

Knowledge Management: Intra-firm *versus*

Development Assistance in Infrastructure Services

Proposal for management research

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Abstract:

Knowledge management efforts in the 1990s centered on intra-firm measures in international corporations. Between firms in different countries, these measures generally fail. This proposal suggests new types of measures, tailored for foreign investors, Joint Ventures and Public Private Partnerships in infrastructure. Lessons learned from World Bank - technical assistance are applied to knowledge management concepts, increasing their focus and depths.

1.) Knowledge Management in Business

Ikujiro Nonaka has shown for the normal operations in firms such as General Electric, Honda and Canon, that four modes of knowledge conversions occur (clockwise in the table below): from conceptual to systemic to routine to experiential and back to conceptual knowledge. Shaping these conversions "organizationally" amplifies the knowledge created by individuals and crystallizes it to enhance its use in the whole firm. Nonaka's research has created the most influential and pervasive "management movement" of the 1990s. Japanese management traditions are more open to enhance the transmission of tacit knowledge, whereas West European firms often follow a bias towards explicit knowledge, neglecting the know-how of workers and front-line employees. Besides such general trends, knowledge management is quite specific, reflecting the past evolution of a firm, its dominant professional groups, and the competitive pressures it faces. However, the analytical side of knowledge management is only weakly linked to practical measures to affect the knowledge conversions.

Table 1

Knowledge assets in intra-firm knowledge management (Nonaka 2001)	
<p>Experiential Knowledge Assets Tacit knowledge shared through common knowledge</p> <ul style="list-style-type: none"> ◆ Skills and know-how of individuals ◆ Care, trust and security ◆ Energy, passion and tension 	<p>Conceptual Knowledge Assets Explicit knowledge articulated through images, symbols and language</p> <ul style="list-style-type: none"> ◆ Product concepts ◆ Design ◆ Brand equity
<p>Routine Knowledge Assets Tacit knowledge routinized and embedded in actions and practices</p> <ul style="list-style-type: none"> ◆ Know-how in daily operations ◆ Organizational routines ◆ Organizational culture 	<p>Systemic Knowledge Assets Systemized and packaged explicit knowledge</p> <ul style="list-style-type: none"> ◆ Documents, specs, manuals ◆ Database ◆ Patents and licences

Nonaka's approach is based on two premises. The most important one is his analytical separation between the epistemological dimension and the ontological dimension of organizational knowledge. To express it in less sophisticated language, the analysis of knowledge contents (what) can be

separated from the analysis of knowledge containers (who). The second premise holds that contents can be divided into two broad categories, explicit and tacit knowledge. This distinction is the analytical workhorse of knowledge management. The above table presents Nonaka's typology of content, what knowledge consists of. All operational features in a firm are studied with this distinction. A particular operation, customer service, product development, and so on, is assessed for its knowledge conversions. What knowledge is explicit and what is tacit, and, finally, does it support or hinder the business succeed ?

These two premises are fundamental. Other assumptions are not coherently maintained, for example, some tacit knowledge is assumed to be held by individuals, other is proper to groups or departments. The distinction between these two is not defined. Likewise, the distinction between cognitive tacitness, cultural tacitness and sensorial tacitness remains unresolved. These assumptions remain ambiguous notably because Nonaka wants to overcome important dichotomies such as the Cartesian mind / body separation, individual / organization difference, and some more. These are indeed valid reasons to keep the other assumptions not resolved.

However, the disadvantage is that the analytical side and the practical measures remain weakly linked, or in other words, changes to knowledge conversions are imputed to practical measures in a tentative manner and thus there is no basis to derive more general conclusions about these practical measures from a case. For example, the prescriptions for realizing "middle-top-down management", or the "hypertext organization", remain vague and few concrete suggestions have emerged. These unresolved assumptions become fatal because prescriptions remain inseparable from the narrow empirical context of the particular firm, so that its 'intra-firm' knowledge management measures can not be applied elsewhere, notably for the co-operation with other firms. Theory building is still limited and knowledge management risks remaining a cottage consulting industry. The results obtained in the 1990s have been limited to internal learning within IBM, GE and a few large corporations. Knowledge differences between a foreign and a local firm remain to be attained.

It is first necessary to examine these premises and assumptions, and perhaps abandon or adapt them to co-operations between firms. The point of this proposal is that lessons learned in development assistance can be used to go beyond the intra-firm stage of knowledge management. Once the appropriate changes have been made on the analytical side, the following step is to translate

the knowledge analytics into operational measures for knowledge management between firms. Examples of such operational measures will be the conclusion of this research proposal. Next, differences are briefly qualified so that the adaptation of Nonaka's premises becomes clearer.

