context that hinders the gestation and evolution of transfers is said to be barren. Prior research shows that formal structure and systems, sources of coordination and expertise, and behavior-framing attributes of the organizational context affect the number of attempts to transfer knowledge and the outcome of those attempts (cf. Bower, 1970; Burgelman, 1983; Ghoshal and Bartlett, 1994).

Arduous relationship

A transfer of knowledge, especially when the knowledge transferred has tacit components, may require numerous individual exchanges (Nonaka, 1994). The success of such exchanges depends to some extent on the ease of communication (Arrow, 1974) and on the 'intimacy' of the overall relationship between the source unit and the recipient unit (cf. Marsden, 1990). An arduous (i.e., laborious and distant) relationship might create additional hardship in the transfer.

METHOD

Sample and research process

The data used to test the model were collected through a two-step questionnaire survey. The first step of the survey allowed self-selection of theoretically relevant companies and generated, for companies that completed it successfully, a list of transfers for study and a list of parties involved in those transfers (i.e., of respondents). Firms were considered theoretically relevant for the study if they had strong incentives to transfer best practices, were actively attempting to do so, and saw the transfer of best practices as an important corporate priority. The exchange of information was regulated by the benchmarking code of conduct devised by the American Productivity and Quality Center.

More than 60 companies expressed initial interest and initiated the feasibility test. Of that group, 12 completed the first phase of the survey and eight were accepted for the second phase. 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 test the model. The final sample consisted of 271 returned questionnaires, spanning 122 transfers of 38 practices,⁵ for a response rate of 61 percent. 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 type of respondent, 110 questionnaires were received from sources units, 101 from the recipient units and 60 from third parties. Average item nonresponse was lower than 5 percent. 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 between peer units, and to prefer ones that showed evidence of difficulty during the transfer and in the adaptation of the practice by the recipient. 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 people. Those practical guidelines were intended to ensure selection of organizational activities that correspond closely to the theoretical considerations involved in the replication of an organizational routine (Nelson and Winter, 1982).

The questionnaire

In the design and administration of the questionnaire, several measures were taken to mitigate measurement error (cf. Nunnally, 1978). The questionnaire was formulated only after extensive fieldwork. The pilot questionnaire was pretested extensively by all the participating companies, experienced academics, and respondents who volunteered to record in detail their reactions while completing it. Finally, the cognitive load on the respondents was reduced by customizing each questionnaire with transfer- and company-specific information collected during the first phase of the survey.

⁵ 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.

Construction of measures

The items forming all constructs used in the study are described in Appendix 1 (dependent variables) and Appendix 2 (independent variables). Multi-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 helped in the generation of the initial constructs and the *a priori* assignment of items to measure those constructs. In-depth clinical work helped refine the choice of constructs and identify the most relevant items for those constructs given the empirical context. Item selection was based also on feedback obtained from the pilot questionnaire and constructs were refined further by using the full data set.

For simplicity in scoring, a single balanced 5-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 scale score was 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 summarizes the performance of the measurement model. Convergent validity (reliability and unidimensionality) was evaluated for each construct (cf. Gerbing and 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 $\alpha > 0.7$, thus providing an adequate level of reliability for predictor tests and hypothesized measures of a construct (see Nunnally, 1978: 245–246). The two less 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 criterion for scalability (cf. McIver and Carmines, 1981). Unidimensionality was assessed through factor analysis and computation of the theta coefficient (Armor, 1974; Carmines and Zeller, 1979; Zeller and Carmines, 1980). The unidimensionality of all 10 scales was adequate.

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 $(\alpha_i^{.5}) \times (\alpha_j^{.5})$, 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 (see Howell, 1987: 121 for a critique of this approach and Morrison, 1976: 104–105 for the underlying mathematics). Table 2 reports on the correlations for the independent variables. Table 3 reports the correlations for the independent variables. All construct pairs meet the discriminant validity test at $p < 0.0012$.

