TERMINAL EVALUATION REPORT

INTERNATIONAL TRAINING COURSE
ON
MANUFACTURING AUTOMATION SYSTEMS

Japan International Cooperation Agency

JICA/Brazil

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Contents of Evaluation Report

Form B-7

Summary

I. Outline of the Project:		
Country : Brazil		Project title : International Training Course on Manufacturing Automation Systems
Issue/Sector :		Cooperation scheme :Third Country Training Program
Division in charge: Brazil Office		Total cost 28,150,130Yen Cost per participant : 541,348Yen Share of Japan's Contribution : 77.1%
Period of Cooperation	(R/D) : FY 2003 – FY 2007	Partner Country's Implementing Organization : National Service of Industrial Learning (SENAI)
Related Cooperation :	Japanese Technical Cooperation for the SENAI-SP Manufacturing Automation Center project	

1-1 Background of the Project:

JICA and Brazilian counterpart, the National Service of Industrial Learning (SENAI), have implemented SENAI/SP Manufacturing Automation Center Project in order to attend demand on manufacturing automation technology in Brazil from 1990 to 1994.
In December 1996, Brazil and Japan signed a letter of agreement establishing a TCTP, with the aim of disseminating advanced technology in manufacturing automation in Latin America, via their respective cooperation agencies: ABC (Agência Brasileira de Cooperação) and JICA (Japan International Cooperation Agency). The coordinating agency is the national office of SENAI, through its Networking Agency for National and International Cooperation (GEART); the executing agency is the SENAI Center for Manufacturing Automation in the state of São Paulo, located at the Armando de Arruda Pereira SENAI School in São Caetano – SP, situated in greater São Paulo.The first five year project was from 1997 to 2001. After a one year interval, the second five year project commenced.

1-2 Project Overview:

This terminal evaluation covers the first four years of the second project, from 2003 to 2006. Each June and July, a six week training program was held in São Caetano, with thirteen participants from different Spanish speaking countries of Latin America and the Caribbean. The instructors are regular SENAI staff.

(1) Project Purpose: To provide the participants from Latin American Countries with an opportunity to improve their knowledge and techniques in the field of manufacturing automation system.
Outputs of the Training Program
1) Output 1: Ability to design products utilizing resources of graphic communication, CAD (Computer Aided Design) at engineering stations, going on to generate the respective milling (CAM) programs and sending them to CNC (computerized numerical control] machines) via DNC (Direct or Distributed Numerical Control).
2) Output 2: Ability to program and operate CNC machines and FMS (Flexible Manufacturing Systems).
3) Output 3: Ability to program and operate welding and manipulation robots with visual systems.
4) Output 4: Ability to integrate automatic manufacturing systems.
(2) Inputs
Japanese side :
Trainees received 52
SENAI's Side :
Local Cost (training) 116.958,59 reals local currency (6,434,207Yen)

2. Evaluation Team		
Members of Evaluation Team	Program evaluator Robert K. Walker, professor, Universidade Católica de Brasília.	
Period of Evaluation	14/07/2006 ~19/10/2006	Type of Evaluation : Terminal

3. Results of Evaluation

3 -1. Achievement of the Training Program

Achievements of each component of course can be summarized as below.

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Number of Applicants	22	15	40	39	n.a.	116
Number of Participants	13	13	13	13	n.a.	52
Countries Participated	6	5	8	11	n.a.	30
Duration	6 weeks (240 hours)	6 weeks (240 hours)	6 weeks (240 hours)	6 weeks (240 hours)	n.a.	

3 -2. Result of Evaluation

(1) Analysis on the Achievement in terms of Outputs

	Year 1 (2003)	Year 2 (2004)	Year 3 (2005)	Year 4 (2006)	Year 5 (2007)	Average	Note if any revision in criteria during the course duration
Result 1 CAD/CAM/CAE/ CAT	91.923	82.772	93.313	85.802	n.a.	88.452.5	
Result 2 CNC	83.072	80.232	82.852	79.002	n.a. n.a.	81.292	
Result 3 Robotics	100.003	81.652	97.003	98.303	n.a.	94.242.75	
Result 4 FMS (integration)	97.303	88.462	87.312	91.903	n.a.	91.242.5	
Mean	93.07	83.28	90.12	88.80	n.a.	88.82	

*Achieved: 3, Partly Achieved: 2, Not Achieved: 1. Key: Achieved = average final grade > 89.99. Partly Achieved = average final grade > 78.99 and < 90.00. Not Achieved = average final grade < 79.00.

(2)Relevance

(1) Relevance of the reasons for setting up the training program

1) Judging from the development needs and policies of the targeted countries, was the training program necessary?

Considering that nowadays export success seems to be a requirement for economic growth in small or medium sized emerging or less developed countries (which generally lack sufficient domestic demand to provide an incentive for substantial investment), it is noteworthy that it is restricted to just a few countries in Spanish speaking Latin America: Mexico, Argentina, Colombia and certain Central American countries. Of these, Mexico is the only one regularly characterized by quality

exports to world markets (more in dynamic than in stagnant sectors); even there the predominance of "maquila" production for export, mainly to the United States, implies a situation which may be considered a mixed blessing. At any rate, countries such as Paraguay have made a political option for maquila-based production for export, through incipient but growing industrial modernization (although the country is still at the first stage of maquila, where the main attraction for foreign companies is cheap labor and low taxes). In this effort, the TCTP training program, as well as other JICA support within Paraguay, has been necessary. Furthermore, three of the thirteen 2006 participants (two from Peru and one from Venezuela) agreed that "Demand on the part of certain companies in my country for the technologies presented in the TCTP is very great, and there was never any pressure to participate in the TCTP." All participants agreed that "The diffusion of these innovations in my country is probable, among other reasons, because they represent the future." In terms of participant opinions regarding practical application at work, need seems to have been greater in 2004 and 2005 than in 2003 and 2006.

2) Was the training program the best way to transfer appropriate technology?

Technology transfer implies that the former participants will share what they have learned with their countrymen, and relevant technology will be adopted in local factories; however, there are many and varied obstacles to this process. While some presence-based learning is no doubt essential, because of the need for visits to factories and hands-on experience with the equipment in the training center, blended learning might be an even better alternative, with leveling of knowledge among participants prior to the presence-based course and continuing education afterwards, both through distance education provided in Spanish.

3) Was the condition for conducting training better in the host country than in Japan? If so, why?

Yes, because the cultural and linguistic differences are fewer, and the available competence, facilities and equipment were adequate.

4) In the case of TCTP, designing of curriculum, administration and management of the training course are entrusted and under the responsibility of training institutions in the host country. In this regard, was the entrustment of the training program reasonable in terms of improving capacity and ownership of the training institution?

Yes, although more advanced instructional technology, isomorphic with the sophisticated manufacturing technologies being transmitted, might well have been employed.

5) Was the training program meaningful in terms of promoting networking and cooperation among developing countries?

Yes, but networking via the internet, particularly via simulation and chats in association with distance education, might help to make this an enduring reality.

6) What were the pros/cons of conducting the training course in the host country?

SENAI has the competence to impart a systemic view of integrated manufacturing systems, and there are nearby factories in Greater São Paulo where participants can observe the practical utilization of the new technologies. The language difference (Portuguese is similar to Spanish) seems not to have been a major problem in presence-based education; however, collaboration with counterparts in nearby Spanish speaking countries may well be necessary if it is decided to develop and offer distance education in Spanish.

3-3. Factors promoting sustainability and impact

(1) Factors concerning Planning

The program itself is well structured, within a traditional training framework, and tested over the years: the activities (theoretical, practical and visits), together with the assigned or recommended readings, lead to evidence of learning (exercises and tests).

(2) Factors concerning the Implementation Process

The only adaptation to learners' needs is some remedial instruction for those lacking certain prerequisites (often holding back the others); a few more advanced participants are sometimes permitted to work on their own problems. It is considered inefficient. Some measures should be taken to provide those trainees who lack of sufficient knowledge with minimum information before the beginning of course.

3-4. Factors inhibiting sustainability and impact

(1) Factors concerning Planning

Assuming that the overall goal concerns the intended impact in the region, context analysis should have been conducted in advance, in order to identify needs and opportunities.

(2) Factors concerning the Implementation Process

In spite of the recommendation regarding distance education in the terminal evaluation of the previous five year project, the course is strictly presence-based. The instructional technology employed is commendable but less than state-of-the-art. Instruction is almost never related to each participant's own context.

3-5. Conclusion

The most important conclusion is that teaching and learning should be isomorphic with the sophistication and liberating potential of the new manufacturing technologies. Bringing participants together from many countries to acquire valuable experience with new technologies is one thing; having them sit in rows to listen to lectures in a foreign language is quite another. While there has always been an effort on the part of the TCTP executing agency to distribute class time between "theory" and "practice," there is certainly room for improvement in this regard. No matter what the blend between presence- and distance-based learning may be, modern information and communication technologies open up exciting new possibilities for learning and application.

In the annex, a detailed evaluation using the five DAC criteria (efficiency, effectiveness, impact, relevance and sustainability) is presented.

3-6. Recommendations

1) Adopt a blended learning (semi-presence based) approach to the next five year TCTP project. Ensure that all participants arrive in São Caetano having mastered the essential contents of each subject matter, so that most of the time at the Armando de Arruda Pereira SENAI School can be devoted to hands on practical learning and more time can be devoted to visits to nearby factories.

2) Promote continuing education, transfer of learning and support for professional technological instruction throughout the region through program-related distance education courses in Spanish for former TCTP participants (most of whom are professors or instructors), their students and others. Promote the goal of greater technical and cultural integration among the participating countries through on line discussion (chats) and collaboration.

3)Work toward increasingly sophisticated blended learning approaches, in an isomorphic relationship with the manufacturing technology itself. Simulation of flexible manufacturing systems, virtual factories and "representation" (as INET, in Argentina, refers to it) are possible models.

3-7. Lessons Learned

1) The region is not a major player in high technology global manufacturing, and only one of the participating countries regularly maintains a high quality of exports (measured by the ratio of dynamic to stagnant sector exports).

2) More advantageous dependency relationships are one possibility which may be considered attractive in some countries ("maquila" companies, which transform imported parts into products for export, are the outstanding example in the region). In its more advanced form, generally in electronics and the automobile industry, many of the competencies introduced by the International Course on Systems of Manufacturing Automation are of relevance.

3) Universities and training institutions exist in each country which provide a suitable venue for dissemination of innovations, but they require ongoing support for the efforts of former participants and others in this regard.

3-8. Follow-up Situation

終了時評価調査結果要約表

評価実施部署：JICA ブラジル事務所

１．案件の概要	
国名：ブラジル	案件名: 国際製造オートメーションコース
分野：	援助形態： 第三国研修
所轄部署： ブラジル事務所	協力金額: 21,717 千円
協力期間	R/D: **2003** 年から **2007** 年まで(F/U):無し

1-1 協力の背景と概要:

JICA は 1990 年から 1994 年にかけて、ブラジルに於ける製品の多品種生産に対応した品質管理技術や生産の自動化技術に対するニーズに応えるために、サンパウロ州 SENAI(全国工業関係職業訓練機関)に対してプロジェクト方式技術協力（当時）「SENAI/SP 製造オートメーションセンタープロジェクト」を実施した。
同プロジェクトは成功裏に終了し、製造自動化装置等の技術を習得したサンパウロ州 SENAI は、製造自動化技術にかかる技術者の不足に悩む南米諸国を支援する目的で同内容の第三国研修の実施を JICA に対し要請してきた。
1996 年 12 月ブラジルと日本は ABC（ブラジル国際協力庁）と JICA をとおしてラテンアメリカにおいて製造オートメーションの先進技術を普及する目的で第三国研修を実施する合意文書に署名した。本件のコーディネーション機関は SENAI の本部であり、実施機関はサンパウロ州にある SENAI の製造オートメーションセンター（サンカエターノのアルマード・デ・アルーダ SENAI 学校）である。最初の５年間の第三国研修が 1997 年から 2001 年にかけて実施され、一年後に第二回の第三国研修が開始された。

1-2 協力内容
この終了時評価は延長されたプロジェクト（各５年間実施）のうち 2003 年から 2006 年まで４年間を評価対象としている。毎年６月と７月にサンカエターノでラテンアメリカとカリブのスペイン語圏の国々から１３人の参加者を対象に 6 週間の研修が行われた。講師はすべて SENAI の正規職員である。

（１）概要
プロジェクト目標：ラテンアメリカ諸国からの研修員の製造オートメーションにかかる知見と技術を向上する。

成果（アウトプット）:
本研修終了時に研修員が以下の技術及び知見を習得していることを目的としている。
１）アウトプット１： CAD(Computer Aided Design)システムを利用して切断プログラムを作成し、DNC(Direct or Distributed Numerical Control)を経由し CNC(Computerized Numerical Control)に送付される、設計する能力。
２）アウトプット２：CNC 機材と FMS(Flexible Manufacturing System)をプログラムし、運転する能力
３）アウトプット３：ヴィジュアル・システムを備えた溶接ロボットをプログラムし運転する能力
４）アウトプット４：自動製造システムを総合的に調整することができる。

(２) 投入:
日本側:
研修員受入:52 人
相手国側
ローカルコスト負担：116,958.59 レアル（6,432 千円）

２. 評価調査団の概要

調査者:	ローカルコンサルタント Robert K. Walker	
調査実施期間:	14/07/2006-19/10/2006	評価種類：終了時評価

３. 評価結果の概要

3-1 実績の確認

	1 年目	2 年目	3 年目	4 年目	5 年目	合計
応募者数	22	15	40	39	n.a.	116
研修員数	13	13	13	13	n.a.	52
参加国数	6	5	8	11	n.a.	30
研修期間	6 週間 (240 時間)	6 週間 (240 時間)	6 週間 (240 時間)	6 週間 (240 時間)	n.a.	