2.) Differences between Knowledge Management in a Commercial Context and a Development Assistance Context

There are subtle differences between these two contexts and it is necessary to describe the most important ones tentatively. Development assistance differs from commercial (and intra-firm) knowledge management at least in the following:

heterogeneous organizations from different countries and cultures, restricted policy-making with little feedback from practice, limited choices (technology, organization, locations), fungibility of modernization, hidden symbols and power, divergent professional habits due to educational systems, conflicting economic and social logics, governance traditions and business management paradigms.

In this long list, the following differences between the general commercial context and the context of economic development efforts are of key importance:

Table 2

Commercial knowledge management	Knowledge management in development agencies
knowledge assets are available for management but are rarely attained	knowledge assets have additional political meaning and are thus less malleable, split between funders and clients creates different learning cycles
evaluation on results	evaluation also on contribution
choice of companies and experts	choice of technologies, but little choice of experts and firms

From a management perspective the **common analytical problems** are:

- accounting for the embeddedness of knowledge and know-how,
- how to translate that into management tools,
- shape the role of knowledge assets: explicit, tacit, embodied, disembodied (these assets are introduced in the next chapter).

What follows from these differences for the premises of Nonaka's approach to knowledge management ? To use his terminology, knowledge management in development assistance is possible only in the epistemological dimension, the 'what' questions. The ontological dimension is politically barred. Within a commercial firm, the knowledge manager can coerce, reward and convince certain groups or individuals that they should give up on their accumulated knowledge and make it available to other individuals and groups (for this reason Nonaka refers frequently to leadership). In development assistance most such measures are not feasible. In addition, this premise is also considerably weak on scientific grounds, questions of what to know can not be fully separated from question of who knows, according to influential theorists such as Kuhn, Wittgenstein, Foucault or Taylor.

What seems more important here is that the sociocultural differences between different organizations involved in development assistance render this premise even more difficult to maintain. Within one firm, employees share social and cultural conditions and these commonalties certainly render the distinction between epistemological and ontological dimensions less complex. When the question 'who knows' refers more to individual experience and professional education, it can be separated from the 'what' question. When the individuals concerned share much fewer conditions, the 'who' and the 'what' are more embroiled. In other words, in development assistance, the content of knowledge management is not separable from the question who holds this knowledge. Anyone with experience in development assistance can recall many occasions where it would have better to choose different experts or firms, but it was not possible to hire them. So in sum, the ontological dimension is politically barred and, moreover, unreachable because of sociocultural factors.

This first premise can be replaced with an appropriate one: **In development assistance, the ontological dimension of knowledge management is practicable only indirectly via the epistemological dimension.** This premise has an element of pragmatism as it acknowledges the political conditions and, at the same time, an element of realism as it accepts that the sociocultural

complexity on the analytical side imposes more simplicity. Furthermore, this premise will allow to link operational measures for knowledge management better to the analysis, instead of "middle-top-down management", for example, the knowledge situation leads to more specific and clearly defined measures. Limiting knowledge management to "what" questions, or types of knowledge, excludes "who" questions such as the influence of hierarchy, control on knowledge and relative expert professionalism. The analytical side of knowledge management concentrates on the typology of knowledge pertinent to operational issues between firms and organizations.

3.) Knowledge Components in Development Assistance for Infrastructure Services

Nonaka's second premise can be maintained, there are two broad knowledge categories, tacit and explicit knowledge. Similar to the commercial firm enhancing its business performance, a developmental organization can enhance its operation by analyzing how different knowledge components are accumulated to become knowledge assets. What needs to be adapted are the exact categories. Most knowledge management concerns large corporations producing consumer goods (Nonaka's background is in marketing). This origin is reflected in the two tacit assets and the two explicit assets (see Table 1). On the explicit side, Nonaka distinguishes conceptual knowledge assets from systemic ones. The latter comprise patents, licences, databases, and these are the result of the combination of conceptual assets with information from outside the firm. In development assistance, systemic knowledge assets are much weaker, for example, most databases on projects, technologies or experts are hardly used. On the explicit side, it is therefore not possible to operate the distinction between conceptual and systemic assets.

On the tacit side, Nonaka differentiates experiential assets from routine assets, where the latter are embodied in organizational practices. Both assets have a grounding in a social group, but this grounding is not the same between the experiential and routine assets. The profound sociocultural differences

between foreign and local participants in development assistance render this distinction impractical, tacitness or unconscious concordance hardly arise.