RESULTS

The explanatory power of the framework and the relative importance of each barrier were assessed by canonical correlation, which is unique in that it can assess the relationship between two sets of variables. It is appropriate when the phenomena cannot be adequately expressed or measured by a single variable, when any single criterion variable taken in isolation is at best indicative of only a part of the overall relationship (cf. Bolch and Huang, 1974; Lambert and Durand, 1975; Wherry, 1984). The results of the analysis are summarized in Figure 1.

Explanatory power of the framework

Canonical analysis yields a score called canonical- R , which can be interpreted as the simple correlation between the weighted sums of scores from each set of variables, computed with the weights pertaining to the first canonical root. The canonical- R is fairly substantial (0.87) and highly significant ($p < 0.001$), suggesting that it is not unlikely that the true correlation between the two sets of constructs is very high. The canonical- R^2 indicates that the stickiness canonical variate and the origins-of-stickiness canonical variate share about 75 percent of the variance.

Additional insight about the overall correlation

Table 1. Measures

Construct	Description	Cronbach α	Items	Valid N	Avg. inter-item corr.
Stickiness outcome	Eventfulness of the transfer of knowledge (delay, budget overrun, satisfaction gaps)	0.8	8	140	0.34
Stickiness initiation	Difficulties experienced prior to the decision to transfer	0.74	8	241	0.27
Stickiness implementation	Difficulties experienced between the decision to transfer and start of actual use	0.83	13	240	0.28
Stickiness ramp-up	Unexpected problems from the start of actual use until satisfactory performance obtains	0.77	9	236	0.28
Stickiness-integration	Difficulties experienced after satisfactory performance is achieved	0.79	12	224	0.25
Causal ambiguity	Depth of knowledge	0.86	8	250	0.45
Unproven knowledge	Degree of conjecture on the utility of the transferred knowledge	0.67	3	251	0.4
Source lacks motivation ^a	Motivation of the source unit to support the transfer	0.93	13	271	0.5
Source not perceived as reliable	Degree to which the donor of the best practice is <i>perceived</i> as reliable	0.64	8	210	0.19
Recipient lacks motivation ^a	Motivation of the recipient unit to support the transfer	0.93	14	271	0.48
Recipient lacks absorptive capacity	Ability of the recipient unit to identify, value and apply new knowledge	0.83	9	252	0.36
Recipient lacks retentive capacity	Ability of the recipient unit to routinize the use of new knowledge	0.81	6	249	0.43
Barren organizational context	Degree to which the organizational context supports the development of transfers	0.77	14	247	0.2
Arduous relationship	Ease of communication and intimacy of the relationship	0.71	3	237	0.46

^aThese scales are composed of binary items. Both scales qualify marginally as Guttman scales. The Guttman coefficient of reproducibility (CR)—computed according to Goodenough-Edwards' (a more conservative) criterion for counting errors—is 0.84 for the source motivation scale and is 0.8 for the recipient motivation scale. Todd's coefficient of scalability (CS) is 0.72 for the source motivation scale and 0.63 for the recipient motivation scale. A scale with CR ≥ 0.9 and CS > 0.6 can be considered an adequate Guttman scale (see McIver and Carmines, 1981: 40–55).

Table 2. Correlations between the dependent variables

	1	2	3	4
1. Stickiness outcome				
2. Stickiness process: initiation	0.57 <i>n</i> = 137			
3. Stickiness process: implementation	0.48 <i>n</i> = 135	0.53 <i>n</i> = 222		
4. Stickiness process: ramp-up	0.41 <i>n</i> = 126	0.42 <i>n</i> = 216	0.64 <i>n</i> = 222	
5. Stickiness process: integration	0.44 <i>n</i> = 122	0.30 <i>n</i> = 203	0.49 <i>n</i> = 211	0.45 <i>n</i> = 211

Table 3. Correlations between the independent variables

	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	n.s.	0.27	0.39					
5. Recipient lacks retentive capacity	n.s.	n.s.	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	n.s.	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

All correlations in Tables 2 and 3 are significant at $p < 0.05$, unless otherwise noted as not significant.