3-2. 評価結果の概要

(1) 到達目標達成度

学習到達度については以下のとおり。

	1 年目 (2003)	2 年目 (2004)	3 年目 (2005)	4 年目 (2006)	5 年目 (2007)	平均
アウトプット 1 CAD/CAM/CAE/CAT	91.92 3	82.77 2	93.31 3	85.80 2	n.a.	88.45 2.5
アウトプット 2 CNC	83.07 2	80.23 2	82.85 2	79.00 2	n.a. n.a.	81.29 2
アウトプット 3 Robotics	100.00 3	81.65 2	97.00 3	98.30 3	n.a.	94.24 2.75
アウトプット 4 FMS (integration)	97.30 3	88.46 2	87.31 2	91.90 3	n.a.	91.24 2.5
平均	93.07	83.28	90.12	88.80	n.a.	88.82

*達成された: 3, 部分的に達成された: 2, 達成されなかった: 1. Key: 達成された = 平均点> 89.99. 部分的に達成された= 平均点> 78.99 and < 90.00.達成されなかった=平均点 < 79.00.

⑵ 妥当性

１）開発ニーズと対象国の政策から判断して、研修コースは必要だったか。

今日、輸出の成功は小規模国、中規模の新興国もしくは途上国（それらの国々では一般的に実質的な投資のインセンティブとなるに足る十分な国内需要が不足している）の経済成長の必須条件となっている。研修対象国のうち、メキシコは唯一世界市場に対する質の高い輸出で知られている国である。そのメキシコでさえ主にアメリカ合衆国に対する輸出のための「マキーラ」生産が隆盛している状況は恩恵と問題が混在した状況といえる。いずれにしてもパラグアイなどの国々はまだ緒についたばかりであるものの、産業の近代化をとおしてマキーラを基盤にした輸出生産への政治的選択を行った。（外国企業にとってのパラグアイの主な魅力は安価な労働力と低率の税であり、パラグアイはマキーラの初期の段階にある。）この文脈においてパラグアイにおける JICA の他の協力と同様に、本第三国研修はパラグアイにとって必要であった。さらに 2006 年の 13 人の研修参加者のうち 3 人（ペルーから２人、ベネズエラから一人）は、「わが国のある企業の第三国研修で紹介された技術に対するニーズは非常に大きかった。」という点で一致している。他方で、コロンビアからの参加者 3 人とペルーからの参加者 1 人は「その技術が妥当と感じられていないとしてもわが国はこの機会を失いたくない」という。他の 6 人の参加者は「需要プル要因と技術プッシュ要因の二つの要因が研修に参加者を送り出す際の決定に同等の重要性を持っている」と指摘している。すべての参加者は「これらの新技術はわが母国でおそらく普及すると思われる。それにはいろいろな理由があるが、何よりも未来を体現しているからだ」という点で一致した。自分の業務に対する活用にかかる参加者の意見によると、ニーズは 2003 年と 2006 年より 2004 年と 2005 年のほうが大きかったことが伺える。毎年 13 人の参加者のうち、「あなたの業務に対する適用」という項目に対する評価については「非常によく活用している」という評価に対しては 2004 年には８名、2005 年には７名、しかし 2003 年には１名、2006 年には３名しかいなかった。「ある程度適用している」という評価は 2004 年に 2 名、2005 年には 1 名であったが、2003 年には４名、2006 年には 8 名であった。

２）研修が技術の移転方法として最適であったか？

技術移転は研修参加者が母国への帰国後、母国の人々と研修で学んだことを共有することを意味し、母国の工場にて妥当な技術が採用されるであろうことを意味する。しかしながら、この過程には多くのそしてさまざまな障害がある。工場を見学し、研修センターにて機材を手に触れて操作する授業形式の学習は間違いなく重要である一方で、授業に参加する前に参加者の知識レベルを一定にし、研修後も勉強を継続することができる混合学習（どちらもスペイン語で遠距離学習として行われる）はよりよいオルタナティブであると思われる。

３）日本で実施するよりも当該国で実施したほうが研修実施によい条件を有しているか。もしそうなら、その理由。

文化的言語的差異が少なく、能力、施設、機材が適したものとなっている。

４）第三国研修において、カリキュラム・デザイン、運営、管理当該国の実施機関に託されている。これらの委託は実施機関の能力向上とオーナーシップを醸成する意味で合理的であったか。

合理的であった。研修にて伝授された洗練した製造技術と同じく、より先進的な指導技術が用いられたらなおよかった。

５）研修プログラムは参加国間のネットワーク、協力を促進する意味で有意義があったと思うか？

有意義であった。しかしインターネットを介したネットワーク、特に遠隔教育と関連させたチャットやシミュレーションは研修にて構築されたネットワークをより持続的なものにすることに役立つと思われる。

６）当該国における研修実施の賛成意見、反対意見があれば。

SENAI は総合製造システムの全体像を提供する能力を有し、大サンパウロ圏に所在する近隣の工場では新技術の実際の活用状況を参加者が見学することが可能である。言語の差異は（ポルトガル語とスペイン語は類似）講義においては大きな問題ではなかったようである。

しかしながら、もしスペイン語での遠隔教育を開発し、提供するというのであれば、近隣のスペイン語圏の国のカウンターパートの協力が必要となるかもしれない。

3-3 効果発現に貢献した要因

(1) 計画内容に関すること

プログラムそれ自体は伝統的な研修の枠組みであるが、長年の経験に基づいたもので、非常によく練られたものである。講義、実務と見学が、読書の宿題によって補強され、学習の確認（テスト）へとつながる流れとなっている。

(2) 実施プロセスに関すること

研修参加への必須知識を有していない参加者には研修開始にあたって補講がなされた（しばしば他の参加者はそれを待つこととなった）。研修員のレベルをそろえるという意味で補講自体は必要であり有効であった。しかし、補講をしている時間、知識を十分持ち合わせた参加者は自習となり、効率的とはいえないため研修前の事前の学習等の工夫が必要である。

3-4 問題点及び問題を惹起した要因

(1) 計画内容に関すること

研修の最終的な目標が「当該地域にある程度のインパクトをもたらすこと」であると仮定するとニーズと機会を特定するために現状分析が前もって実施されるべきであった。

(2) 実施プロセス関連要因

前回５年間の第三国研修にかかる終了時における遠隔教育を実施したほうがよいという評価にもかかわらず、研修は依然として講義に固執している。指導技術は非常によいものであるが、最新技術を利用しているものではない。指導はほとんど参加者の母国の置かれた状況を反映したものではない。

3-5 結論

もっとも重要な結論は新しい製造技術が切り開く潜在性や先進性と同様に指導方法や学習方法も洗練されたものであるべきだということである。多くの国々から新技術とともに貴

重な経験をさせるために参加者を連れてくることと彼らを外国語での講義を聞かせるために講義室に並べて座らせることは別である。第三国研修実施機関が授業を講義と実務に振り分けることに腐心しているものの、この点でさらなる改善の余地がある。講義と遠隔教育は、その比率がどうだろうと、現代の最新情報コミュニケーション技術が学習と応用の新たな可能性を開くことは間違いない。

3-6 提言

１）次の第三国研修については複合学習（講義と遠隔教育の組み合わせ）アプローチを採用したほうがよい。すべての研修員はそれぞれの課目について重要な内容をマスターしたうえでサンカエターノにくるようにする。そうすることにより SENAI 学校で実務と近隣工場の見学に多くの時間を割けるようになる。

２）地域全体を対象に、第三国研修の帰国研修員（大部分が教授もしくは指導者の立場にある）、その生徒等を対象にスペイン語による遠隔教育コースを開講し、教育の継続、学習の移転、専門技術指導の支援を推進する。オンラインの議論（チャット）や協力をとおして参加国間のさらなる技術的、文化的統合を促進する。

３）製造技術と同様により洗練された複合的な学習アプローチに向けて努力すべきである。柔軟な製造システムシミュレーション、バーチャル工場などが可能性のあるモデルである。

3-7 教訓

１）この地域は先進技術グローバルマニュファクチュアリングにおいて主要なプレーヤーとはなっていない地域である。高品質の輸出を維持している国は参加国ではメキシコのみであるものの、研修参加者は研修をきわめて妥当なものであったとみなしている。

２）いくつかの国々では魅力的と思える一つの可能性は相互に利益となる依存関係である（この地域では輸入製品を輸出のための製品にするマキーラ会社が目立つ存在となっている）。一般的に電子産業と自動車産業において本研修にて紹介された多く技術はそのより高度な形態として妥当性が高いものと考えられる。

３）それぞれの参加国に存在する大学や研修機関は技術革新の普及に必要な適切な場を提供する。ただしそのためには帰国研修員等の努力に対する支援が必要である。

3-8 フォローアップ状況

Form B-6

Main Body of the Report

Chapter 1 Outline of Evaluation Study

1-1 Objectives of Evaluation Study

1. To evaluate the capacity of the Brazilian institution to conduct the course of study.
2. To assess the impact of the course of study in the candidates' countries of origin.

1-2 Members of Evaluation Study Team

Robert Kenyon Walker

1-3 Period of Evaluation Study

14 July to 9 October 2006

1-4 Methodology of Evaluation Study

Except for effectiveness (accomplishment of the specific objectives), the five DAC criteria require a broad view of the region and of the technological alternatives available. Thus, in addition to gathering data in São Caetano, São Paulo (the training site) through questionnaires, semi-structured interviews and observation, and to reviewing project documents, the evaluator drew upon global and regional information sources. Relevant literature was consulted and internet searches conducted. A visit to several sites in Paraguay, including the JICA offices, was undertaken, in the company of a participant in the 2006 TCTP course. Telephone calls were placed to former participants and their supervisors.

Chapter 2 Outline of the Training Program

2-1 Background of the Training Course

In December 1996, Brazil and Japan signed a letter of agreement establishing a Third Country Training Program (TCTP), with the aim of disseminating advanced technology in manufacturing automation in Latin America, via their respective cooperation agencies: ABC (Agência Brasileira de Cooperação) and JICA (Japan International Cooperation Agency). The coordinating agency is the national office of the National Service of Industrial Learning (SENAI), through its Networking Agency for National and International Cooperation (GEART); the executing agency is the SENAI Center for Manufacturing Automation in the state of São Paulo, located at the Armando de Arruda Pereira SENAI School in São Caetano – SP, situated in greater São Paulo.The first five year project was from 1997 to 2001. After a one year interval, the second five year project commenced.

2-2 Summary of Initial Plan of the Training

(1) Course title	**International Training Course on Manufacturing Automation Systems**
(2) Number of participants a year	**Thirteen**
(3) Duration	**Six weeks**
(4) Year of cooperation	**FY 2003 ~ FY 2007 (five years)**

Requirement for Application

(1) Level of knowledge and/or skills which participants are expected to have	• **Sufficient mastery of the Portuguese language (conversation and reading)**
(2) Desirable current position/duties	• **Currently working in the mechanical area, in a teaching capacity**
(3) Years of experience in the sector/issue in question	**Five years**
(4) Age limit	**None.**
(5) Target countries	**Thirteen Spanish speaking countries of Latin America and the Caribbean.**

Chapter 3 Implementation of the Training Program

3-1 Implementation frameworks

The coordinating agency is the national office of the National Service of Industrial Learning (SENAI), through its Networking Agency for National and International Cooperation (GEART); the executing agency is the SENAI Center for Manufacturing Automation in the state of São Paulo, located at the Armando de Arruda Pereira SENAI School in São Caetano – SP, situated in greater São Paulo.

3-2 Achievement in terms of Activities

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Number of Applicants	22	15	40	39	n.a.	116
Number of Participants	13	13	13	13	n.a.	52
Countries Participated	6	5	8	11	n.a.	30
Duration	6 weeks (240 hours)	6 weeks (240 hours)	6 weeks (240 hours)	6 weeks (240 hours)	n.a.	