Both on the tacit and on the explicit side, the horizontal division in Table 1 is not viable. The corresponding knowledge conversions according to Nonaka, socialization (routine to experiential) and combination (conceptual to systemic assets), are quite unlikely to be discernible in development assistance. This leaves us with only the explicit / tacit distinction. Indeed, analyzing the day-to-day operation of development projects with these concepts usually reveals a great deal about the problems and obstacles for project success.

To gain a more adequate conceptual model, other disparities between Nonaka's knowledge management and development assistance for infrastructure can be considered. The markets for large consumer companies imply a variety of individual reasons for consumers to buy and equally not to buy, for example, a car or a camera, and a company competes with a few similar ones. In other words, there is a ratio between number of customers / number of producers, varying over a certain range. In infrastructure, on the contrary, there is a large number of captive customers. One can not choose not to consume water, not to consume electricity or not to use banking services. Captive customers' preferences can only be considered to an extent. On the other hand, the technologies have important systemic characteristics and the service provider can not sell other than 220 volts, different currencies or change water pressures at certain times. The large number of captive consumers is also the reason for the role of the state setting rules for the service provision. In science and technology studies (STS), this is also known as a QWERTY-type causality, an irreversible characteristic of a technical system which needs to be mandated by political authority.

Example: Modernisation of District Heating in Eastern Europe

New technology affects the following aspects in a complex manner:

- tenants' habits of using radiators, hot water and paying their energy bills
- relations between owners of housing units and district heating administration
- planners in municipalities forecasting demand and prices
- technical skills of the operating personnel in the district heating plant
- energy policy and local political factors shaping prices

Typically, substations for each housing block are added and their design implies anticipating the impact on tenants' habits and planners' forecasts.

The systemic attributes of district heating are typical for infrastructure services in general. The technical knowledge embedded in the system is modified by adding new technical knowledge from equipment suppliers, consulting companies, or foreign investors. Such modernisations have been hampered by managerial problems and despite available loans (EBRD, EIB), only a few have been undertaken. A modernisation achieves its full potential when foreign and local experts co-operate to redesign the operation and to introduce local technicians, administrators and customers to the new system. This co-operation needs to be managed in an iterative process, monitoring the knowledge interactions between experts and other parties. Because development assistance in infrastructure is so demanding on knowledge exchanges, it is an ideal laboratory to assess what knowledge management can learn from development assistance and also to assess what development assistance can really import from knowledge management.

In development assistance, systemic knowledge attributes are in part responsible for many so-called White Elephants - inappropriate technology and unused equipment. Such characteristics are an advantage and a disadvantage, they favour the co-operation between foreign and local experts but they impose high demands for this co-operation. Therefore, it is adequate to **distinguish knowledge components intrinsic to technology from those not intrinsic to technology while, at the same time, inseparably linked to it or to its application.** The following typology of knowledge reflects these characteristics of knowledge exchanges between the local and foreign firms:

Table 3

Knowledge Components in International Infrastructure Projects

<p>Explicit knowledge: conceptually defined, separable from a person, can be demanded or suggested from all firms</p>	<p>Tacit knowledge: experiential, implicit, context and firm specific, evidence only indirect and with hindsight</p>
<p>Disembodied and explicit knowledge: blueprints, designs, calculations, only by mutual and repeated intention is a transfer possible</p>	<p>Embodied tacit knowledge: intrinsic in artefacts, machines, software, transferred without and even despite intention</p>

On the explicit side, the degree of mutual intention required for knowledge exchange is taken to distinguish explicit knowledge that can be "exported". That is to say, the provider can provide all elements necessary so that the receiver acquires full command of the knowledge. Whereas for disembodied knowledge both sides need to scrutinize all elements repeatedly to assure command of the knowledge; neither side alone can assure that the elements are complete. Likewise, tacit knowledge is divided into two components using the degree of mutual intention necessary. Embodied knowledge is tacit, but the embodiedness implies that the simple transfer of the artifact, software, machine, tool, etc., is sufficient to supply the knowledge to the receiver; which is different from tacit knowledge that is indirectly accessible, through repeated application of the knowledge by both sides. **This typology is adequate for foreign investors, Joint Ventures and Public Private Partnerships in the infrastructure sector because the crucial embeddedness of knowledge is reflected and can be weighted for the parameters of the co-operation between firms.**

The first premise had to be adapted to the political and sociocultural conditions and the second premise to sociocultural and technological conditions. The four components in Table 3 reflect the explicit / tacit distinction (second premise) of intra-firm knowledge management, but the two explicit and the two tacit components are adapted to the embeddedness of knowledge in infrastructure systems and allow dissimilarities between local and foreign firms. Each firm involved in an infrastructure project has particular habits of dealing with each of the four components, which it has acquired during previous activities. Following this typology, knowledge management addresses the passage of knowledge between firms, the characteristics of the components as such are not affected. Knowledge management can reflect that foreign firms store, mobilize and assess each of the four components differently than local firms. Knowledge management derives operational measures from these differences. Thereby, the different habits of dealing with these components produce less misunderstandings, errors and other interferences.