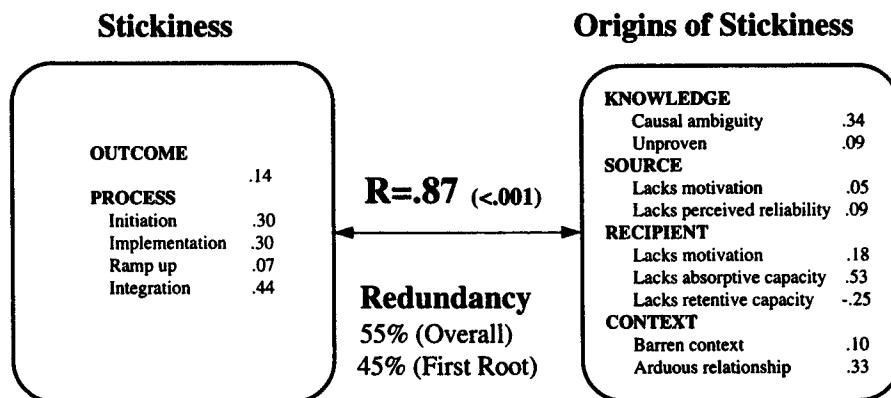


Figure 1. Canonical correlation results

between the two sets of variables is obtained by inspecting the redundancy scores, which measure the redundancy of one set of variables given the other set of variables. The redundancy scores are obtained by multiplying the canonical R^2 by the proportion of variance extracted, which is computed by summing the squared canonical weights in each canonical variate and dividing by the number of variables in that variate. Hence, there are two redundancy scores, one for the left-side variables and the other for the right-side variables.

The redundancy scores computed with only the first canonical root indicate that, given the stickiness variables, it is possible to account for 29 percent of the variance on the origins-of-stickiness variables. Conversely, given the origins-of-stickiness variables, it is possible to account for roughly 45 percent of the variance of the stickiness variables.

Because the canonical roots are uncorrelated, the redundancies can be summed across all roots

to arrive at a single index of redundancy (as proposed by Stewart and Love, 1968). The total redundancy values, based on all canonical roots, indicate that on the average it is possible to account for 39.1 percent of the variance in the origins-of-stickiness variables given the stickiness variables and 55.5 percent of the variance of the stickiness variables given the origins-of-stickiness variables. These results suggest a fairly strong overall relationship between the variables of the two sets.

Relative importance of each barrier

The canonical weights reflect the contribution of each construct to its canonical variate—that is, the linear combination of dependent or independent variables to which it belongs. The weights pertain to the standardized (z -transformed) values and thus could be interpreted in the same way as standardized beta coefficients

in a regression analysis.⁶ Weights therefore can be compared and the larger the absolute value of a coefficient, the more important is the contribution of the corresponding variable. Figure 1 summarizes the findings.

The results suggest that the three most important barriers are the lack of absorptive capacity of the recipient (0.54), causal ambiguity (0.34) and an arduous relationship between the source and the recipient (0.33). Contrary to expectation, the coefficient for the recipient's lack of retentive capacity is negative (-0.25).

Robustness of the results

A key consideration in the objective interpretation of canonical correlation analysis is weight instability (cf. Lambert and Durand, 1975). When weights are unstable, a statistically significant canonical correlation can occur even though the criterion and predictor sets are not strongly related. To rule out that possibility, each dependent variable was regressed separately on the independent variables. All proved to be highly significant, with R^2_{adj} ranging from 0.4 to 0.51. Weight instability is partly a function of sample size and intercorrelation between variables. The canonical analysis used only 87 observations out of the 271 sample points. Because the high number of missing observations was due primarily to nonresponse to stickiness-outcome items, a second canonical analysis was conducted in which that variable was excluded from the left-side canonical variate. The number of valid cases was thus raised to 142. This second analysis confirmed that the canonical- R is a robust finding (the canonical- R decreases slightly to 0.84 and remains highly significant). As expected, variations occur both on the left- and right-side canonical weights, yet the rank ordering of the weights does not change on the left side. On the right side the rank ordering does not change for the three most important variables, which continue to account for most of the variance on their canonical variate. The change in ranking and the fluctuation of the parameters suggest that the sample size may be too small to ensure the stability of any but the three largest canonical weights yet it does not undermine the overall conclusion derived

from the analysis, i.e., that knowledge-related barriers dominate motivation related barriers.

