Canadian International Development Agency
Agence canadienne de développement international

TECHOLOGY TRANSFER ASSESSMENT

COMPONENT

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Canada

Summary

TECHOLOGY TRANSFER ASSESSMENT COMPONENT

Introduction

Technology Transfer (TT) is mentioned in virtually all Private Sector Development (PSD) projects, yet it is rarely detailed, with little or no explanation provided of how it is to be achieved within the project. As a result, TT has come to have multiple interpretations throughout CIDA, ranging from simply being the transfer of any equipment, to the transfer only of know-how about an industrial process. Given the variation in understanding, obtaining consistent reports across sectors on the developmental resources expended on TT is difficult. Yet TT is often reported within CIDA at high levels as if all aspects were identical, which could lead to misinterpretations.

Additionally, the successful transfer of technology often involves more than simply providing some technology to a partner. The sustainable transfer of technology often means: modifying the technology to meet local conditions; recognizing the need for appropriate skills to put the technology to use; ensuring appropriateness of the technology to the local culture; and ensuring that it can be maintained. Some other factors are: the nature of the regulatory and societal context in which the project will be delivered; the accessibility to raw materials; and the need for the local partner to take ownership. Just as a good gender analysis in a project examines the larger social concerns and implications, a good TT analysis will consider the wider set of issues described above. Yet neither the criteria to assess the quality of the TT approach within a project nor the best practices have been well defined within CIDA. There is no standard TT definition within the Agency and the coding structure does not capture the TT dimension. This leads to inconsistency in the application of lessons learned, and in reporting. CIDA would benefit from a more structured approach to TT.

This TT study was part of a series of Assessment Studies conducted by the Performance Review Branch (PRB). A preliminary assessment before the study began detected the existence, if not the extent, of the inconsistencies discussed above, and concluded that a TT model or framework would be a useful tool for the Agency to achieve better understanding of TT issues and how to approach them. Hence, while the TORs for this study included a component to assess the current treatment of TT in CIDA projects and programs, the main focus of the study was to develop a TT framework or model that could be used in future projects and which would promote a consistent approach to TT issues across the Agency. Given the specific industrial focus of PSD projects, the TORs also limited the TT assessment to technology transferred in support of an industrial or manufacturing process, and any associated immediate training (rather than broad knowledge and general training, which other studies would cover).

Hence, the **Purpose** of this particular study was:

To review CIDA and international experience to:

a) propose a conceptual framework; and
b) determine key factors and considerations that should be taken into account in PSD projects involving technology transfer.

The **Objective** (Goal) of the evaluation assessment was:

- *to determine how best to achieve technology transfer within a developmental project.*

Findings on TT use within CIDA

The analysis of internal CIDA documents, the corporate data base, all published policy and most CDPF (Country Development Policy Framework) documents confirmed the assessment that TT is not applied in a consistent manner within CIDA. There are no specific policies in place, other than a short reference in the most current draft of the Private Sector Development (PSD) policy (Sept., 1999), where TT is considered to be a means of improving an industrial process. When TT is mentioned in CDPF documents it is described as one of many methods to assist in meeting a developmental goal, with no specific indication of what is meant by TT.

In assessing several TT projects identified in the corporate database, TT ranges from being the transfer of a manufacturing process to the simple transfer of any equipment, (not necessarily in support of an industry), to the transfer of knowledge, and variations on these combinations. The one consistency in bilateral projects is that TT is used in support of a broader developmental goal.

At the strategy level: INC, CEE, and the Americas Branch have programs specifically involving TT. The INC Programme states that, for an INC project to be approved, it must include TT, (or, more recently, incorporate knowledge about TT), and it must be led by the private sector. There is no specific definition of TT in CIDA INC documents, but "hard technology", and/or industrial processes are implied, along with training for the particular technology transferred.

The REE Program (Renaissance Eastern Europe) of the CEE Branch is designed to help increase Canadian trade and investment links with the 27 countries of Central and Eastern Europe, similar to INC's initiatives in Asia. It works in co-operation with Canadian private sector companies, helping them to establish long-term business relationships with CEE private sector companies, including technical assistance to TT projects. The program is not as extensive as the INC initiative.