Before deriving operational measures from these knowledge components, a comparison with current knowledge management efforts in the World Bank allows to qualify them, is this typology similar to current knowledge management, is there evidence that this typology can be useful to development

agencies in general, and is it reflected in recent reforms in development assistance ?

4.) Knowledge Management within a Development Agency

The World Bank has invested most heavily in knowledge management and bilateral agencies such as DFID or GTZ have been more reluctant to commit resources. One could argue that UNDP, CIDA, Sida, DFID, BMZ or Danida pursue small and tentative experiments. Much of this work in the World Bank concerns so-called 'communities of practice' (King 2001). This is a direct import from intra-firm knowledge management. Individuals are encouraged to share their experiences, assuming that the intensity of the exchanges in such a community can reach a state where tacit knowledge is shared. A key feature here is the extent to which the Bank can associate outsiders to these communities without blocking its standard decision-making.

Communities of practice and the two other initiatives in the Bank, the Global Development Network and the Global Development Gateway, are all Internet-based. The principal goal is to enable individuals previously unaware of the commonalties in their work to share their thoughts. The most promising efforts in the Global Development Network is the "Bridging Research and Policy Project". The following announcement was circulated on Nov 14, 2002, with its public E-mail listserver:

The Bridging Research and Policy project aims to collect 50 case studies of research-policy linkage during 2002. Over 26 case study proposals have now been received, 10 are finished and posted with the other 16 coming soon. But we urgently need more proposals if we are to reach the target of 50 cases by the end of October. We are especially interested in cases from regions other than South Asia, particularly the Middle East and Africa; on all issues, but particularly political issues; and from sources other than researchers – policymakers, NGOs and the media. We will pay \$1000 for only 1000 words !

The difficulty of getting content into the Network reflects the restricted criteria for what qualifies as pertinent knowledge. In other words, there is an in-built contradiction: the Bank wishes to accumulate and share knowledge about development, but outsiders can not express their views and experiences in a manner that fits the criteria. Therefore, David Teece's critique of "information management masquerading as knowledge management" applies quite

well to the Bank's efforts at present:

"IT assists in the storage, retrieval and transfer of codified knowledge, but, unassisted by other organizational processes, the productivity benefit it gives is likely to be limited. Efficiently organized information is not knowledge!" (Teece in Nonaka and Teece 2001: 130).

The conclusion to draw is of course that knowledge management in the Bank has been too IT-oriented and needs to be opened to operational issues, how the Bank relates to clients and other constituencies and how knowledge circulates inside and outside its operation. Imagine the Bank would have something akin to General Electric's call center (Nonaka's favorite example), which receives 14,000 calls per day from customers and records some of them to allow product designers in General Electric to listen to customer voices and thereby capture tacit knowledge in these calls! Obviously intra-firm knowledge management is quite inadequate for the development context.

In 2001, the World Bank has changed its label for knowledge management, now called "knowledge sharing" instead. This semantic change is quite pertinent because it is the sharing that does not succeed. Of course a real appreciation of the Bank's efforts can not be considered in the scope of this research proposal. The objective of this proposal is also to draw attention to knowledge management in the infrastructure sector as a field where the Bank can experiment with its knowledge sharing efforts. Therefore these remarks must suffice to indicate how this proposal seeks to innovate.

One successful operational innovation in the last 10 years of development assistance is institutional twinning. For example, a chamber of commerce in the UK co-operates with a chamber of commerce in Tanzania over a long period of time. Their experts and managers learn from one exchange of know-how, information and skills to another exchange how to advance the Tanzanian chamber's operation. Both institutions go through trial and error in sending experts, technology and information back and forth between them. Institutional twinning is seen as the best solution wherever there are "twinable" institutions. The second premise of intra-firm knowledge management, four specific knowledge components, is coherent with the twins successful learning to adjust to their respective habits in storing and mobilizing knowledge components. The proposed knowledge components in infrastructure services can perhaps create twinning-type learning between firms in a shorter time span than present twinning arrangements.

5.) Operational Measures for Knowledge Management

Linking the analytical side directly to operational measures is an important feature of the approach suggested here. All operational parameters of a technology transfer or foreign investment can be coherently assessed for their influence on each component and the relations between firms. Different habits of dealing with the knowledge components appear in the efforts, relative achievements and failures of the experts involved in the form of 'latent processes'. The remainder of this proposal explains these processes and how these connect operational parameters and knowledge components logically.