The negative sign on the canonical weight of the lack of recipient retentive capacity (-0.25) is also a stable finding. In interpreting this finding, it is important to note that all transfers in the sample were reported between 4 and 8 months after the first day recipients started using the transferred knowledge. That is a relatively short time in which to develop effective retentive capacity for the use of new knowledge, let alone to reveal the influence of that capacity on stickiness (cf. Lawless, 1987; Tyre and Orlikowski, 1994). A potential explanation for this finding is that retentive capacity, when measured early in the integration stage, represents to some extent the formalized routine use of *previous* knowledge. Hence, unlearning (Hedberg, 1981) will be required to replace prior knowledge (cf. also Hamel, 1991). Dismantling retentive capacity for prior knowledge contributes to stickiness.

The plot of the canonical scores computed with the first root solution did not reveal outliers, a nonlinear (U- or S-shaped) trend around the regression line, or clusters of cases. That finding rules out major violations of a main assumption of canonical correlation analysis and suggests that the sample is homogeneous.

DISCUSSION

The results suggest that the three most important origins of stickiness are the lack of absorptive capacity of the recipient, causal ambiguity, and an arduous relationship between the source and the recipient. Those three constructs represent knowledge barriers. Indeed, absorptive capacity is a function of the recipient's knowledge endowment prior to the transfer, causal ambiguity reflects the recipient's depth of knowledge or irreducible uncertainty about cause-effect relationships, and the quality of the relationship affects the recipient's ability to acquire knowledge when needed (i.e., the relationship serves as a conduit for knowledge).

It is interesting to contrast these results with conventional wisdom, which attributes stickiness almost exclusively to motivational factors. Indeed, practitioners typically cite as barriers interdivisional jealousy, lack of incentives, lack of confidence, low priority, lack of buy-in, an incli-

⁶ However, canonical analysis does not provide indications of their statistical significance.

nation to reinvent the wheel or to plow the same fields twice, recipients' refusal to do exactly what they are told, resistance to change, lack of commitment, turf protection, and of course the NIH syndrome.

Researchers who have looked at the phenomenon from a general management perspective seem to agree with the dominant view of practitioners. For example, Porter (1985: 352), notes that 'the mere hope that one business unit might learn something useful from another is frequently a hope not realized.' He blames both the recipient, who can 'rarely be expected to seek out know-how elsewhere in the firm,' and also the source, who 'will have little incentive to transfer [know-how], particularly if it involves the time of some of their best people or involves proprietary technology that might leak out' (p. 368). Porter's diagnosis is unequivocal: 'Unless the motivation system reflects these differences [in perspective], it will be extremely difficult to get business units to agree to pursue an interrelationship and to work together to implement it successfully' (cf. also Goold, Campbell, and Alexander, 1994: 176).

Yet the statistical findings suggest that knowledge-related barriers—lack of absorptive capacity, causal ambiguity, the arduousness of the relationship—clearly dominate motivation-related barriers. These findings point to sources of difficulty that have received scant systematic attention from researchers and suggest to practitioners an alternative way to frame the problem of internal stickiness.

In light of the findings, using only incentive systems to mitigate internal stickiness—not unusual in practice—seems inadequate or misled. The findings suggest that it might be profitable instead to devote scarce resources and managerial attention to develop the learning capacities of organizational units, foster closer relationships between organizational units, and systematically understand and communicate practices.

Such an approach could be useful beyond the domain of best practice transfer. Barriers to the transfer of skills and capabilities reduce organizational flexibility (cf. Kogut, 1985), the potential value of an acquisition (cf. Hespelagh and Jemison, 1991), the chances for the success of strategic alliances, technology partnerships, and technology transfer agreements (cf. Hamel and Prahalad, 1988; Hamel, Doz, and Prahalad, 1989),

and more broadly the ability of an organization to leverage current knowledge (cf. Bartlett and Ghoshal, 1989). Researchers and practitioners who are concerned with those issues may find that hitherto poorly explained phenomena can be addressed by examining the impact of knowledge barriers.