The Americas Branch has a Technology Transfer Fund Program. The TT fund was created in 1996. This fund is available under a partnership arrangement. A definition of TT, (the only one in CIDA), was produced for this program, being:

> *"Technology" refers to Canadian know-how or expertise, policy or regulatory approaches, and organizational or managerial models. The "transfer" of technology is the transmission of this know-how to partner institutions in the Southern Cone and its adaptation to, and use in, their own culture and developmental environment.*

Projects funded under the TT Fund specifically exclude "hard technology". Experience is considered to be a transferable item. The goal of each project is to create sustainable linkages between the country and Canada, with the long-term beneficiary being the private sector (in both countries). However, under the terms of the fund, the private sector cannot take the lead, but can be involved as a subsidiary partner to an NGO or government agency.

From these findings, the assumption that the limited information available would lead to inconsistencies was verified. Further exploration of TT as part of the full PSD Review would only confirm this without adding new information, and is not recommended, (see below).

Definition of TT

One requirement of the study was to propose a definition of TT that could be used within CIDA, and which was consistent with the conceptual model developed. A review of the literature, and practice, found many widely varying definitions in use for TT, (including the America's definition above). A "typology" was developed as part of the study, and, when coupled with the model shown below, prompted the following proposed definition of TT for use within CIDA:

> *Technology transfer includes the transfer of industrial and/or information processes and equipment, the skills and knowledge necessary to use and exploit the technology, and any associated strategies and policies necessary to support a developmental goal.*

This definition can include more than the private sector development aspects, (e.g., equipment transferred to support an environmental project being conducted by an NGO), or can be constrained to just the private sector by adding the phrase: "*designed to strengthen the private sector*" to the end of the sentence. A decision on whether to adopt this definition (or a modification), should await a more in-depth assessment of the proposed model, and this report, by CIDA managers.

Canadian Industry and International Development

A recent paper by the North-South Institute notes that Canada's trade and investment by business now dwarfs its developmental aid to the South[1]. Private capital flows have increased by fivefold during the 1990s. Canada's trade with developing countries now accounts for almost one-third (some $39.5 billion in exports and imports), of our non-US trade. While Canadian corporations do not rank amongst the world's largest, they are nonetheless formidable entities. For example,

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[1] *Canadian Development Report 1998: Canadian Corporations and Social Responsibility*, North-South Institute.

the gross revenues of BCE Inc., Canada's largest corporation, exceeded the GDP of countries such as Côte d'Ivoire, Sri Lanka, Guatemala, Ecuador, Uruguay and Vietnam.

Manufacturing accounts for an important share of Canadian foreign direct investment abroad. The North-South Institute study notes that companies such as Northern Telecom, the Bata Shoe Organization, British Columbia Packers Ltd., and Premdor Inc. have provided positive contributions to countries in terms of technology transfer, environmental protection, equitable labour practices, and industrial and community development. Canada's manufacturing companies are introducing codes covering ethical, environmental and labour practices in all their operations.

According to the North-South study, for developing countries to become economically viable, a "sustainable infrastructure" is essential. This usually requires, first, improving the efficiency of the existing infrastructure, and secondly, finding more efficient ways to meet demands. For Canada, infrastructure initiatives in energy, water supply, waste management, transportation, and telecommunications match our skills. Integral to these developments are *engineering* services. Canada is the world's fourth-largest exporter of engineering services. Nine Canadian companies are in the top 200 international design firms. In terms of market share, Canadian firms rank fifth in Asia and second in both Latin America and Africa. The technology transferred to assist with infrastructure is mainly "know-how" at the design and maintenance level, though in the energy, water, transportation, and telecommunications area, equipment is often provided to meet local needs.

A large part of the work of engineering consultants consists of planning infrastructure projects in the power, water and telecommunications sectors. As such they are able to influence or determine the social and environmental impact of the projects they design. They also transfer technology know-how to local counterparts. While Canadian firms have been involved in controversial projects such as the Three Gorges Dam in China, they have also won awards for social and environmental impact planning such as Acres International hydropower feasibility study in Nepal.

While Canadian non-engineering service companies, (e.g., training, management consulting, etc.), cannot be considered major players globally, their contribution is increasing. The growth leader is management consulting. A large part of Canadian management consulting is done under the auspices of CIDA, and other development agencies. Management consultants deal with issues such as public sector restructuring and legislative and regulatory reform, and can make a difference in terms of recommending industrial support and technology transfer policies that incorporate gender equity, environmental assessments and alleviation of poverty.