Research on World Bank - funded technical assistance has revealed three latent processes determining the interactions between firms for these four knowledge components (Grammig 2002). The latent **content process** concerns mostly explicit knowledge, the latent **interface process** decides how embodied knowledge is mobilized, the latent **interface and exchange processes** define tacit knowledge, and the latent **content and exchange processes** appear in the passage of disembodied knowledge (see next table). Brief definitions of the latent processes (content, exchange and interface) are included in Annex 1.

Table 4

Latent Processes Bearing on Knowledge Components

<p>Explicit knowledge shaped by the content process: differences between sociocultural ends of knowledge and instrumental core are gradually discovered, specific to sector, firm and profession.</p>	<p>Tacit knowledge shaped by interface and exchange process: the latter is formed by the macro-political context and social history, the exchange p. appears in two configurations, exo-social when the exchange shapes knowledge, endo-social when exchanges are rigid.</p>
<p>Disembodied and explicit knowledge shaped by content and exchange process: most often, the exchange process is the most important one because it is at first convenient for an individual to ascribe an origin label to a blueprint or design when working with someone from another firm.</p>	<p>Embodied tacit knowledge shaped by the interface process: misunderstandings between the groups are stabilized with folk theories about their differences, the interface is manifest in shifts in rhetoric, publicly negotiated, average communicative capacities.</p>

These latent processes are defined through participant observation (fieldwork) for a particular set of firms. They are midrange constructs, in other words, defined from one case, they allow to compare context and operational measures with another case. Direct observation is required to

capture the *practice*, that is behaviour, action and discourses in expert interaction (Grammig 2002: 28-43). Participant observation is increasingly used in development assistance financed by the World Bank to overcome the rigidity of project cycles and planning methods (Kirsch 2001). The latent processes serve to derive general lessons learned from the conclusions of a participant observation.

With these latent processes defined, it is then possible to adjust all operational parameters, rendering the interactions between the firms more effective. Irrespective of the particular technology involved, operational parameters comprise the definition of tasks, terms of expert contributions and team design. For common parameters, the following table shows the alternatives from which co-operations benefit or suffer. For any particular case, additional parameters can be added accordingly, for example, to reflect the business strategy, market and sector. These alternatives have powerful

Table 5

Management Parameters of the Interaction between Firms

Parameter:	indicative alternatives:
task structuration	horizontal <-> vertical
local and foreign output	parallel <-> intermittent
technology output	function <-> object
budgeting	aggregated <-> specific
performance indicator	discretionary, individual <-> public, group
role conflict	passively tolerated <-> acknowledged
meeting agendas	separate, fixed <-> intermittent
reporting, data, language, etc.	respectively

repercussions, affecting the latent processes. For the first parameter, for example, tasks can be divided horizontally, where the output of one activity is input for the next, or vertically, where the same person pursues all tasks on a particular product or service. Intermediate options are often possible. Because in the horizontal form the obstacles from professional biases (expert heuristic habits and so on) become stronger, the task structure has many repercussions for the content and interface processes, and thus for tacit and disembodied knowledge components. Other likely links between parameters, latent processes

and knowledge components are given in Table 6. Distinguishing the salient links from those with little influence, follows from the participant observation.

In the energy sector in Mexico, for example, cogeneration power plant design (Grammig 2002: 165) requires a vertical task structure to introduce explicit and embodied knowledge (and to strengthen the content process), combined with data management and reporting for crucial tacit components (weakening the exchange process). This set of operational parameters reflects the engineering and management habits in Mexican utility companies and facilitates the combination of know-how from foreign and local firms. This case study on a World Bank - funded project revealed that the interaction within the team was blocked because it was not structured beyond the formal equality among experts. Therefore, the adaptation of cogeneration systems to the Mexican context could not be realized. The foreign and local firms refused to co-operate when the project ended out of a general uncertainty about the results. In its subsequent science infrastructure project, the IBRD has withdrawn from industrial technology support.

In order to focus task structuration, reporting and role conflicts in teams, knowledge management can introduce tools to re-organize expert interaction, according to the degree of explicitness and tacitness of the engineering data, maintenance and backup systems involved. While each team requires a particular managerial solution, knowledge management can provide tools which are likely to be effective in an industrial sector, based on latent processes observed in similar cases. At present, such tools are not used. The assessment of the IBRD's industrial technology support programmes (IBRD 1995), only recorded an exceptional reliance on technology imports in Mexico, despite of the high quality of local research institutions.