3-3 Achievement in terms of Outputs

	Year 1 (2003)	Year 2 (2004)	Year 3 (2005)	Year 4 (2006)	Year 5 (2007)	Average	Note if any revision in criteria during the course duration
Result 1 CAD/CAM/CAE/CAT	91.92 3	82.77 2	93.31 3	85.80 2	n.a.	88.45 2.5	
Result 2 CNC	83.07 2	80.23 2	82.85 2	79.00 2	n.a. n.a.	81.29 2	
Result 3 Robotics	100.00 3	81.65 2	97.00 3	98.30 3	n.a.	94.24 2.75	
Result 4 FMS (integration)	97.30 3	88.46 2	87.31 2	91.90 3	n.a.	91.24 2.5	
Mean	93.07	83.28	90.12	88.80	n.a.	88.82	

*Achieved: 3, Partly Achieved: 2, Not Achieved: 1. Key: Achieved = average final grade > 89.99. Partly Achieved = average final grade > 78.99 and < 90.00. Not Achieved = average final grade < 79.00.

3-4 Achievement in terms of Input

Total cost (operating expenditures): 511,820.55 reals (_____Yen)

Cost per participant: 9,842.70 reals (_____Yen)

Share of Japanese Contribution: 77.1%

Japanese Side:

Short-term Experts	0 person	0 M/M
Training Expense	394,861.96 reals	Yen
Others		
Total Cost	Local currency	Yen

Host Country's Side:

Lecturers, Staff	7 persons	3 persons	M/M
Training Expense	116.958,59 reals	Yen	Yen
Others	1.818.986,13 reals	Yen	
Total Cost	1.935.944,72 reals	Yen	Yen

*Please attach detailed information, if necessary.

Chapter 4 Evaluation Results

4-1 Analysis of Outputs

1. (1) Output 1: Ability to design products utilizing resources of graphic communication (CAD) at engineering stations, going on to generate the respective milling (CAM) programs and sending them to CNC [computerized numerical control] machines (via DNC) [direct or distributed numerical control].

1) b. Partly Achieved (Average 88,45)
Describe the reason for the above judgment.

One or more years, the average final test result in the CAD/CAM/CAE/CAT course was between 82,77 and 93,31 per cent.

2) What were the promoting (if you chose "a" or "b" in 1) or impeding (if you chose "c" or "b" in 1)) factors?

x☐ setting of outputs ☐ requirement of application ☐ willingness of participants ☐ curriculum x☐ targeted countries x☐ duration ☐ text/materials ☐ lecturers ☐ equipments ☐ others ( )

Describe the promoting/impeding factors in detail.

Eighty hours were dedicated to this output. The setting was adequate (see below). In 2004, three of the five Bolivian participants and one of the two Peruvians had no knowledge of computers and found it difficult to understand Portuguese. Each had a final grade of less than 75%.

(2) Output 2: Ability to program and operate CNC machines and flexible manufacturing systems (FNS).
1) b. Partly Achieved (Average 81,29)
Describe the reason for the above judgment.

One or more years, the average final test result for the CNC course was between 79 and 83,07 per cent.

2) What were the promoting (if you chose "a" or "b" in 1)) or impeding (if you chose "c" or "b" in 1)) factors?

x☐ setting of outputs ☐ requirement of application ☐ willingness of participants ☐curriculum ☐targeted countries x☐duration ☐text/materials ☐lecturers ☐equipments ☐others ( )

Describe the promoting/impeding factors in detail.

Eighty hours were dedicated to this output. The setting was adequate (see below).

(3) Output 3: Ability to program and operate welding and manipulation robots with visual systems.

1) b. Achieved (Average 94,24)
Describe the reason for the above judgment.

One or more years, the average final test result for Robotics was between 81,65 and 100 per cent.

2) What were the promoting (if you chose "a" or "b" in 1)) or impeding (if you chose "c" or "b" in 1)) factors?

x☐ setting of outputs ☐ requirement of application ☐ willingness of participants ☐ curriculum ☐ targeted countries ☐ duration ☐ text/materials ☐ lecturers ☐ equipments ☐ others ( )

Describe the promoting/impeding factors in detail.

Only forty hours were dedicated to this output. The setting was adequate (see below).

(4) Output : Ability to integrate automatic manufacturing systems.

1) b. Achieved (Average 91,24)
Describe the reason for the above judgment.

One or more years, the average final test result for the FMS course was between 87,31 and 97,30 per cent.

2) What were the promoting (if you chose "a" or "b" in 1)) or impeding (if you chose "c" or "b" in 1)) factors?

x☐ setting of outputs ☐ requirement of application ☐ willingness of participants ☐ curriculum ☐ targeted countries x☐ duration ☐ text/materials ☐ lecturers ☐ equipments ☐ others ( )

Describe the promoting/impeding factors in detail.

Only thirty-two hours were dedicated to this output. The setting was adequate in part (see below).

(3) Overall judgment on the achievement of outputs.

Results were generally good, but could be further improved through greater application of instructional technology.

4-2 Relevance

(1) Relevance of the reasons for setting up the training program

Write the evaluation team's opinion regarding the following issues, with concrete evidence the team has found through its research. *1) Judging from the development needs and policies of the targeted countries, was the training program necessary?* Considering that nowadays export success seems to be a requirement for economic growth in small or medium sized emerging or less developed countries (which generally lack sufficient domestic demand to provide an incentive for substantial investment), it is noteworthy that it is restricted to just a few countries in Spanish speaking Latin America: Mexico, Argentina, Colombia and certain Central American countries. Of these, Mexico is the only one regularly characterized by *quality*

exports to world markets (more in dynamic than in stagnant sectors); even there the predominance of "maquila" production for export, mainly to the United States, implies a situation which may be considered a mixed blessing. At any rate, countries such as Paraguay have made a political option for maquila-based production for export, through incipient but growing industrial modernization (although the country is still at the first stage of maquila, where the main attraction for foreign companies is cheap labor and low taxes). In this effort, the TCTP training program, as well as other Jica support within Paraguay, has been necessary. Furthermore, three of the 2006 participants (two from Peru and one from Venezuela) agreed that "Demand on the part of certain companies in my country for the technologies presented in the TCTP is very great, and there was never any pressure to participate in the TCTP." All participants agreed that "The diffusion of these innovations in my country is probable, among other reasons, because they represent the future." In terms of participant opinions regarding practical application at work (choice of the option, "excellent"), need seems to have been greater in 2004 and 2005 than in 2003 and 2006.

2) Was the training program the best way to transfer appropriate technology?

Technology transfer implies that the former participants will share what they have learned with their countrymen, and relevant technology will be adopted in local factories; however, there are many and varied obstacles to this process. While some presence-based learning is no doubt essential, because of the need for visits to factories and hands-on experience with the equipment in the training center, blended learning might be an even better alternative, with leveling of knowledge among participants prior to the presence-based course and continuing education afterwards, both through distance education provided in Spanish.

3) Was the condition for conducting training better in the host country than in Japan? If so, why?

Yes, because the cultural and linguistic differences are fewer, and the available competence, facilities and equipment were adequate.

4) In the case of TCTP, designing of curriculum, administration and management of the training course are entrusted and under the responsibility of training institutions in the host country. In this regard, was the entrustment of the training program reasonable in terms of improving capacity and ownership of the training institution?

Yes, although more advanced instructional technology, isomorphic with the sophisticated manufacturing technologies being transmitted, might well have been employed.

5) Was the training program meaningful in terms of promoting networking and cooperation among developing countries?

Yes, but networking via the internet, particularly via simulation and chats in association with distance education, might help to make this an enduring reality.

6) What were the pros/cons of conducting the training course in the host country?

SENAI has the competence to impart a systemic view of integrated manufacturing systems, and there are nearby factories in Greater São Paulo where participants can observe the practical utilization of the new technologies. The language difference (Portuguese is similar to Spanish) seems not to have been a major problem in presence-based education; however, collaboration with counterparts in nearby Spanish speaking countries may well be necessary if it is decided to develop and offer distance education in Spanish.

(2) Appropriateness of Output Setting and Curriculum Design

Write the evaluation teams opinion regarding the following issues, with concrete evidence the team has found through its research.

1) Was the setting of output 1 and training components (lecture / practice etc….) appropriate?

Yes. Module: Computer Assisted Design, Manufacturing, Engineering and Testing (CAD/CAM/CAE/CAT) – 80 hours. According to the teaching plan, the sequence was always the same: oral presentation of contents, reading of texts and group exercises. The instructors reported

also using CD's, films and handouts. Simulated exercises are presented on a big monitor, then the participants execute the tasks. Dassault Systemes software (Catia) and LADSIM - Ladder Logic Editor and Programmable Logic Controller Simulator are employed. Just one 2006 participant (the Venezuelan) worked on real problems from her own country.

2) Was the setting of output 2 and training components (lecture / practice etc.…) appropriate?

Yes. Module: Computerized Numerical Control (CNC) – 80 hours. The first requirement is to bring all the participants up to the required basic level. Mastery of conventional machinery is a prerequisite. In turn, knowledge of CNC is a prerequisite for CAM and for FMS (outputs 1 and 4, respectively). After the theoretical presentation, there is group work, followed by simulation and correction, then machine application. The simulators are rather old, but this has not been a major problem, except for the lack of an interface with the machinery.

3) Was the setting of output 3 and training components (lecture / practice etc.…) appropriate?

Yes. Module: Robotics – 40 hours. Two Scorbot teaching robots are used. The task the participants must perform is to write a program in conformity with INFORM II programming language, in order to make the main robot pick up a part and move it to a nearby position, on a different axis.

4) Was the setting of output 4 and training components (lecture / practice etc.…) appropriate?

In part. Module: Flexible Manufacturing Systems (FMS) – 32 hours. The course involves theoretical classes with audiovisual resources, followed by practical applications using Mazak equipment. As the last course offered, FMS provides an opportunity to apply and consolidate previous learning. On the other hand, such an overview would also seem important at the beginning and throughout the program. Although FMS may be considered too "conceptual" and without direct application in most of the participating countries (Mexico is seen as the notable exception), its systemic approach would seem to be essential to the program as a whole. Just one day (the fourth day of the course and the last day of the TCTP) would seem insufficient for practical application of FMS by the participants.

(3) Appropriateness of the Requirements for the Applicants, and Selection

Each year, invitations were sent to the same thirteen Spanish speaking countries of the Americas. It is not clear why the other Spanish speaking countries (the Dominican Republic, Honduras and Nicaragua), and Brazil itself, were not invited. While some thought has been given to excluding certain less developed countries (such as Bolivia), there was no support for this idea among the participants interviewed; in fact, Paraguay has proven to be one of the most receptive countries; and the Bolivian participants themselves present good reasons why their countrymen should be included. As for why basic subject matter information was not provided in advance through some form of distance education, in order to save time for more practical applications in São Caetano (as recommended in the terminal evaluation report on the first project), one justification given was that some countries wait until the last moment to report the results of the selection process, especially when unforeseen circumstances make a substitution necessary. While the selection process does need to be primarily the responsibility of each country, the program administrators might well reserve the right to filter out candidates who do not meet or acquire the basic prerequisites (and thus to set deadlines for submission). The application form and accompanying self evaluation provide important information, but it is not clear how this information is utilized, if at all.

(4) Overall Judgment on Relevance

The Economic Commission for Latin America and the Caribbean recommends that "The countries of Latin America and the Caribbean must adopt strategies oriented to the use of ICT to facilitate a broad process of economic development and systemic competitiveness." At present, the Latin American and Caribbean countries are gradually advancing into the digital age. However, "In contrast to the more developed economies, informatization in Latin America does not yet constitute a decisive determinant of competitiveness – which is mainly due to a lack of scale."

Among the applications of Information and Communication Technology (ICT), alongside mechatronics, is distance learning. The relevance of distance learning for training, development and education (TD&E) is widely acknowledged. Specialists refer to the "third generation" of distance learning as "collaborative technologies." One relevant example for our purposes is virtual factory teaching systems in support of manufacturing education. To be successful in this new manufacturing environment, an engineering college graduate must understand the total business process from design to production to delivery in order to develop a holistic view of manufacturing system. However, factory experimentation through full scale on campus laboratories is an infeasible alternative for engineering programs, due to the high expense associated with development and maintenance. Web-Based Training (WBT) employing a virtual factory teaching system, preferably in conjunction with presence-based teaching whenever possible (blended learning at the workplace), is an attractive alternative, especially when great distances are involved and funds are limited.

If the relevance of the TCTP course were to be restricted to the thirteen annual participants and a few countrymen whose appetite for advanced technology may be whetted by the stories they tell, it would hardly justify its cost per participant. If, on the other hand, continuing education of the former participants, their colleagues and students and others makes possible diffusion of useful innovations, the program may well be considered highly relevant.

4-3 Conclusions

4-3-1 Factors Promoting the Effectiveness of the Training Program

- The equipment and initial training provided by JICA or the counterpart organization. While the equipment is not top of the line, latest model, it is adequate to the training needs. The training provided in Japan reportedly had its limitations, related to cultural and language adaptation among the many nationalities present and to teaching methods also not considered particularly advanced. However, the instructors have acquired the necessary additional technical competence in their university courses and elsewhere.
- The experience and technical competence of the national counterpart (SENAI). SENAI is increasingly geared up for advanced technological training.
- The receptivity of nearby high tech manufacturing companies to visits by participants is an important factor stressed by several 2006 participants.
- The support of key universities and training institutions in each country. This is a requirement for transfer of knowledge.
- The interest, dedication and collaboration among the participants was evident.