Key Success Factors

In reviewing the literature, and CIDA's "Lessons Learned", a number of success factors for TT projects were identified. To achieve successful technology transfer within a developmental project, CIDA managers should ensure:

1. Technological readiness of the transferee;
2. The design is consistent with the transferee's needs and capabilities;

3. The use of appropriate technology;
4. The transferee country have an appropriate enabling and regulatory environment relative to the technology being transferred;
5. The technology is supportive of the market needs;
6. Long-term mutually beneficial partnership arrangements are established;
7. The identification of a local "change" agent as a champion for the technology; and
8. The society has the necessary infrastructure elements to support the diffusion of the technology.

To deal with these components in a consistent manner, this report has developed a model to explain the interaction, and a decision tool based on CIDA's *Framework of Results and Key Success Factors*. The body of the report expands on these elements[2]. The model and the tool developed during this study are described below.

Conceptual Model for TT

No conceptual model is commonly used within CIDA, nor is there a framework or model available from IDRC. In a world-wide internet search of research papers for a model, it turns out that there are several models in the "developed" world, but only a few aimed at transferring technology to the developing world. Many, however, are very basic models.
Most of the papers that review TT to the developing world describe best practices for a specific technology, rather than a model. Some very detailed models for a particular technology exist, (e.g., chemical process systems for a specific process), but very few deal with the broad issues involved. However, three studies were found which included a model for transferring some elements of TT, each report being based on 3-7 case studies, but none covering all components. As a result, this paper has developed a conceptual model that integrates the three models, and incorporates some best practices found in the literature, and the success factors identified above. The final model is shownon next page in Figure E-1. It will probably need refinement before final adoption.

See figure on next page.

[2] See in particular the table and TT assessment tool on pages 54 and 55.