Once respective changes have allowed to conclude that the co-operation improves, the experts involved can accord further changes between them. In other words, the latent processes are procedural instruments for firms to accumulate international management experience, and in addition, might serve as didactic help for individuals. As long as there are no hidden conflicts of interest which result in strategic manipulation among experts, their social skills let them assess the embeddedness of their knowledge. The outside observer is far more effective, however. The operational solutions for technology co-operations are even more idiosyncratic than intra-firm knowledge management. While the definitions of the four knowledge components and the latent

processes are generic, the interferences between them are very complex and specific for each combination of firms, technology work or joint R&D.

6.) Management Tools for Technology Co-operation

In most cases, the parameters for a technology co-operation are chosen from limited previous international experience. Given the complexity of social and cultural factors however, direct comparisons are difficult and thus these parameters are often set according to engineering aspects. This creates an unwanted and implicit assumption, that explicit, tacit, embodied and disembodied knowledge would circulate similarly in all firms, despite all the evidence for failure in international ventures. To surpass this state, the understanding of the latent processes allows to monitor an ongoing technology co-operation, improve the effectiveness, reduce conflict and create new forms of combining the capacities of all firms involved.

The crucial links between particular knowledge components and the operational parameters have to be reconstructed for each co-operation. When the co-operation has been sufficiently intensive (a period of a couple of months and a team of experts) the latent processes are well evident in expert behaviour. The relative importance of a particular knowledge component determines which operational parameter is most influential but this importance can not be predicted from the technologies as such. Actual tools are derivations of potential links.

Only the team interaction reveals which components are the central objects of their achievements and failures. Experts often agree amongst themselves which tasks are most difficult. Their accounts reflect the technological aspects. The analytical side of knowledge management consists of identifying the important components by distinguishing the explicitness and the embodiedness of the knowledge components and then determining which latent process is relevant for them.

The knowledge management tool is the modification of the operational parameters to allow the team to address the crucial knowledge component effectively. Whatever the differences between firms are, the complexity of expert interaction is sufficient to identify an appropriate modification. The

best results follow from an iterative round of analysis, modification, analysis, and so on. The following table lists examples of the relevance of a component for typical operational parameters. Some are typically much more influential than others.

Table 6

Parameter alternatives:	affect a Latent Process because:
task structuration horizontal - vertical	<ul style="list-style-type: none"> ➤ content process by exposing professional biases: transfer of tacit knowledge or facilitating explicitness ➤ interface by changing competition: transfer of tacit knowledge and disembodied k. <u>less explicit k. and more embodied k.</u>
local / foreign output intermittent - parallel	<ul style="list-style-type: none"> ➤ content: transfer of tacit knowledge, no effect on explicitness ➤ exchange by affecting local / foreign attributes - exo-social: adjusts tacitness, reduces embodied knowledge endo-social: <u>strengthens tacitness, weak explicit knowledge</u>
technology output function - object	<ul style="list-style-type: none"> ➤ content process by showing differences in sociocultural ends: allows tacit knowledge, affects specific disembodied and embodied knowledge
budgeting aggregated - specific	<ul style="list-style-type: none"> ➤ exchange weakly adding identity risks: affects tacitness, via roles all knowledge types ➤ interface process by categories and ambiguities: exo-social: one best set, endo-social: little influence
performance indicator discretionary - public	<ul style="list-style-type: none"> ➤ content by indirectly strengthening attribution: better explicit knowledge versus better tacit knowledge ➤ interface because indicators can reduce ambiguity: increases trust between experts
role conflict passively - acknowledged tolerated	<ul style="list-style-type: none"> ➤ exchange in endo-cases: acknowledge differences is a precondition for tacit and embodied knowledge; in exo-social cases weakly: acknowledge helps explicit knowledge, passively tolerate better on tacit knowledge

For intra-firm knowledge management, Nonaka's practical suggestions are: creating a knowledge vision, a knowledge crew, a high-density field of interaction, to piggyback on new product development, middle-top-down management and switching to a hypertext organization (Nonaka 1995: 227). These measures rely on key personnel and leadership influence. The tools derived here for international co-operation between firms are more explicit and focus entirely on operational parameters. This reflects that the differences between management traditions among the firms hold the potential to specify interferences between firms.