4-3-2 Factors Inhibiting the Effectiveness of the Training Program

- The need to spend a large amount of class time presenting basic information restricted the time available for hands-on application.
- The need for even greater expertise in instructional technology on the part of the teaching staff and supervisors, along with appropriate instruments, was clear.
- Frequent failure to relate the information presented to the participants' own individual context and that of his or her country was reported by both instructors and participants.
- Limited contact with and among the participants before and after the six week course was reported.
- Limited adaptation to learner needs and strengths, through formative evaluation.

Chapter 5 Recommendations and Lessons Learned

5-1 Recommendations

5-1-1 Recommendations for Partner Country Side (Direction of Future Activities of Project)

1. Adopt a blended learning (semi-presence based) approach to the next five year TCTP project. Ensure that all participants arrive in São Caetano having mastered the essential contents of each subject matter, so that most of the time at the Armando de Arruda Pereira SENAI School can be devoted to hands on practical learning and more time can be devoted to visits to nearby factories.
2. Promote continuing education, transfer of learning and support for professional technological instruction throughout the region through program-related distance education courses in Spanish for former TCTP participants (most of whom are professors or instructors), their students and others. Promote the goal of greater technical and cultural integration among the participating countries through on line discussion (chats) and collaboration.
3. Work toward increasingly sophisticated blended learning approaches, in an isomorphic relationship with the manufacturing technology itself. Simulation of flexible manufacturing systems, virtual factories and "representation" (as INET, in Argentina, refers to it) are possible models.

5-1-2 Recommendations for JICA (Necessity for Follow-up Cooperation)

1. Develop the next five year project within the context of Mercosur, centered around the Triple Frontier (Brazil, Argentina and Paraguay).
2. Consider heavier initial investment in hardware, software, instructional development and training, in order to make possible lower per participant costs and greater impacts in the medium term, through dissemination, multiplier effects and sustainability.

5-2 Lessons Learned

5-2-1 Lessons Learned regarding Situations in Evaluated Country and Sectors (policy, technological level, social and cultural aspects, institution, economic and financial aspects, etc.)

1. The region is not a major player in high technology global manufacturing, and only one of the participating countries (Mexico) regularly maintains a high quality of exports, as measured by the ratio of dynamic to stagnant sector exports (see discussion in the appendix, based on ECLAC data). Nevertheless, this does not lessen the relevance of the program. If blended learning is adopted (see recommendations above), there will be no reason to restrict access to certain countries, as some have suggested. Instructors and participants from the more advanced countries can help the others. It is felt that the program should continue, with the necessary adaptation to existing opportunities and needs.
2. Technological dependency is a reality in the region, as numerous studies have shown (see, for example, Fernando Henrique Cardoso's dependency theory). More advantageous dependency relationships are one possibility which may be considered attractive in some countries ("maquila" companies, which transform imported parts into products for export, are the outstanding example in the region). In its more advanced form, generally in electronics and the automobile industry, many of the competencies introduced by the International Course on Systems of Manufacturing Automation are of relevance. There are other possible industrial applications, as the Paraguayan example illustrates.

3. Universities and training institutions exist in each country which provide a suitable venue for dissemination of innovations, but they require ongoing support for the efforts of former participants and others in this regard.

5-2-2 Lessons Learned regarding Project Management (Findings, Formulation, Implementation, Evaluation, etc.)

In general, the possibility of intentional, positive impact depends on the prior or concurrent existence of needs. Training needs are descriptions of gaps in competencies or repertories of knowledge, abilities and attitudes (KAA) at work. The Record of Discussions between the Japan International Cooperation Agency, the Brazilian Cooperation Agency and the Serviço Nacional de Aprendizagem Industrial, Regional Department of São Paulo, on the Third Country Training Program specifies the course purpose and objectives, but does not make reference to any prior needs assessment. Analysis of contextual factors is very important to the success of TD&E [Training, Development and Education]. Few studies deal directly with this matter. A vision of context as opportunity or as a factor engendering conditions for stimulating the development of new competencies requires the adoption of strategies of prospective assessment of future scenarios surrounding the organization and its environments. The diagnostic vision is one possibility for needs assessment, but it is not the only one, nor is it the most relevant nowadays. JICA and project management need to ask, for example, whether the course has contributed, or has the potential to contribute, to “endogenous development” in each country of origin, within a context of globalization. If not, will the country benefit anyway, perhaps through finding a niche in global production systems (e.g., “maquila”)? This present report may be considered to provide a preliminary context analysis for a possible future project.

Annex 1

List of Persons Interviewed

SENAI – São Paulo Regional Department

Adelmo Belizário, Regional Manager.
João Alberto Simões, Human Resources Director.
João Ricardo Santa Rosa, Education Manager.
Roberto Monteiro Spada, Technical Director.
Érulos Ferrari Filho, Industrial Technology Director.

SENAI – Armando de Arruda Pereira SENAI School

Marcos Cardozo Pereira, Director.
Daniel Camusso, instructor.
Dagoberto Gregório, instructor.
Fausto Hironobu Kobayashi, instructor.
Marcos Vinicius, instructor.
Carlos Gonzáles, instructor.
Júlio César de Almeida Freitas, instructor.
Paulo Bueno Santos, instructor.

Participants, 2006

Alejandra Sánchez Calvo, Costa Rica.
Anamelis Sánchez Rodriguez, Venezuela.
Carlos Andrés Pérez Tristancho, Colombia.
Fredy Sucojayo Troche, Bolivia.
Humberto Sanchez Florez, Panama.
José Olger Pérez Silva, Ecuador.
Julio César Chauca Palomino, Peru.
Marcos Ruiz Diaz Alfonso, Paraguay.
Mario Sergio Valencia Ticona, Bolivia.
Rafael Antonio Avella Arenas, Colombia.
Victor Hipolito Pumisacho Alvaro, Ecuador.

Paraguay

Pedro Sosa, Director, Department of International Cooperation, Technical Planning Secretariat.
Sandra Gómez de Mujica, General Director; César L. Ramírez Laloux, Administrator; and Ernesto A. Paredes L., Administrative and Financial Coordinator, the National Council of Export Maquila Industries, of the Ministry of Industry and Commerce.
Yukata Iwatani, Adjunct Resident Representative; Tomochika Sakuda, Adjunct Director of Technical Cooperation and Volunteers; and Jun Takakura, Coordinator of Technical Cooperation, JICA Paraguay office.
Francisco Rubén Rios, training manager, regional center, National Service of Professional Promotion (SNPP).
Eleno Bron, Director; and Sandra Rufinelle, professor of automation and control, National Service of Professional Promotion in San Lorenzo.
Alan Gerlach, Technology Coordinator, American School of Asuncion.

Norma, Planning Director, Ministry of Justice and Labor.
Arnaldo Rafael Maciel Riveros, Director, Senai-SNPP, Hernandarias.
Percy Engel, Paraguay-Brazil Project Coordinator, Senai-SNPP, Hernandarias.

Juán Manuel Kipshenbaum, National Center Director, National Institute of Technological Education (INET), Argentina (telephone interview).

Annex 2

Results of Questionnaire Survey
Response Frequencies (n=13)

Nombre:_____

Evaluación del Curso TCTP 2006
Sistemas de Automação de Manufatura
Cuestionario

Estimado participante,

Ruego llenar este cuestionario, leyendo el texto y marcando una de las cinco alternativas.

Si quiere, puede escribir sus comentarios después de las cinco alternativas. Habrá, también, oportunidad de conversar durante la entrevista o en otro momento.

1. Entre 1970 y 2000, en América Latina, la productividad relativa de las industrias con uso de factores productivos intensivos en metalmecánica cayó por la mitad *vis à vis* la industria norteamericana, de cerca de 32 a cerca de 16. Solamente en Brasil el peso relativo del sector metalmecánica/automotriz en el producto manufacturero era elevado e creció en el período (de 28,7 a 31,5). En nuestra región, "las actividades económicas más cercanas a las ventajas comparativas estáticas, basadas en recursos naturales y mano de obra poco calificada, tienden a incorporar más progreso tecnológico y a cerrar relativamente más la brecha de productividad laboral".[1] Las exportaciones de nuestros países (con la excepción del Méjico) para el mercado mundial van mucho más a los mercados estancados que a los dinámicos.[2]

Considerando esa realidad, Vd. considera válido un curso con las características del TCTP para participantes de su país?

__a) No, de ninguna manera.
__b) Es relevante para el participante individualmente, pero no para el país.
1_c) Tiene alguna relevancia para el país, para que conozca un poco lo que está ocurriendo en el mundo globalizado.
3_d) Es relevante para el país, pero solamente para aplicación a largo plazo.
9_e) Tiene relevancia inmediata, pues lo que estamos aprendiendo puede ser aplicado ya en el contexto actual.

2. Según Carlota Pérez,[3] "la tecnología debe ocupar un lugar central, y no periférico, en las políticas de desarrollo… exige una reformulación completa tanto de los sistemas de educación y capacitación como de las políticas de ciencia y tecnología".

Como resultado del TCTP, Vd. se considera apto a contribuir para la reformulación de la educación o la capacitación tecnológica en su país?

[1] Mario Cimoli y Jorge Katz, "Reformas estructurales y brechas tecnológicas". IN Ocampo, José Antonio, ed., *El desarrollo econômico em los albores del siglo XXI*. Bogotá, ONU/CEPAL/Alfaomega, 2004.
[2] CEPAL (2002c). *Panorama de la inserción internacional de América Latina y el Caribe.* Santiago, Naciones Unidas.

[3] Carlota Pérez, "Cambio tecnológicy y oportunidades de desarrollo como blanco móvil". IN Ocampo, José Antonio, ed., *El desarrollo econômico em los albores del siglo XXI*. Bogotá, ONU/CEPAL/Alfaomega, 2004.

__a) No, porque las metodologías usadas en el curso no son adecuadas a nuestra realidad.
__b) Puedo tratar de hacer eso, pero en absoluto no hay apertura para ello en mi país o en la institución donde trabajo.
__c) Encontraré apoyo para hacer un poco, dentro de mi realidad, introduciendo algunas innovaciones didácticas, sin pretensiones mayores.
10d) Puedo promover una reformulación en la institución donde trabajo.
_3e) Las autoridades en mi país reconocen esa necesidad y estarán muy abiertas a mis recomendaciones.

3. Según Paulo Bastos Tigre,[4] "em países em desenvolvimento, onde a capacidade científica para gerar tecnologías é mais limitada e a capacidade e autonomia das empresas para realizar inovações radicais é menor, a demanda constitui o principal estímulo à inovação".

En su país, es la demanda (nacional o internacional) por mayor productividad e mejor cualidad que motiva el interés en el TCTP y las innovaciones propuestas, o más bien seria el "*technology push*" (la propia existencia de nuevas tecnologías y los intereses de sus propietarios y proponentes) en su despliegue?

3_a) La demanda por parte de algunas empresas en mi país por las tecnologías presentadas en el TCTP es muy grande y nunca hubo presión para participar en el TCTP.
__b) Las empresas y el gobierno nacionales fueron persuadidos que podría ser interesante aprovechar la oportunidad, para posiblemente aumentar la productividad.
6_c) Los dos factores ("demand-pull" y "technology push") fueron igualmente importantes en la decisión de enviar participantes nacionales para hacer el curso.
4_d) Mi país quiso aprovechar la oportunidad, aunque no haya percibido su relevancia.
__e) Las autoridades de mi país cedieron a la presión de los japoneses o los brasileños para enviar participantes.

4. La difusión de esas innovaciones en mi país es probable, entre otras razones, porque en este momento se perciben ventanas de oportunidad en el mercado internacional.

7_a) Estoy plenamente de acuerdo.
3_b) Estoy parcialmente de acuerdo.
1_c) No tengo ninguna opinión al respecto.
2_d) En general, no estoy de acuerdo con esa afirmación.
__e) Discuerdo totalmente de esa afirmación.

5. La difusión de esas innovaciones en mi país es probable, entre otras razones, porque hay apoyo empresarial y gubernamental para la formación de redes locales o regionales de innovación ("Os chamados 'arranjos produtivos locais', que reúnem *clusters* de empresas com forte sinergia entre si"[5]).

3_a) Estoy plenamente de acuerdo.
9_b) Estoy parcialmente de acuerdo.
__c) No tengo ninguna opinión al respecto.
1_d) En general, no estoy de acuerdo con esa afirmación.
__e) Discuerdo totalmente de esa afirmación.

[4] Paulo Bastos Tigre, *Gestão da inovação: a economia da tecnologia do Brasil.* Rio de Janeiro, Elsevier, 2006.
[5] Paulo Bastos Tigre, *Gestão da inovação: a economia da tecnologia do Brasil.* Rio de Janeiro, Elsevier, 2006.

6. La difusión de esas innovaciones en mi país es probable, entre otras razones, porque representan el futuro.

8_a) Estoy plenamente de acuerdo.
5_b) Estoy parcialmente de acuerdo.
__c) No tengo ninguna opinión al respecto.
__d) En general, no estoy de acuerdo con esa afirmación.
__e) Discuerdo totalmente de esa afirmación.