Figure E-1

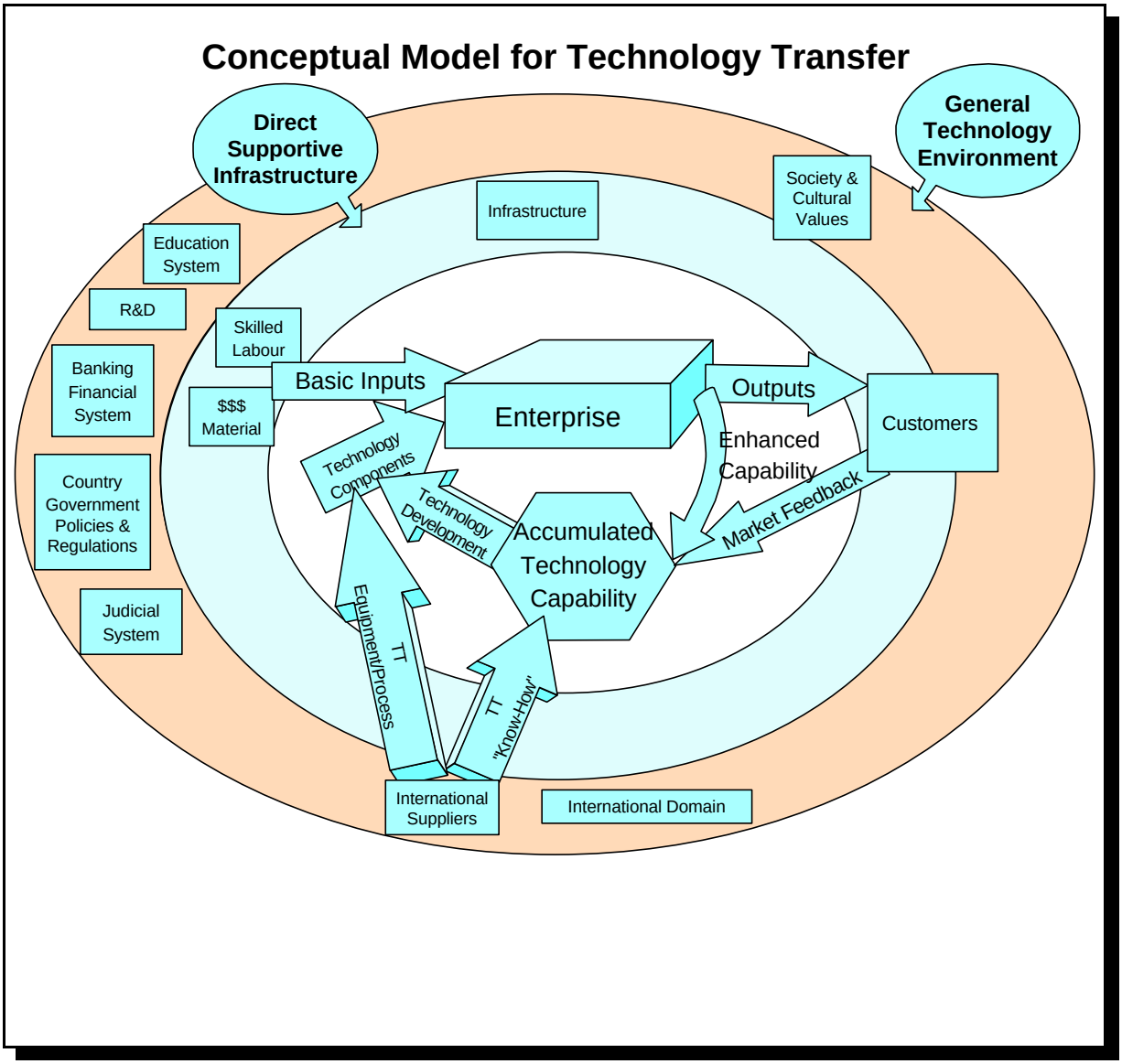

Figure E-1: Conceptual Model of TT for Industrial or Manufacturing Operation

The proposed model focuses on industrial processes. The process is at the heart of the model (in the middle). The enterprise takes the basic inputs (labour, material, and funding), along with a "technology component" and transforms them to an output(s). Two TT inputs are shown in the lower part of the figure which may or may not be used by an organization. During the transformation process an essential by-product is produced, being the accumulated knowledge and skills, (i.e., capability), of the organization on how to produce the product. This accumulated capability and its exploitation is what makes firms successful.

Initially, a firm will consider enhancing their operations through introducing one (or both) of the two types of "technology transfer", as shown in the centre of the model. The first technology type is a process and/or equipment. The second is "knowledge" about the product/process, etc. As the firm learns more about the product, the process, and the market (the feedback to the accumulated capability), it can do its own "technology development" towards either the process or making some of the equipment itself. The technology development element (shown as an arrow from the accumulated capability) will include ways to make the technology more appropriate for the nature of the society and the local culture, based on meeting the market need. The enterprise may still, however, need to transfer specific technology to meet the needs. The goal of developmental TT is to make the firm sufficiently self-sufficient over time that they can meet market demands without TT.

Surrounding the "organization" heart of the model is the environment in which it works. Two main environments are shown. The "nearest" environment consists of five main components which directly impact on the success of the firm: the customer (market), funding, skilled labour, material and/or local suppliers of material/components, and the supporting infrastructure, (e.g., road/rail/air/ ocean transportation system, energy system, information system including telecommunications, etc.), and may include technology parks, if they exist. The supporting infrastructure also includes organizations such as couriers, international brokers, sea and airports, etc., which are needed to ship the goods and products and/or the input components (e.g., transportation for workers to the plant).

The second "surrounding" environment also impacts on the success of the firm. It consists of a set of societal components that determine the "cultural" and technological environment in which the firm must operate. At this higher level are items such as the education system, (including, for example, the extent of university R&D in the area in which the firm operates, and the availability of schools for children of workers); government policies and regulations related to industrial development (e.g., decentralized or centralized regulations, protection policies, etc.); judicial regulations (e.g., the nature of the rule of law and contracts, intellectual property protection, adherence to international law, etc.); and regulations regarding the financial community (e.g., the banking system, monetary approaches, foreign currency rules, etc.). This higher level will also include industry- related organizations such as engineering associations, lobby groups, ministries of education and industry, international suppliers, and international donors.

From this model, it is clear that technology transfer can focus on several areas. For example, at the enterprise level, TT may simply focus at the "process" level, providing either "hard" technology, and some limited knowledge such as how to operate the equipment. Or it may include significant knowledge transfer on how the product works, and how to utilize local material, or it may provide training on marketing, or management. At this level, training of engineers on the product/process through an extended attachment to a firm in Canada may also constitute TT. (However, this study is not considering this broader training component, though the element has been included in the model to allow for integration with other studies).