Knowledge management is based on premises regarding the types of knowledge components and their distribution within a firm. Between firms, the typology of knowledge components can be adapted and simplified (because the conversions are not specified) so that these can be related to the latent processes amongst participating experts. For this adaptation, development assistance for industry organized by international donors such as the World Bank is a well established practice from where to gain definitions of latent processes for knowledge management between firms. The adaptation suggested here, distinguishing knowledge components intrinsic to technology from those not intrinsic, for explicit and for tacit knowledge, yields knowledge components for which the observation of ongoing technology co-operations has shown three distinct latent processes. Understanding which process determines how far experts can deal with a component allows to align operational parameters. The empirical cases used so far were energy projects and the degree of **embeddedness of knowledge is the reason why these latent processes appear distinct for the four knowledge components**. Future case studies in different countries and sectors should reconfirm this.

I could not argue here whether these processes are salient in other technology fields, nor how far competition, size and diversity of an industrial sector limit the comparison of the processes. As a first approximation, these should be specific to country and sector. The latent processes determine the extent to which firms can exchange skills and know-how via their experts in that sector.

7.) Proposal for Management Research for Ongoing Technology Co-operation

The proposed research can proceed in stages, depending on the extent of the management issues addressed.

Stage 1: desk study - review of the state-of-the-art in a specific sector.

Stage 2: one week field study, including a workshop with participants.

Stage 3: full analysis of an ongoing project, including participant observation, average length one month.

Stage 4: intermittent fieldwork to monitor the evolution of a project.

The management tools derived from the research can remain proprietary simply by not revealing the results of the participant observation. These can also be kept within an international alliance of firms. The latter, when previously agreed, can facilitate the research. Ideally, the modifications to an ongoing co-operation can be discussed with participants and by integrating their sensitivities their acceptance of the modifications increases. Finally, these results can be published anonymously (protecting the individuals) to allow feedback from other knowledge management practitioners.

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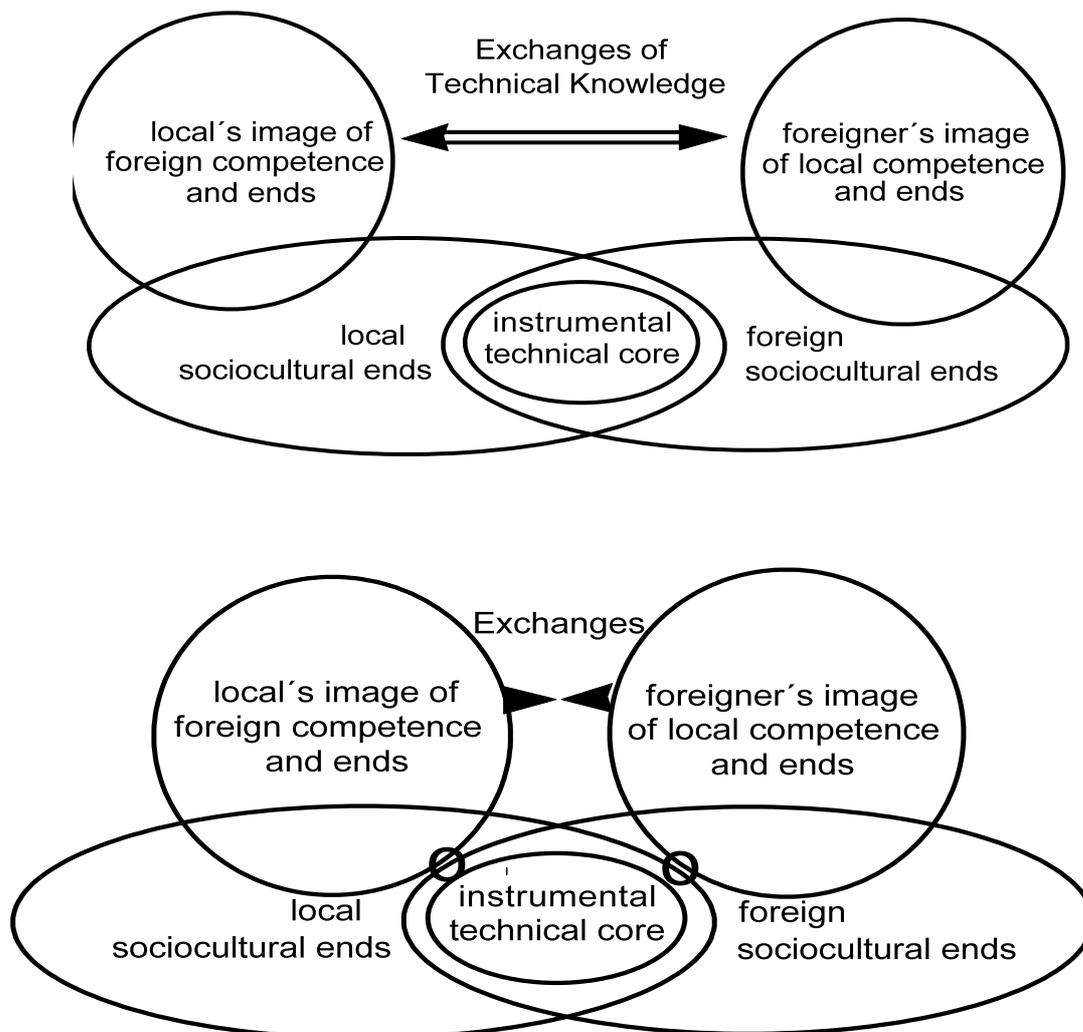
ANNEX 1 Latent Processes