7. La difusión de esas innovaciones en mi país es improbable, entre otras razones, porque son muy difíciles de ser entendidas y usadas.

1_a) Estoy plenamente de acuerdo.
2_b) Estoy parcialmente de acuerdo.
__c) No tengo ninguna opinión al respecto.
5_d) En general, no estoy de acuerdo con esa afirmación.
5_e) Discuerdo totalmente de esa afirmación.

8. La difusión de esas innovaciones en mi país es improbable, entre otras razones, porque son muy caras.

1_a) Estoy plenamente de acuerdo.
7_b) Estoy parcialmente de acuerdo.
__c) No tengo ninguna opinión al respecto.
5_d) En general, no estoy de acuerdo con esa afirmación.
__e) Discuerdo totalmente de esa afirmación.

9. La difusión de esas innovaciones en mi país es posible solamente en las empresas multinacionales.

1_a) Estoy plenamente de acuerdo.
5_b) Estoy parcialmente de acuerdo.
__c) No tengo ninguna opinión al respecto.
4_d) En general, no estoy de acuerdo con esa afirmación.
3_e) Discuerdo totalmente de esa afirmación.

10. La difusión de esas innovaciones en las empresas nacionales en mi país es improbable, entre otras razones, porque no hay flexibilidad en las empresas que las podrían adoptar.

__a) Estoy plenamente de acuerdo.
4_b) Estoy parcialmente de acuerdo.
2_c) No tengo ninguna opinión al respecto.
5_d) En general, no estoy de acuerdo con esa afirmación.
2_e) Discuerdo totalmente de esa afirmación.

11. La posibilidad de ofrecer capacitación en el uso de esas innovaciones en mi país es pequeña, entre otras razones, porque los equipamientos necesarios para la enseñanza son muy caras.

3_a) Estoy plenamente de acuerdo.

5_b) Estoy parcialmente de acuerdo.
__c) No tengo ninguna opinión al respecto.
4_d) En general, no estoy de acuerdo con esa afirmación.
1_e) Discuerdo totalmente de esa afirmación.

12. La posibilidad de ofrecer capacitación en el uso de esas innovaciones en los diferentes países de la región existe, entre otras razones, desde que ella puede ser realizada en ambiente virtual.

4_a) Estoy plenamente de acuerdo.
6_b) Estoy parcialmente de acuerdo.
__c) No tengo ninguna opinión al respecto.
3_d) En general, no estoy de acuerdo con esa afirmación.
__e) Discuerdo totalmente de esa afirmación.

13. La posibilidad de ofrecer capacitación en el uso de esas innovaciones en mi país existe, entre otras razones, porque hay buena voluntad y capacidad en por lo menos una universidad o centro de investigación.

9_a) Estoy plenamente de acuerdo.
4_b) Estoy parcialmente de acuerdo.
__c) No tengo ninguna opinión al respecto.
__d) En general, no estoy de acuerdo con esa afirmación.
__e) Discuerdo totalmente de esa afirmación.

Annex 3

Employment of the DAC (Development Assistance Committee) Criteria in the Intermediate Evaluation of the Third Country Training Program (TCTP),

International Course on Systems of Manufacturing Automation

Japan International Cooperation Agency / National Service of Industrial Learning (JICA/SENAI)

Robert K. Walker, Consultant Evaluator

Introduction

In December 1996, Brazil and Japan signed a letter of agreement establishing a Third Country Training Program (TCTP), with the aim of disseminating advanced technology in manufacturing automation in Latin America, via their respective cooperation agencies: ABC (Agência Brasileira de Cooperação) and JICA (Japan International Cooperation Agency). The coordinating agency is the national office of the National Service of Industrial Learning (SENAI), through its Networking Agency for National and International Cooperation (GEART); the executing agency is the SENAI Center for Manufacturing Automation in the state of São Paulo, located at the Armando de Arruda Pereira SENAI School in São Caetano – SP, situated in greater São Paulo.

The first five year project was from 1997 to 2001. After a one year interval, the second five year project commenced. This intermediate evaluation covers the first four years of this current project, from 2003 to 2006. Each June and July, a six week training program was held in São Caetano, with thirteen participants from different Spanish speaking countries of Latin America and the Caribbean. The instructors are regular SENAI staff.

This evaluation was conducted between mid July and early October, 2006. Taken as a basis of comparison were the five criteria of the Development Assistance Committee (DAC), also adopted by JICA: effectiveness, relevance, sustainability, efficiency and impact. Further details are provided in the Methodological Appendix. Obs.: the final version of this intermediate evaluation report will be concluded after receipt from the executing agency of the report on the 2006 training program (expected in early October).

Evaluation Results

1. Effectiveness

The objectives of the TCTP are as follows.

Overall objective: To train mechanical engineers in advanced technologies employed in the automation of production of manufactured goods, as well as to promote greater technical and cultural integration among the participating countries.

Specific objectives:

2. To design products utilizing resources of graphic communication (CAD) at engineering stations, going on to generate the respective milling (CAM) programs and sending them to CNC [computerized numerical control] machines (via DNC) [direct or distributed numerical control].

3. To program and operate CNC machines and flexible manufacturing systems (FNS).
4. To program and operate welding and manipulation robots with visual systems.
5. To integrate automatic manufacturing systems.

The courses and respective laboratories seem to roughly correspond to the specific objectives, as follows:

I. Computerized Numerical Control (CNC) – 80 hours – (objectives 1 and 2) – module 2.
II. Flexible Manufacturing Systems (FMS) – 32 hours – (objectives 2 and 4) – module 3.
III. Computer Assisted Design, Manufacturing, Engineering and Testing (CAD/CAM/CAE/CAT) – 80 hours – (objectives 1 and 4) – module 1.
IV. Robotics – 40 hours – (objective 3) – module 4.

Module 3, FMS, was actually the last one taught (overlapping with or following Module 4, Robotics).

Average achievement in the four annual events to date was as follows:

Table 1
Mean Final Evaluation of Student Achievement
International Course on Systems of Manufacturing Automation

	N	CNC	FMS	Robotics	CAD/CAM/ CAE/CAT	Mean
2003	13	83.07	97.30	100.00	91.92	93.07
2004	13	80.23	88.46	81.65	82.77	83.28
2005	13	82.85	87.31	97.00	93.31	90.12
2006	13	79.00	91.90	98.30	85.50	88.80
Mean	13	81.29	91.24	94.24	88.45	88.82

Note that in 2004, the five Bolivian participants had four of the five lowest overall scores: 66.75, 67.13, 70.00, 78.38 and 86.88, contributing to the low mean that year.

Each year, the thirteen participants rated the curriculum on each of five items. The scale presented went from 0 (very bad) to 5 (excellent); in practice, no ratings from 0 to 2 were attributed. The results for the four years are shown in Tables 2 and 3, below. Since the extreme ratings turned out to be "excellent" and "satisfactory," and there were no missing data, it was not necessary to show the frequency of the intermediate "good" response. These two tables clearly show the improvement in ratings from 2003 to 2005 (increasing frequency of "excellent" and decreasing frequency of "satisfactory"), and the decline in 2006.

Table 2
Student Evaluation of Aspects of the Curriculum
International Course on Systems of Manufacturing Automation

Number of Participants (out of 13) Rating the Item "Excellent" (rating 5)

	2003	2004	2005	2006
Topics covered	3	6	8	5
Technical visits made	5	7	10	7
Program structure	5	7	11	3
Compliance with the program	4	8	9	5
Practical application in your work	1	8	7	3

Table 3
Student Evaluation of Aspects of the Curriculum
International Course on Systems of Manufacturing Automation

Number of Participants (out of 13) Rating the Item Just "Satisfactory" (rating 3)

	2003	2004	2005	2006
Topics covered	2	0	0	4
Technical visits made	3	0	1	5
Program structure	2	0	0	9
Compliance with the program	2	0	1	5
Practical application in your work	4	2	1	8

The number of participants rating the technical visits "excellent" doubled between 2003 and 2005, from five to ten, then fell to seven in 2006. Each year, one automobile manufacturer was visited (respectively GM do Brasil, Volkswagen do Brasil and Daimler Chrysler do Brasil; the later plant assembles buses and trucks). In addition, one other plant was visited each year. All reportedly are highly automated. It is not known what factors account for the improved ratings on this item after 2003.

The items, "topics covered," "program structure" and "compliance with the program" all show steady improvement from 2003 to 2005, then a moderate decline in 2006. Although one cannot rule out the possibility of differences in actual time allotments, the reported percentages of the three types of activity are identical in all four years: 65% theory, 31% practice and 4% visits. One marked difference relates to participant evaluations of the time allotted to drawing up the work plan: while three respondents rated it "excellent" in each of the four years, six rated it merely "satisfactory" in 2003; the number rating it "good" rose from four in 2003 to ten in 2004 and 2005 and eight in 2006. Four 2003 participants rated the time allotted to content also as merely "satisfactory"; none gave that rating in

2004 or 2005, but five did so in 2006. Perhaps the best explanation for these differences is simply a more pessimistic or critical response set in the first group.

SENAI offered courses in Pedagogy for Middle School (March-December 2003, 540 hours), Competency Development and Teaching Methodology (just one day in October 2004) and Methodology and Didactics in Professional Education (just two days in January 2006). Of the seven TCTP instructors, six took the two short courses, but just two took the 540 hour course. These courses may have helped improve teaching, leading to improved ratings.

The main pieces of equipment were the same from 2003 to 2006: Mazak machining center and CNC turning center, Mazak FMS system, Catia V5 for CAD/CAM/CAE/CAT, Yaskawa cooperative robot cell, and Mazak CNC simulator – off line robot simulator (workspace). Modern audiovisual equipment is also available. The classroom space, library facilities and administrative structure are more than adequate. There is very little overlap among the teaching materials reportedly to have been acquired by the participants in the different years.

2. Relevance

The most striking difference seen in Tables 2 and 3, above, is in the item, "practical application in your work," with "excellent" ratings rising from 1 to 8, and merely "satisfactory" ratings falling from 4 to 2, between 2003 and 2004. With five Bolivians in 2004, vs. just two in 2003, one might have expected the opposite. Furthermore, there were two Argentineans and three Mexicans in 2003, and no participants of either nationality in 2004. Considering that these are the two most advanced countries in industrial automation in Latin America (alongside Brazil), one might have expected the ratings on this item to have been higher that year. Obs.: in 2006, "excellent" ratings fell to 3, while merely "satisfactory" ratings rose to 8.

In general, the possibility of intentional, positive impact depends on the prior or concurrent existence of needs. Abbad, Freitas and Pilati (2006) state that "Training needs are descriptions of gaps in competencies or repertories of knowledge, abilities and attitudes (KAA) at work." The Record of Discussions between the Japan International Cooperation Agency, the Brazilian Cooperation Agency and the Serviço Nacional de Aprendizagem Industrial, Regional Department of São Paulo, on the Third Country Training Program specifies the course purpose and objectives, but does not make reference to any prior needs assessment. Therefore, we feel impelled to begin this chapter with a retrospective analysis of the situation.

Abbad, Freitas and Pilati (2006) point out that "Analysis of contextual factors is very important to the success of TD&E [Training, Development and Education]. Nevertheless, there are few Brazilian or foreign studies dealing directly with this matter." In addition to needs related to current activities and work, the authors identify two other kinds of situations:

- changes provoked by factors external to the organization;
- internal changes made within the organization.

These seem to be related to first of three "perspectives on context analysis," which the authors call "opportunity-restriction." This is related to the "internal and external environment":

They are external stimuli for the development of new KAA's for the doing new jobs which, depending on the situation, may be experienced as difficulties or threats to people's professional lives. They are factors related to technological, social, economic, demographic, ecological and other kinds of change, and which serve as stimuli to or constraints on performance, learning and the transfer of new learning to the workplace.

A typical example of changes in the external environment leading to new opportunities and constraints relates to "the phenomena of globalization and internationalization of the economy." Broadening horizons opens up new perspectives:

Another characteristic of traditional TD&E needs assessment is the clinical vision of diagnosis rather than prognosis or prospection. A vision of context as opportunity or as a factor engendering conditions for stimulating the development of new competencies requires the adoption of strategies of prospective assessment of future scenarios surrounding the organization and its environments. The diagnostic vision is one possibility for needs assessment, but it is not the only one, nor is it the most relevant nowadays.

Has the course contributed, or does it have the potential to contribute, to "endogenous development" in each country of origin, within a context of globalization? Vásquez Barquero (2006) points out that "It is the high technology industrial activities (such as microelectronics, biotechnology, robotics or the aerospace industry), and also those manufacturing activities which, in the fifties and sixties, were characterized by standardized production, and which have since restructured and diversified production through introduction of innovations…, that have shaped the productive system in the most dynamic cities and urban regions." Production in such cities and urban regions is mostly export-oriented, mainly to dynamic world markets outside developing countries such as those found in Latin America and the Caribbean.