At a higher level, if the developmental goal is to improve the "environment" in which the firm must operate, TT initiatives may focus on the "infrastructure", on developing more "skilled workers" directly involved in the process, etc. Alternatively, a TT initiative may focus on the regulatory and social environment such as assisting the industry by setting up a banking system to provide easier access to funds, or by working on improving the educational system to train workers, or by focusing on R&D of specific value to the industry, (and even recommending policies that promote certain industries, etc.). The higher level interventions should have a direct influence on those parameters of key interest to the industry (e.g., training workers, providing access to funds, etc.)

The conceptual model proposed fits the wide variation of TT application used in CIDA, and hence the model can be used to focus TT ideas and initiatives in a number of areas beyond the enterprise, though new "TT" arrows would need to be included. The model here is specifically for manufacturing processes. The balance of the report develops an analysis tool for use by CIDA managers in defining where TT can best be applied in a "broad" sense, and how the initiative can be monitored to determine if the intervention resulted in a change to key "success" components. A number of questions to be asked, and strategies for intervention are also provided in the main report.

TT Assessment Tool

The model itself has been adapted to allow CIDA's *Framework of Results and Key Success Factors* to be mapped to key components of the "best practices" identified, resulting in a graphical display and questionnaire, (termed "TT Assessment Tool" in this report), that can be used in future studies to assist in determining where best to apply developmental resources to maximize the developmental benefits of TT for an industrial or manufacturing type of process. The TT Assessment Tool developed is shown in Figure E-2 on next page.

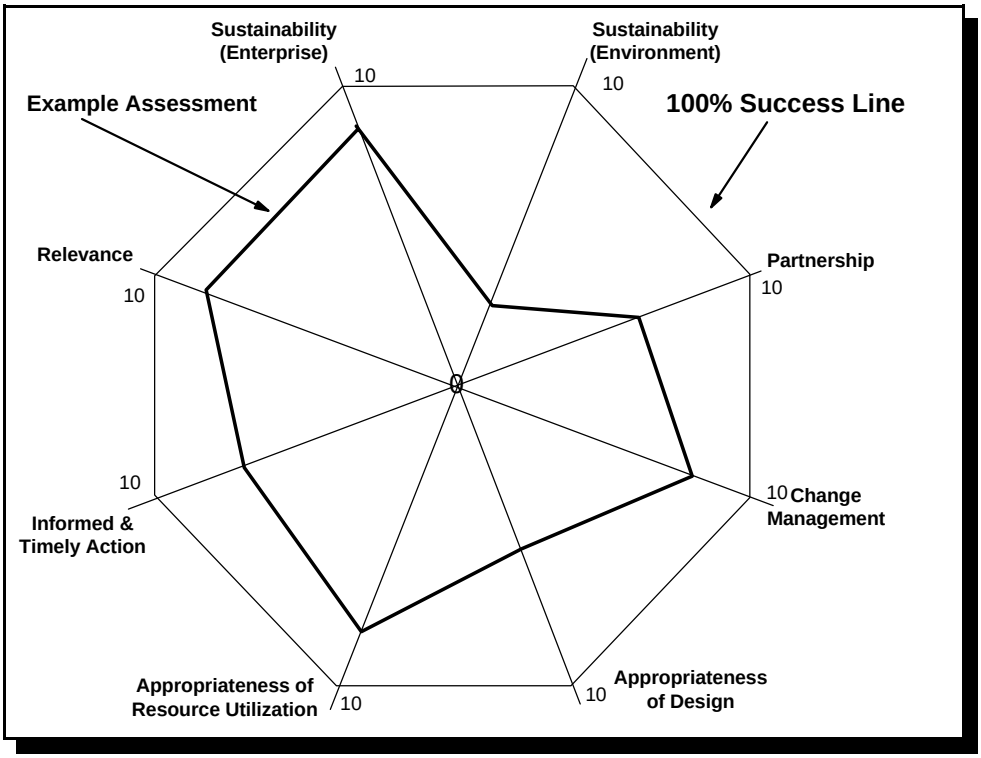

Figure E-2: "Snow-Flake" Graphical Display of Key Success Parameters for TT

The TT Assessment Tool is a graphical approach which maps "key success" factors to the model components. The success factors shown are based on CIDA's *Framework of Results and Key Success Factors*, linked to those success factors identified in the literature. One of CIDA's factors, (*Sustainability*), has been split into two components to more accurately reflect the findings, while a new parameter, (*Change Management*), has been added, since this is one of the most important parameters identified, and because the nature of TT is to introduce change. The TT Assessment Tool will likely need refinement, by testing it on some new cases to determine its value as a evaluation tool that can be used by CIDA. The details on the "assessment tool" are included in the body of the text.