SUMMARY AND CONCLUSION

The findings of a systematic investigation of internal stickiness are reported. The research framework proposes a definition of stickiness based on the notion of eventfulness and a comprehensive taxonomy of barriers to intrafirm knowledge transfer that is grounded in a tradition pioneered by Arrow. The framework is validated by canonical correlation analysis with data collected through a two-step survey. Contrary to conventional wisdom, which blames motivational factors almost exclusively for internal stickiness, the findings suggest that knowledge-related barriers—recipient's lack of absorptive capacity, causal ambiguity, and the arduousness of the relationship between source and recipient—are most important impediments to knowledge transfer within the firm.

The limitations of the study call for caution in deriving implications from the findings. The correlational design precludes strong imputations of causality, and survival bias influenced the selection of transfers because problematic or aborted transfers remained elusive. Yet the study is one of the most extensive systematic investigations of internal stickiness, and the first to seek a balanced perspective by triangulating the perceptions of the source, the recipient, and an external observer of the transfer. Further, because general theoretical criteria were used to select the companies and the practices for study, the findings should be broadly generalizable to situations in which the knowledge being transferred is already in use. The convergent and discriminant validity in and among the constructs, the strength of the canonical correlation, and the clear and rather substantial differences between the canonical weights attached to knowledge and motivation factors enhance the plausibility of the results.

A major motivation for the study was to explain the persistence of the best practices puzzle—why, though one would expect visible

best practices to be recommended by superiors and emulated by peers, those practices do not spread inside firms (cf. Walton, 1975). This puzzle raises a fundamental question for the knowledge-based view of the firm—why organizations do not know what they know. When best practice does not transfer, a gap develops between what is known within the organization and what is actually put to use. The findings of the study suggest that it may be less because organizations do not want to learn what they know but rather because they do not know how to. Conventional wisdom after all may have led to a blind alley. Pursuing knowledge-related factors—that is, devoting scarce resources and managerial attention to develop the learning capacities of organizational units, to foster closer relationships between organizational units, and to systematically understand and communicate practices—is perhaps a promising alternative worthy of future research.

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APPENDIX 1: OPERATIONALIZATION OF THE DEPENDENT VARIABLE—FIVE 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. Additional explanation is supplied for the outcome-based measure of stickiness.
- Unless otherwise indicated, answers were scored by using the default scale (Y! Y o 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-outcome-based measure ($\alpha = 0.8$, Items = 8)

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

Stickiness-process-based measure: Initiation stage. ($\alpha = 0.74$, 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. ($\alpha = 0.83$, 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. ($\alpha = 0.77$, 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. ($\alpha = 0.79$, 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: OPERATIONALIZATION OF THE INDEPENDENT VARIABLES—ORIGINS OF STICKINESS

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

Causal ambiguity ($\alpha = 0.86$, 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 ($\alpha = 0.67$, 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 ($\alpha = 0.93$, 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 ($\alpha = 0.64$, 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 a 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 ($\alpha = 0.93$, 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 ($\alpha = 0.83$, 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 ($\alpha = 0.81$, 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 ($\alpha = 0.77$, 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; Perform-

ance 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 ($\alpha = 0.71$, 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 BY «SOURCE»
2. IS WELL RECEIVED BUT NOT SOUGHT BY «SOURCE»
3. IS PREFERABLY AVOIDED BY «SOURCE»
4. OCCURS ONLY IF «SOURCE» HAS NO CHOICE

Collaboration between «source» and «recipient»:

1. IS SOUGHT ACTIVELY BY «RECIPIENT»
2. IS WELL RECEIVED BUT NOT SOUGHT BY «RECIPIENT»
3. IS PREFERABLY AVOIDED BY «RECIPIENT»
4. OCCURS ONLY IF «RECIPIENT» HAS NO CHOICE