The 2005 course had participants from nine Latin American countries. Other countries with participants just one year between 2003 and 2006 were Argentina and Cuba. These countries vary widely in terms of "quality of exports." We may take the position index (percent of exports in dynamic sectors divided by percent of exports in stagnant sectors) by period (CEPAL, 2002c, Table III.4), both in the markets of the world and in those of the developing counties of the Americas, as a point of reference. The data are derived from the 2001 Competitive Analysis of Nations. The figures are as follows:

Table 4

Quality of Exports (Ratio of Dynamic to Stagnant Sector) Position Index in the Nineties, Countries of Origin of Participants, JICA TCTP 2003-2006						
	World Market			**Developing Countries of the Americas Market**		
	1990-93	**1993-96**	**1996-99**	**1990-93**	**1993-96**	**1996-99**
Argentina	.39	.63	.27	.46	.71	.50
Bolivia	.18	.40	.12	.12	.68	.75
Colombia	.27	.58	.19	.70	1.11	.70
Costa Rica	1.84	.38	.63	1.46	1.16	1.57
Cuba	.23	.50	.15	1.02	1.38	.89
Ecuador	1.05	.11	.10	.14	.31	.17
Mexico	1.19	.89	1.99	.51	.84	.68
Panama	.89	.18	.30	1.63	.68	.84
Paraguay	.18	1.49	.14	1.51	1.21	.52
Peru	.33	.72	.15	.32	.55	.65
Venezuela	.05	.18	.06	.25	.56	.22

An index value greater than one means that more of the country's exports go to dynamic markets than to stagnant markets. For example, in 1996-99, Mexico exported almost twice as much to world dynamic markets (mostly in the U.S.) as to world stagnant markets; within the developing countries of the Americas, however, its exports went more to stagnant markets than to dynamic markets in that same period. The figures for exports to the world market from Costa Rica, Ecuador, Panama, Paraguay and Peru are highly volatile.

Except for Mexico, all figures on exports to world markets show minimal to moderate participation in dynamic markets in 1996-99. The participation of dynamic sector exports to the developing countries of the Americas market in that same period was moderate for all the countries except Ecuador and Venezuela, which had low relative participation, and Costa Rica, the relative participation of which was consistently high in that market.

Venezuela's very low relative participation in dynamic markets reflects its heavy reliance on oil exports: 80.1% of all its exports to world markets in 1990 were energy-related. To some extent, Bolivia's low relative participation reflects a similar phenomenon – a wealth of subterranean natural resources: in 1990, 24.6% of its exports to world market were energy-related and 28.2% mineral. On the other hand, Venezuela did have 1.4% (US$247,312,000) of its exports included in the category of "engaged in diffusion of technical progress," while Bolivia's exports in that category did not reach 0.1% (US$67,000).

The document cited above (CEPAL, 2002c) concludes that "Analysis in accordance with the CAN program reveals that in Latin America … export success is restricted to a few countries: Mexico, Central America, Argentina and Colombia." Here, Central America is represented by Costa Rica and Panama.

Fifteen of the twenty biggest exporting firms in Latin America in 2000 were incorporated in Mexico (eleven were foreign owned, one was government owned and four were privately owned local companies). In Mexico, "An estimated 6,000 partly or wholly foreign-owned companies (40% *maquila* enterprises) undertook investments in the year 2000, with two thirds of the total coming from the United States and 80% directed towards manufacturing and telecommunications (CEPAL, 2002b). Characteristic of the "maquila" companies is the localization of their plants mainly near the U.S. border, their transformation of imported parts into products for export, and the concentration of their exports in the U.S. market.

Labarca (1999b) points out that maquila enterprises play an important role in industry in the Caribbean and Central America, as well as in Mexico. Throughout the entire region of Latin America and the Caribbean, they employ between one third and one half of the industrial labor force. "There are two main forms of maquila: the traditional, generally in food products and clothing and with very little value added, and one that is more recent, in electronics and the automobile industry." The TCTP is of relevance mainly to the second type: In it, "even when simple operations are still performed, it evidences more technological complexity and demands higher levels of basic worker education, not only for work discipline but also because of the need for certain basic knowledge. Furthermore, in these, training and capacity building processes are important."

To be sure, the maquila companies do form a part of "international systems of integrated production (ISIP)." As pointed out in CEPAL 2002a), "The great advantage of the ISIP lies… in that it provides economies of scale; but its cost for the countries of the region is represented by the fact that efforts to adapt products and processes to the local milieu are eliminated, in favor of the "commoditization" of goods and services."

Major multinational industrial firms are the principal other potential users of manpower with the kinds of competencies the TCTP attempts to develop, although they may prefer to train their own technical

personnel by themselves, or jointly with other institutions in the region.[6] Electronic and automotive companies are the main candidates; of these, automobile manufacturers would be the most likely to employ personnel with advanced competencies in these areas. In Latin America, automobile manufacturers are concentrated in Brazil, Argentina, Mexico, Colombia and Venezuela.

Recently, automobile company managers have argued that quality standards and productivity must be increased to globally competitive levels in order to meet the challenges posed by liberalization. As a result, firms and state elites have sought reforms in labor laws and work rules that would permit the introduction of team concepts, pay-by-knowledge compensation, and other practices associated with the Japanese, or "lean," model of production.

With reference to Mexico, Labarca (1999a) points out that

The processes of economic liberalization [“openness”] have made it necessary to improve the quality of production – which has generated a true change of work habits and new systems of control. These have been configuring a new culture in the activities of the companies. Training activities have been demanded that would support the transition to new forms of work and the required quality of operations.

Sharpe (1998) notes that

The automobile industry has led Mexico's transformation from a highly protected economy based on import substitution to a moderately successful export-led economy. However, in spite of the dramatic changes in this sector and its growing importance to the overall health of the Mexican economy, the automotive industry illustrates the considerable limits to converting Mexico into an export base for advanced industrial products. While the industry has been transformed from a backwater of U.S. transnational operations to an integral part of a revived North American car complex, it has yet to expand beyond the confines of the northern half of the Western hemisphere, and certainly falls far short of broader globalization. Clearly, this is the result of the continuing geographical segmentation of the global car market, or what one study labels "glocalization," as opposed to globalization (Ruigkrok et al. 1991). This process reveals some of the fundamental weaknesses of relying on automobile production to lead the transition to a liberalized (re)industrializing economy.... Essential to the restructuring of the automotive industry in Mexico have been managerial and production innovations intended to introduce greater efficiency and quality by increasing the "flexibility" in the use of labor power and minimizing inventories. Generically these innovations are broadly classified under the rubrics of "post-Fordism" or "flexible specialization," and are contrasted with the rigidities of so-called "Fordist" mass production. [6]

As the industry has restructured, a great effort and significant resources have been dedicated to education and training, which perhaps partially offsets the losses of earning power, worker autonomy, job security, and participation in decision making. Carrillo (1990b) observes that some 50 percent of the workers that inaugurated the Ford assembly plant in Hermosillo spent six months abroad for training. Additionally, a large national survey of technological change in Mexican manufacturing commissioned by the Ministry of Labor confirms that significant resources are being dedicated to education and training in the automotive sector (*Secretaria del Trabajo y Previsión Social*, 1995). The data reported in the study demonstrate extensive training at all levels in the larger plants of the

[6] For an example of a collaborative effort involving several public and private institutions, see the experience of the Training Center in High Technology (Cenaltec), together with Philips, in Juarez, México (Hualde and Lara, 2002). The center’s objective is to “Form technicians capable of developing precision parts in lathes, drills, rectifiers and boring mills. Able to: conduct tasks and fabricate parts in combined operations, interpreting and writing simple CNC (Computerized Numerical Control) programs, and working independently and in a team (internal Cenaltec document).

automobile industry. For instance, the study reports that over 74,000 workers in the automotive industry received training in 1991 (*Secretaría del Trabajo y Previsión Social*, 1995, 531-32).

In spite of extensive training, Carrillo observes that the dramatic increase in education and training of the work force has been accompanied by a general devaluation of skill (1990b, 93). Carrillo argues that the reduction of the number of job categories and levels from about twenty or thirty in the old contracts to about six to ten in the new contracts has created a situation in which previously highly ranked skill levels have been ranked much lower. This "devaluation" of skills is compounded by the tendency of workers in the northern plants to work between 45 and 48 hours in northern plants, compared to about 40 in the center. Additionally, the workers in the northern plants achieve greater levels of productivity. In sum, workers in the north are better trained, paid less, work longer hours, and are more productive, relative to their counterparts in the center. These results, combined with the shift in the balance of installed capacity to the north, have created what Carrillo refers to as the *maquilization* of the automobile industry in Mexico.

The preponderance of the evidence, then, indicates that the Mexican automotive industry is simultaneously an improbable and undesirable model for the national and subregional automotive industries developing in other parts of Latin America. It is improbable because of the special circumstances that prompted Mexico's integration into the North American complex, a process of restructuring that began almost two decades ago and that continues to tie it closely to the North American market. It is an undesirable model because of significant domestic social costs, as well as continuing concerns with balance of automotive trade associated with integration in the North American automotive complex.

Although it has no automobile industry (except for motorcycles), Paraguay is attempting to imitate the Mexican maquila model. Law no. 1064, of 20 December 1996, along with Decree 9585, of 17 July 2000, provides numerous advantages for maquila production. The decree optimistically states “That maquila, by the very nature of its ‘shared production’ operations, inserted in the context of globalization in which Paraguay is immersed, implicitly brings with great integrative capacity at the regional and global levels.”

Could the Mexico-United States relationship (NAFTA) be replicated for Paraguay and Brazil, and perhaps Argentina (Mercosur)? Would this be desirable for all parties concerned? What consequences would such a relationship have for the relevance of the TCTP? According to the General Director of the National Council of Export Maquila Industries, of the Ministry of Industry and Commerce (interview 29 August), Paraguay is still in the first stage of maquila, where the main attraction for foreign companies is the cheap labor and low taxes in the country. A report published in the *Gazeta do Povo*, of Curitiba, 27 August 2006, entitled “Paraguay seduces companies to enter the industrial age,” asks

Why not invest in a country near Brazil, with taxes six times lower, almost insignificant labor and social security contributions, cheap power, broad commercial openness and generous export incentives? This is the question the government of Paraguay has been posing to Brazilian businessmen, many of whom are from Paraná state, since the start of this year when greater weight began to be accorded to REDIEX, which is the abbreviation for Network of Investments and Exports. The advantages offered by our “hermanos” are so numerous that there are those who consider the historical ill repute in which the neighboring country has been held, motivated by the profusion of merchandise of doubtful origin and quality sold on that side of the Friendship Bridge, to be a lesser problem.

With regard to maquila, the report states that

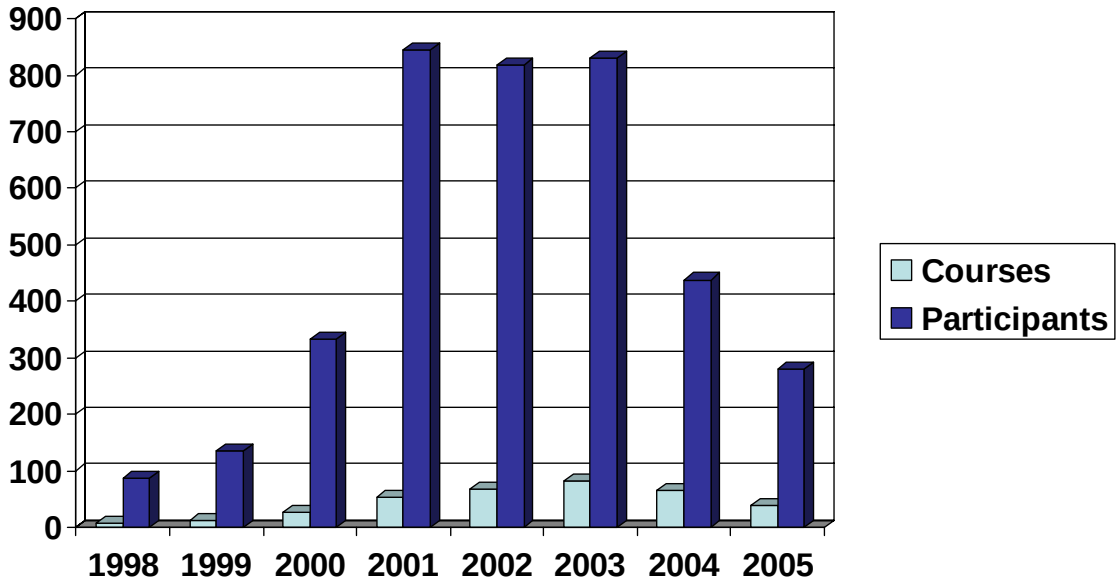
Although their participation in Paraguayan foreign trade is still limited, the maquilas are growing fast: in 2004, exports through this program totaled US$8.9 million. Just in the first half of 2006, they reached US$32.3 million.