In Figure E-2, eight key success parameters for TT are shown as "spokes" reaching from a central point. On each of these spokes a scale of 0-10 is used, with 0 being the centre point, and 10 being considered to be an "ideal situation" for the parameter listed for the "spoke". The concept is that each spoke is relatively independent of the others, (though there is obviously a relationship).

To use the tool, a manager would assess each of the 8 components through a series of questions, and make an assessment of how well each component is currently being met (on a scale of 1-10), plotting the final "value" on the line. If all factors are being well met, the result would be the "ideal curve" shown in Figure E-2, where all the "10" points are connected. Normally, however, several points may be lower, resulting in a "curve" that connects the key points, as shown in

Figure E-2. The "low" points (i.e., those points closest to the centre), are evident areas for intervention. The body of the report includes additional information on the types of questions to be used.

Conclusions and Recommendations

The application and understanding of TT is not consistent within CIDA, confirming the early assumption of this study, and demonstrating the complexity of the field. However, as the model developed for this study shows, the various approaches adopted for CIDA projects fit within one or more specific areas of the model. Hence, CIDA's TT initiatives have been consistent with addressing the complexity surrounding TT, but the rationale for individual decisions has not been clear.

It is also clear from the analysis that TT exists at different levels of industry, and has different factors of importance. For small producers, TT usually focuses on the end-product, and uses replication of the technology as a diffusion mechanism. For medium-to-large firms, TT can focus on either the process within the receiving enterprise, or be a product that the firm can produce for end-users. Most often the diffusion mechanism of the product to the customer is via marketing.

The nature of the society and culture are important barriers or supports to effective TT, and these need to be considered. Factors such as the banking system, judicial system, education, local R&D facilities, etc., will impact any TT project. And TT is all about change, hence change management is needed. The implication is that different TT project strategies will be needed at each level.

The model developed for this study provides CIDA with a starting point for further discussion amongst PSD specialists and managers on how best to approach TT. The study also proposes a TT definition that can be used in policy documents, and should allow strategy and policy documents in CIDA to be developed in a more consistent manner. Based on these conclusions, the following recommendations are made.

It is recommended that:

1. *An assessment of TT not be included in the full PSD Review, due to the wide variations about the meaning and application of TT within CIDA when the projects were initiated.*

2. *The TT definition and the Conceptual Model proposed be reviewed by a small team of CIDA managers interested in TT with a view to adopting a common definition for TT within CIDA, and to assess the value of the model and assessment criteria for future projects.*

3. *The Conceptual Model and TT assessment tool be tested with one or two new projects having a high TT content as a means of evaluating and refining the model and the tool for use in CIDA.*

4. *CIDA's PSD Policy should make reference to TT in a more systematic manner, emphasizing its importance as a cross-sectoral issue for all projects, and listing, (possibly in an annex), best practices and lessons learned as guidelines to items that should be considered.*

5. *Given the complexity of TT in general, PSD specialists and managers in CIDA should consider whether they wish to maintain an ongoing database of investments in TT. If a positive decision is reached, then the typology chart proposed in this report can provide a base for discussion of the dimensions to consider in structuring a coding approach for TT that will be consistent with the model.*

6. *All PSD Projects should make references to TT explicit, explaining what technology is being transferred, (in accordance with the model, and any specific coding adopted), and how the transfer will be achieved, taking into account best practices.*

7. *In the absence of a final conceptual model, CIDA should undertake to provide a background document or newsletter identifying the nature of TT, and listing best practices and lessons learned.*

8. *CIDA INC and the REE programs should consider adopting appropriate elements of the TT model, and suitable best practices, as guidelines for the private sector considering investing in TT joint ventures under these programs.*