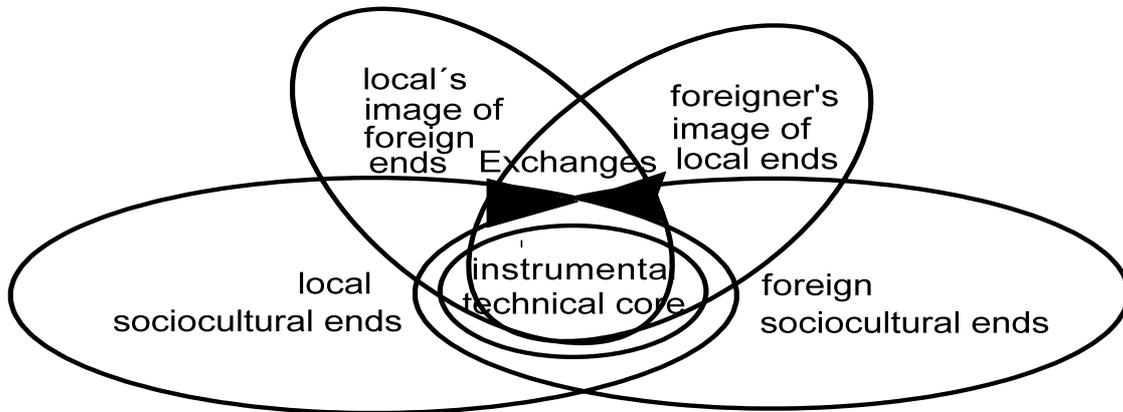
ANNEX 1

Latent Content Process

Origin: experts' tacit knowledge is specific to their professional context, economic sector, firm and organizational culture; experts can not distinguish between instrumental core and sociocultural ends of technical knowledge because this runs counter to their professional socialization; they intent to address the core but end up responding to the foreigner's image of local sociocultural ends and vice versa the local's image of foreign sociocultural ends. (Grammig 2002: chap.5.1)

Appears: in their exchanges these differences appear in the form of the experts' anticipation that they have to make unjustifiable claims that ends be part of the instrumental core; both sides declaring cultural images as context independent and instrumental know-how becomes a vicious circle; repeating and improving the exchanges can bring the images together and experts to realize the difference between core and sociocultural ends.





Latent Exchange Process

Origin: macro-political, social history, social identity, economics and trade in the 'global village', sociality as a *habitus*, an all-encompassing sociocultural practice.

Appears: changes in the usage of knowledge and hardware, sector specific, only attainable via choice of firms and institutions, changes in an **endo-social** or **exo-social** format.

In technology co-operation an exchange pattern contains technical knowledge and professional orientation and identity:

the content of the exchanges (knowledge) is dependent on mutual recognition of professional orientation, between foreign and local experts the contrast is of symmetrical inversion, "consumption of modernity *versus* production of tradition, other-centred *versus* self-centred ...".

exo-social: intrinsic technical aspects do not shape the passage, applying knowledge can reduce sociocultural content and change the relations amongst participants, individual differences are possible but difficult, know-how is unstable.

endo-social: no possibility to add local or foreign label to knowledge and thus relations can not be changed through knowledge, personal differences are sought but are impossible, context know-how is deficient. (Grammig 2002: chap.5.2)

Latent Interface Process

Origin: stabilized misunderstandings between foreign and local experts; folk theories and stereotypes about the other firm or country; average communication skill level; strategic behaviour and reluctance to assert individual judgment.

Appears: an interactive filter between rhetoric; foreign rhetoric comprises foreigners' verbal efforts to express themselves (vice versa locals), the developpee (developer) image is within one rhetoric repertoire when aspects of that image can be pronounced, but the developpee (developer) image remains far from the interface when the image is too violent to pronounce it; locals (vice versa foreigners) never understand the foreign experts' developer (developpee) identity, these images change, align, evolve without them realizing how; interface shifts occur implicitly. (Grammig 2002: chap.5.3)