The article cites a Brazilian authority who remarks that "This modernization process is one of the most interesting things I have ever seen. One is impressed by the country's growth potential." Among the eight areas of opportunity identified by the Institute of Economic and Social Studies of Paraná (INEESPAR) is that of medical and dental equipment: "Ciudad del Este has an industrial hub specialized in this segment. Companies in the region already export to Brazil, the U.S.A. and Spain through the 'maquila' system." One of these Paraguayan companies uses computerized numerical control (CNC), and is reportedly in need of training in this area (interview with Percy Engel, Paraguay-Brazil Project Coordinator, SENAI-SNPP, Hernandarias, 31 August).

If thirst for knowledge of automation is growing in Paraguay, one would expect this to be reflected in increasing demand for courses in this field. Surprisingly, the number of participants in the Industrial Automation and Control program at the Paraguay-Japan Professional Promotion Service, near Asuncion, peaked in 2001-2003 and declined in 2004-2005 (see Figure 1, below).

Figure 1

Servicio de Promoción Profesional Paraguayo Japonés (SPP-PJ) – San Lorenzo (a regional SNPP school) Courses and Participants, Area of Industrial Automation and Control SPP-PJ, 1998-2005



Source: SNPP.

Why the declining supply and demand in this area at the SPP-PJ? The reasons offered by SNPP personnel were as follows.

- Poor marketing;
- Scheduling problems;
- Can't afford qualified full time professors;
- Equipment becoming rather obsolete;
- Inadequate telecommunications infrastructure.

Saturation of demand on the part of still incipient industries was said not to be a relevant factor.

As for Argentina, two instructors from the National Institute for Educational Technology (INET), of the Ministry of Education, Science and Technology, took the TCTP course in 2003. According to the national center director (telephone interview, 18 September), both are actively applying what they learned and have recently contributed to a series of fifty books in the area. INET has a number of training centers nationwide, with automated equipment worth over one million dollars, and makes extensive use of PLC (programmable logical controllers) in its training programs. The institute's

homepage refers to presence and distance based learning. In the former category, there is a technical-professional trajectory in electromechanical equipment and installations, with the following modular areas: Technology, Design and Assembly, Metal Mechanics, and Operations and Maintenance. Among the modules offered are CNC and CAD/CAM applied to production processes; orientation to electromechanical assembly; and operation, maintenance and assays of electromechanical equipment. INET has a major distance education platform. More than 3,500 students are enrolled in forty distance education courses. Among the on-line courses offered is an introduction to the network of simulated enterprises.

3. Sustainability

Program sustainability is related to issues of economic, social and political relevance. Economically, is the cost-benefit ratio favorable, or is it likely to become so in the future? Are the social impacts such that the program is justified in humanitarian terms (or are they likely to be so in the future)? In view of these factors, is there likely to be continued political support in the donor country (Japan), the (Latin American) recipient countries and the country providing the training service (Brazil)? If the program is seen to be irrelevant or detrimental to the interests of key stakeholders, support may evaporate. Do poor countries really need industrial automation, or is this likely to lead to more unemployment ("jobless growth") and dependency? Is the training likely to stimulate demand for the goods and services provided by the donor or service provider country and help their own industries to be more competitive globally?

To what extent is there a multiplier effect of the training? Most TCTP graduates are professors and instructors, who return to their countries to share what they have learned with their students, and perhaps promote the diffusion of innovations. How can they do this if the equipment needed is too expensive, and there is little continuing support for their efforts?

Even big multinationals are beginning to question the cost-benefit of exclusively presence-based training, with participants coming from different countries around the world or in the region. Blended learning (semi presence-based or "dual," as it is called in Bolivia) is increasingly being seen as an attractive alternative where, for technological and social reasons, some face-to-face encounters are seen to be indispensable. A recent report on the experience of the Shell Companies and their Netherlands-based Learning Center and Shell Open University (Macdonald and Imirzalioglu, 2005) bears an optimistic title: "Blended learning in the workplace: Why is it so good?"

This paper looks at a recently redesigned core Shell training unit "Maintenance Professional Discipline Foundation Course", accredited with Curtin University, that is taught in a blend of web-based activities and a face to face workshop. The learning event is primarily based in the participant's workplace, with new content delivered over the web using the TeleTOP learning environment, and a series of interactive web-based communication tools. The training event culminates in a multi-day workshop at the Learning Centre. The new design has had an immediate impact, with high assessment scores, very positive reactions from participants, and most significantly, some immediate, but unforeseen, positive business impacts.

This highly positive evaluation of the new framework is set against the backdrop of conventional training within the corporation:

Traditionally, training in industry has been based on the workshop model. Novices in the field are brought together in a face-to-face environment, where an expert gives an intensive discourse on the area of knowledge, often supported by detailed training notes. As the participants are being taken out of their jobs, which is an expense to their operating unit, the time taken to present the information is minimised. The expert in the field is typically not trained as an educator, other than a brief "train the trainer" course, and the normal format is lecture followed by some form of group case study activity.

Large amounts of information are provided in a fairly general context, with little opportunity for the participants to reflect on the new information, construct a meaningful understanding, or make connections with their workplace. At the end of the training workshop, the participants return to their operating unit and attempt to relate the new knowledge to their jobs. The most meaningful questions or learning contexts are generated after the workshop has concluded.

This format has not provided the sort of learning outcomes required for use as evidence towards competency development. A Shell employee attending a workshop would fly to the Learning Centre in the Netherlands, or a regional learning hub, and be accommodated in a hotel for the duration of the event (commonly 2 to 5 weeks, but up to 17 weeks). The cost of travel, accommodation, time lost from work, and running the courses within a specialist Learning Centre is large. Meaningful evaluation of learning is difficult, as the intensive delivery model relies on later reflection and application in the workplace for its outcomes, which are typically not well regulated or measured.

The new framework has resulted in instructional improvement:

Similarly, on-line education packages have tended towards more and more sophisticated ways to deliver information. Instructional designers break down the intended curriculum into components and then build independent packages to lead the learner through the knowledge, with regular tests or tasks to ensure progression. Because of the expense required to create multi-media modules engaging enough to sustain interest for any length of time, the packages must be generic enough for general sale.

Discussing the Latin America and Caribbean region as a whole, Labarca (1999b) makes a pertinent observation:

Finally, another factor that makes it difficult to design diversified policies and strategies is the inflexibility of the training organizations. Several factors conspire to reinforce such reluctance to respond to specific demands. In the first place, unawareness of the demand, because the businessmen and workers can't or don't want to formulate it, because they lack the material and human resources to change their training approach and, most importantly, the disconnect between the professors at those institutions and the production process, as well as the divorce between production and curriculum design.

The Economic Commission for Latin America and the Caribbean (CEPAL, 2002a) recommends that "The countries of Latin America and the Caribbean must adopt strategies oriented to the use of ICT to facilitate a broad process of economic development and systemic competitiveness." At present, "The Latin American and Caribbean countries are gradually advancing into the digital age." However, "In contrast to the more developed economies, informatization in Latin America does not yet constitute a decisive determinant of competitiveness – which is mainly due to a lack of scale."

Among the applications of Information and Communication Technology (ICT) is distance learning. The relevance of distance learning for TD&E is discussed by Monteiro de Castro and Vieira Ferreira (2006). Following the Lotus Institute (1996), they refer to the "third generation" of distance learning as "collaborative technologies." One relevant example for our purposes is "A virtual factory teaching system in support of manufacturing education" (Dessouky, et al., 1998). The latter authors point out that "To be successful in this new manufacturing environment, an engineering college graduate must understand the total business process from design to production to delivery in order to develop a holistic view of manufacturing systems…. However, factory experimentation through full-scale on-campus laboratories is an infeasible alternative for engineering programs due to the high expense associated with development and maintenance." Web-Based Training (WBT) employing a virtual factory teaching system, preferably in conjunction with presence-based teaching whenever possible, is an attractive alternative, especially when great distances are involved and funds are limited.

Novick (1999), in her paper on training in innovative companies in Latin America and the Caribbean, points to the "new behavioral and intellectual job profiles, based on ever greater 'intellectualization' of labor (mental representations of work, use of hypothetical-deductive reasoning, hypothesis formation and related decision making, etc.)." Problem Based Learning (PBL) is ideally suited to the pursuit of such objectives. Discussing the Danish experience, Fink (2001) shows how PBL in engineering education has been a catalyst for regional industrial development. Vat (2006) presents a "pedagogical re-orientation perspective" related to integrating industrial software development through scenario-based design of PBL activities. Today, as we have seen, such an approach is greatly facilitated by computer-based instruction, whether presence-based, distance based or a mixture of the two.

4. Efficiency

While SENAI reports capital investment in equipment and software each year, JICA's contribution specifically to the TCTP has been restricted to operating expenditures; SENAI also reports project-related annual operating expenses. Considering thirteen participants per year, operating expenses per participant may also be calculated. Table 5 reports the absolute and per capita annual operating expenditures for this project to date.

Table 5
Current Expenditures by Source, Absolute and Per Capita
International Course on Systems of Manufacturing Automation

Expenditure (Brazilian reals)

	JICA	SENAI	TOTAL
2003 Expenditure	105,682.01	30,204.60	135,866.61
Per capita	8,129.39	2,323.43	10,452.82
2004 Expenditure	105,899.75	31,769.93	137,669.68
Per capita	8,146.13	2,443.84	10,589.98
2005 Expenditure	89,897.49	26,969.25	116,866.74
Per capita	6,915.19	2,074.56	8,989.75
2006 Expenditure	93,382.71	28,014.81	121,397.52
Per capita	7,183.29	2,154.99	9,338.27
Total Expenditure	394,861.96	116,958.59	511,820.55
Per capita	7,593.50	2,249.20	9,842.70

Total current expenditure for the four year period amounts to over US$184,000 or 20,866,393 yen. This is more than US$3,500, or 400,000 yen, per participant. If SENAI capital investment in equipment and software were factored into the equation, the cost per participant would be even higher – not to speak of the opportunity cost of thirteen participants spending six weeks away from work. SENAI reports total TCTP-related investments of R$102,067.59 in 2003, R$1,242,761.30 in 2004, R$341,010.21 in 2005 and R$133,147.03 to date in 2006.

The terminal evaluation report of the previous project shows mounting current expenditures the first four years, from 1997 to 2000. JICA's contribution rose from R$60,631.79 to R$ 102,966.56; that of SENAI went from R$9,312.00 to R$30,067.20 in that same period. As we see, current annual expenditures rose slightly between 2000 and 2003-2004, then leveled off or declined in the course of the second project.

In view of these extremely high per pupil costs, what can be said of pedagogical efficiency? Of the TCTP courses offered in June-July, 2006, the last was Flexible Manufacturing Systems (FMS). This

course gives a broad overview of factory management. Coinciding, as they did, with the evaluator's visit, classes were observed on three different occasions. The SENAI course manual, "Sistema Flexível de Manufatura (FMS)," in Portuguese, was also examined. As the last course offered, FMS does provide an opportunity to apply and consolidate previous learning. On the other hand, such an overview would also seem important at the beginning and, indeed, throughout the entire duration. Discussion of the situation in the participants' countries, and perhaps a PBL approach, would seem particularly useful here.

In the TCTP, the FMS course had a "theoretical" part, followed by practical exercises. The theoretical part consisted of quite informative lectures, accompanied by PowerPoint presentations. Occasionally, participants were observed to raise their hands to request clarification, sometimes about Portuguese expressions.[7] According to the participants, the "practical" part consisted of a demonstration, by the instructor, of certain procedures using the FMS equipment available, followed by some hands on student applications the last day of class. At no time were the participants asked to discuss the situation in their own countries or attempt to resolve real life problems.

The Terminal Evaluation Report on the first five-year TCTP program (Tsuzuki, 2001) recommended "To introduce distance learning to allow all the fellows to acquire basic knowledge before actually beginning the course of study, and as an instrument for classifying the fellowship candidates." Such an approach might open up two options: provide opportunities for recycling those whose performance on the entry test[8] is inadequate (formative evaluation to help candidates reach the minimal acceptable levels for the courses in São Caetano) and, as a last resort, rejection of those who do not meet such levels. At the very least, materials such as the FMS manual (translated into Spanish!) could be sent well in advance to the candidates who are signed up or selected. We were informed that implementation of the above recommendation had been considered impossible, because some governments nominate candidates for participation at the last minute. While this may sometimes be unavoidable (e.g., when unforeseen circumstances necessitate replacement), in most case it should be possible to enforce application deadlines.

As we have seen, modern distance learning need not be restricted to imparting basic knowledge. Given that all the TCTP courses are grounded in ICT, simulations are quite feasible, along the lines described above. Of course the opportunity for hands on applications at a facility such as the Armando de Arruda Pereira SENAI School, as well as for visits to nearby factories, should by all means be seized as much as possible (especially if the basic information has already been conveyed at a distance). Virtual learning environments in distance education would seem to be most appropriate as a follow-up to the presence-based course and an instrumentality for reinforcing the lessons to be taught by former TCTP participants in their own countries (see discussion below).

The responses to a 13-item questionnaire administered in São Caetano on July 23 may help to illuminate this issue. Among the thirteen participants in 2006, all agreed with the following affirmation, either fully (9) or partially (4): "The possibility of offering training in the use of these innovations in my country exists, among other reasons, because there is good will and capacity in at least one university or research center."

Despite this optimism, there was a wide variety of opinions regarding the following affirmation: "There is little possibility of offering training in the use of these innovations in my country, among other reasons, because the equipment required for teaching is very expensive." Three respondents (two

[7] Although Portuguese was the language of instruction, the instructor made an effort to explain some things in Spanish; understanding the lectures did not seem to be a problem for the most part, at least by the participants' sixth week in Brazil.

[8] A ten-item pretest on Manufacturing Automation was given in the FMS course, consisting of seven multiple choice items and three short answer questions.

Bolivians and one Colombian) were fully in agreement and five (another Colombian, two Ecuadorians, a Peruvian and a Costa Rican) were partially in agreement with this affirmation; the other five disagreed partially or totally.

Ten (4 totally and 6 partially) agreed that there is a way out of this dilemma: "The possibility of offering training in the use of these innovations in the different countries of the region exists, among other reasons, because it can be offered in a virtual environment." In the interviews held after the questionnaires had been filled out, some of the respondents (among those who agreed as well as those who disagreed) remarked that such training should be *partially* virtual. A similar opinion was voiced by some of the administrators at the São Paulo regional office of SENAI, who pointed out that not all the training could be provided at a distance.

5. Impact

In the best of circumstances, how big an impact could the TCTP course have on the participants' countries of origin? Vásquez Barquero (2006) does mention the importance of "learning on the part of the actors," which "improves the results of their decisions," and of the "express and tacit transmission of knowledge within the productive and institutional fabric," which "improves the quality of the resources, makes the productive processes more efficient and makes the enterprises more competitive." However, these are just two of the elements that comprise the "H factor," which "is a factor of complex efficiency that is produced as a consequence of the joint economies that generate all the factors that determine capital accumulation, as the process of growth and structural change of the local and regional economy occurs." Other essential components of the H factor include "the proper functioning of the network and the interaction of actors and institutions"; "the availability of institutions to meet the needs and demands of the economic, political and institutional agents and actors"; and "local development policy."

In an attempt to prod the participants to react to some of the constraints reported in the literature, preludes were placed before the first three items of the questionnaire, as follows.

1. "Between 1970 and 2000 in Latin America, the relative productivity of industries with productive factors intensive in metal-mechanics fell by half, vis à vis American industry – from ca. 32 to ca. 16. Only in Brazil was the relative weight of the metal-mechanical / automotive sector in the manufacturing product high and growing in the period (from 28.7 to 31.5). In our region, 'the economic activities closest to the static comparative advantages, based on natural resources and poorly qualified manpower, tend to incorporate more technological progress and, relatively speaking, to close to a greater degree the gap in worker productivity.'[9] Exports from our countries (except Mexico) to the global market go much more to stagnant than to dynamic markets."[10] "Considering this reality, do you consider a course of study with the characteristics of the TCTP valid for participants from your country?"

Nine responded that it is of immediate relevance, "because what we are learning can be applied right away, in the present context"; another three responded that "It is relevant for the country, but only for application in the long term." One Bolivian responded that "It is of some relevance to the country, in order to become aware of what is happening in a globalized world."

[9] Mario Cimoli y Jorge Katz, "Reformas estructurales y brechas tecnológicas". IN Ocampo, José Antonio, ed., *El desarrollo económico en los albores del siglo XXI*. Bogotá, ONU/CEPAL/Alfaomega, 2004.
[10] CEPAL (2002c). *Panorama de la inserción internacional de América Latina y el Caribe*. Santiago, Naciones Unidas.

2. "According to Carlota Pérez,[11] 'technology should be at the center, not on the periphery, of development policy… a complete reformulation is required, both of educational and training systems and of science and technology policy.' " "As a result of the TCTP, do you consider yourself capable of contributing to a reformulation of education or technological training in your country?"

Ten of the respondents marked the alternative, "I can promote a reformulation at the institution where I work," while three others (from Panama, Paraguay and Colombia) agreed that "The authorities in my country recognize this need and will be very open to my recommendations."

3. "According to Paulo Bastos Tigre,[12] 'in the developing countries, where the scientific capability to generate technology is more limited and the companies' capacity and autonomy to carry out radical innovations is smaller, demand constitutes the principal stimulus to innovation.' " "In your country, is it demand (whether domestic or international) for greater productivity and better quality that motivates the interest in the TCTP and the innovations proposed, or might it be "*technology push*" (the very existence of new technologies and the proprietors' and proponents' interest in their deployment)?"

Three of the participants (two from Peru and one from Venezuela) marked the alternative, "Demand on the part of certain companies in my country for the technologies presented in the TCTP is very great, and there was never any pressure to participate in the TCTP." On the other hand, the three Colombians and one Ecuadorian agreed that "My country wanted to take advantage of the opportunity, even though it may not have perceived its relevance." The other six participants agreed that "The two factors ('demand-pull' and 'technology-push') were equally important in the decision to send participants from my country to take the course."

In the long range, all the participants were generally optimistic. Eight were fully in agreement, and 5 partially in agreement, with the following affirmation: "The diffusion of these innovations in my country is probable, among other reasons, because they represent the future." However, opinions were divided on the supporting arguments and their implications.

Regarding the affirmation, "The diffusion of these innovations in my country is probable, among other reasons, because at this moment windows of opportunity may be perceived in the international market," 7 participants were fully in agreement and 3, partially. One each from Bolivia and Colombia were generally not in agreement with this affirmation, and the Venezuelan had no opinion in this regard.

Regarding the affirmation, "The diffusion of these innovations in my country is probable, among other reasons, because there is corporate and governmental support for the formation of local or regional innovation networks (the so-called 'local productive arrangements,' which bring together clusters of companies with strong synergy among themselves),[13] the proportions among those in agreement were inverted: 3 fully and 9 partly in agreement. One of the Ecuadorians disagreed in general.

The distribution of responses to the other questions was as follows (see Table 6, below). Disagreement with the respective affirmation implies that the respondent does not find the diffusion of the innovations to be improbable (or, with respect to the last question, restricted to multinationals).

[11] Carlota Pérez, "Cambio tecnológico y oportunidades de desarrollo como blanco móvil". IN Ocampo, José Antonio, ed., *El desarrollo económico en los albores del siglo XXI*. Bogotá, ONU/CEPAL/Alfaomega, 2004.
[12] Paulo Bastos Tigre, *Gestão da inovação: a economia da tecnologia do Brasil*. Rio de Janeiro, Elsevier, 2006.
[13] Paulo Bastos Tigre, *Gestão da inovação: a economia da tecnologia do Brasil*. Rio de Janeiro, Elsevier, 2006.

Table 6 Responses to Questions regarding the Reasons for the Improbability of the Diffusion of these Innovations					
	Response				
	Fully agree	**Partly agree**	**No opinion**	**Partly disagree**	**Fully disagree**
Hard to understand and use.	1	2	0	5	5
Expensive.	1	7	0	5	0
Companies inflexible.	0	4	2	5	2
Only multinationals.	1	5	0	4	3

Recomendations and Comments

4. Adopt a blended learning (semi-presence based) approach to the next five year TCTP project. Ensure that all participants arrive in São Caetano having mastered the essential contents in each subject matter, so that most of the time at the Armando de Arruda Pereira SENAI School can be devoted to hands on practical learning and more time can be devoted to visits to nearby factories.
5. Promote continuing education, transfer of learning and support for professional technological instruction throughout the region through program-related distance education courses in Spanish for former TCTP participants (most of whom are professors or instructors), their students and others. Promote the goal of greater technical and cultural integration among the participating countries through on line discussion (chats) and collaboration.
6. Work toward increasingly sophisticated blended learning approaches, in an isomorphic relationship with the manufacturing technology itself. Simulation of flexible manufacturing systems, virtual factories and "representation" (as INET, in Argentina, refers to it) are possible models.
7. Develop the next five year project within the context of Mercosur, centered around the Triple Frontier (Brazil, Argentina and Paraguay). The respective national industrial training organizations, SENAI, INET and SNPP, would be the logical partners. The SENAI-SNPP facility in Hernandarias, near Ciudad del Este, although at present only a junior technical school, might be a good focal point, and might eventually function as a source of Spanish speaking distance education tutors, working under the supervision of SENAI and INET experts. The SNPP regional center in San Lorenzo, near Asuncion (the Paraguay-Japan school), can contribute its experience in using National Instruments system control hardware and software in instruction. Both SENAI and INET have relevant experience in distance education. A pilot project, perhaps restricted to these three countries or focusing on preparation for the course in São Caetano in June and July, may already be feasible in 2007.

Comments: Telecommunications limitations in Paraguay may make it impracticable to locate the hub of the distance education network in that country. A facility is required with advanced hardware and software, and the internet connection should be directly to the "backbone." On the other hand, it will

be important to have technically qualified but affordable Spanish speaking operational and subject matter tutors on line most of the day, backed up by specialists in each subject, in distance education and in computer science and simulation. One possible location might be the SENAI facilities in Maringá, near Foz de Iguaçu, Paraná – well within commuting distance from nearby cities in Paraguay and Argentina.

Conclusion

"Man's reach must exceed his grasp, else what's a heaven for?" wrote English poet Robert Browning. Even in the least developed countries in the region, there is a demand for knowledge of manufacturing automation. Several of the 2006 course participants expressed the conviction that the Bolivians, for example, should not be excluded; the two participants from that nation argued for the relevance of the program to their country. Many in Paraguay are currently avid for advancement in this area,[14] even for application in "maquila" industries, which are seen as an alternative to the prevailing image of falsification and smuggling characteristic of that country. Distance education could make high quality continuing education in the automation area available to Spanish speakers worldwide, at a relatively low per pupil cost. Blended learning (semi presence-based) approaches, with regional presence-based instruction in São Caetano and national or local presence-based instruction at the various universities and institutes with which the former participants are affiliated, and ideally with practical application in the workplace, is an attractive alternative.

Another equity concern has to do with the phenomenon of "jobless growth." It is always possible that automation, albeit a requirement for survival in the global marketplace, may put workers out of a job, or not open up many new jobs. This is of special concern in a region with high and growing rates of unemployment, especially among young people. Only enlightened worldwide policies will enable mankind to collectively reap the fruits of the escape from drudgery, without subjecting anyone to undue hardship.

Perhaps the most important conclusion is that teaching and learning should be isomorphic with the sophistication and liberating potential of the new manufacturing technologies. Bringing participants together from many countries to acquire valuable experience with new technologies is one thing; having them sit in rows to listen to lectures in a foreign language is quite another. While there has always been an effort on the part of the TCTP executing agency to distribute class time between "theory" and "practice," there is certainly room for improvement in this regard. No matter what the blend between presence- and distance-based learning may be, modern information and communication technologies open up exciting new possibilities for learning and application.

The International Course on Systems of Manufacturing Automation offers a balanced curriculum difficult to match in other countries in the region. In particular, Flexible Manufacturing Systems (FMS), now taught in the sixth and final week (often with less than five full class days), could provide a systemic context for all the other, more specific disciplines. Applying the "spiral curriculum" concept, participants could alternate between integration (through FMS) and differentiation (through the other "segments" of the curriculum), as they simulate the application of a variety of tools to solve real or realistic problems. SENAI's experience with distance education courses for Brazilians, including one in mechatronics, opens up new possibilities for the International Course on Systems of Manufacturing Automation, but needs to be upgraded and adapted to this purpose.

At the same time, neighboring Spanish speaking countries have much to contribute to a more comprehensive future TCTP project. Argentina is well advanced in the subject matter area and in distance and presence-based technologies, while Paraguay offers the enthusiasm of the beginner. Furthermore, while the use of Portuguese seems not to have been much of a problem in presence-based learning, any distance education directed at Spanish speakers will obviously have to be conducted in the Spanish language. Perhaps Mercosur would be a suitable institutional context for a new project.

[14] The decline in recent years in demand for the factory automation course in San Lorenzo, Paraguay, seems to be mainly related to poor marketing on the part of the regional training facility, as well as to the fact that its equipment is somewhat outdated.

Annex 4

Methodological Appendix

This evaluation applies the evaluation criteria of the Development Assistance Committee (DAC): effectiveness, relevance, sustainability, efficiency and impact, for a well-rounded evaluation report. Except for effectiveness (accomplishment of the specific objectives), these criteria require a broad view of the region and of the technological alternatives available. Thus, in addition to gathering data in São Caetano through questionnaires, semi-structured interviews and observation, and to reviewing project documents, the evaluator drew upon global and regional information sources. Relevant literature was consulted and internet searches conducted. A visit to several sites in Paraguay, including the JICA offices, was undertaken, in the company of a participant in the 2006 TCTP course and SNPP employee, Marcos Ruiz Dias Alfonso. Telephone calls were placed to former participants and their supervisors. The period of the evaluation, July-October 2006, coincided with the International Conference on Distance Education in Rio de Janeiro, where the evaluator presented a paper on a related topic; much information of relevance to the evaluation was gathered on that occasion, especially in conversations with Ian MacDonald, primary author of the paper on blended learning at Shell cited above.

Annex 5

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