

行政院所屬機關因公出國人員出國報告書
(出國類別：會議)

「生產力推動者之綠色生產力進階研討會 (Advanced
Workshop on Green Productivity for productivity facilitators)」
出國報告

出國人：陳良棟技正
出國地點：菲律賓馬尼拉
出國日期：91年5月26日至6月1日
報告日期：91年8月1日

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壹、目的

綠色生產力是一種觀念，它源自於永續發展的兩大主力 - 「生產力的持續提升」和「環境資源的有效保護」。綠色生產力同時也是一種策略，藉著正確的、妥當的環境措施達到提昇生產效率。要落實此一策略，必須慎重選擇和使用適當的科學工程技術，以及可靠、成熟的管理工具，以求產出高品質、符合環境要求的產品和服務。

為了協助產業節省環境成本，提昇環境績效，經濟部工業局二十年來結合產官學研各界，相繼推動一系列先進環保觀念和做法，包括污染控制、工業減廢、工業安全、清潔生產、環境管理系統、職業安全衛生管理系統、工安環保之中心衛星工廠輔導及整合性環安衛輔導等，綠色生產力的推廣輔導自 2001 年起，配合亞洲生產力組織的推廣活動及國際經驗交流，將我國已執行多年的工安環保改善工作，整合成促進生產力之綠色生產力，並將我國推廣成效介紹給其他國家，建立綠色生產力示範工廠，組織國際綠色生產力協會，辦理綠色生產力訓練，邀請其他國家人員至我國觀摩訓練等，使我國盡到國際社會成員的責任。

本人於 91 年度起承辦經濟部工業局「綠色生產力推廣與國際交流計畫」，負責促進及推廣我國綠色生產力相關活動，極需對綠色生產力有更深入的了解，更企盼能多認識其他國家此一領域的推動人員，以便可以順利推動國際合作交流工作。

此次亞洲生產力組織在菲律賓馬尼拉辦理「生產力促進者之綠色生產力進階研討會」，本人獲經濟部工業局及亞洲生產力組織中華民國理事辦公處的推薦，代表我國參加此次研討會，對於綠色生產力的本質及做法，得以有更深一層的認識，並能夠認識此一領域其他亞洲地區國家的人員，對於日後推動綠色生產力及促進綠色生產力國際交流，將有很大的幫助。

貳、過程

本次研討會自 5 月 26 日赴菲律賓至 6 月 1 日返回台北，共一週時間，實際課程為 5 天，包括課堂講授、分組討論、上台報告、工廠觀摩，以觀摩工廠為例，製作綠色生產力實施計畫等，詳細時程如后：

5 月 26 日 台北飛馬尼拉，自行至 Pasig City 之 Astoria plaza
(星期日) 飯店報到，報到時飯店櫃台已準備好每一個學員一袋資料，並引導到個人住宿的房間，承辦單位菲律賓生產力中心已？每位學員準備好馬尼拉近郊地圖、菲律賓介紹、飯店設施介紹、菲律賓生產力中心簡介、亞洲生產力中心 (APO) 簡介及整個研討會之時程資料。

5 月 27 日 (星期一)

08：30 - 09：00 報到登記

09：00 - 10：00 開幕儀式

包括演奏菲律賓國歌、菲律賓生產力中心副總經理 Carlos A. Sayco, JR 致歡迎詞、亞洲生產力組織特別顧問 YUJI Yamada 致詞、菲律賓環境及自然資源部 Dionisio Tolentino 處長專題演講：主題 - 「在菲律賓的綠色生產力」

10：00 - 10：15 團體照及休息

10：15 - 10：30 亞洲生產力及世界性的綠色生產力

主講者：亞洲生產力組織環境部處長 Augustine Koh

10：30 - 10：45 菲律賓的綠色生產力活動

主講者：菲律賓生產力中心副總經理 Carlos A. Sayco, JR

10：45 - 11：15 永續發展與綠色生產力

主講者：泰國清邁大學 (Chiang Mai University) 環

工系副教授 Suporn Koottatep 博士

11 : 15 - 12 : 00 綠色生產力的概念、原則和實務

主講者：Suporn Koottatep 博士

12 : 00 - 13 : 00 午餐

13 : 00 - 14 : 30 綠色生產力方法的回顧

主講者：印度國家生產力協會副秘書長 Ramesh Monga

14 : 30 - 14 : 45 休息

14 : 45 - 15 : 30 綠色生產力的技術和工具

主講者：Suporn Koottatep 博士

15 : 30 - 16 : 00 開始前的準備

主講者：Ramesh Monga 副秘書長

16 : 00 - 16 : 30 播放綠色生產力成功故事錄影帶

16 : 30 - 17 : 00 問答及第一天總結

20 : 00 - 22 : 00 亞洲生產力組織的歡迎晚宴

5月28日(星期二)

09 : 00 - 09 : 15 綠色生產力分組作業的介紹

主講者：Suporn Koottatep 博士

09 : 15 - 10 : 00 步驟一：起始 - 團隊的組成及現地勘察

主講者：Suporn Koottatep 博士

10 : 00 - 10 : 45 步驟二：計畫 - 問題鑑別及設定目標和標的

主講者：Ramesh Monga 副秘書長

10 : 45 - 11 : 00 休息

11 : 00 - 12 : 00 步驟一及步驟二的分組討論

12 : 00 - 13 : 00 午餐

13 : 00 - 18 : 00 參觀工廠

5月29日(星期三)

08 : 30 - 10 : 30 繼續分組討論 - 步驟一及步驟二報告的準備

10 : 30 - 10 : 45 休息

10 : 45 - 12 : 00 繼續分組討論 - 步驟一及步驟二報告的準備

- 12 : 00 - 13 : 00 午餐
13 : 00 - 14 : 00 對於政策、問題鑑別、目標和標地的分組報告
14 : 00 - 15 : 00 步驟三：篩選改善方案
主講者：Suporn Koottatep 博士
15 : 00 - 15 : 15 休息
15 : 15 - 17 : 15 篩選改善方案的分組討論

5月30日(星期四)

- 08 : 30 - 10 : 30 分組討論：國家報告的異同討論，隨即提出分組簡報
10 : 30 - 11 : 00 休息
11 : 00 - 12 : 00 步驟三：改善方案的過濾及評估
主講者：Ramesh Monga 副秘書長
12 : 00 - 13 : 00 午餐
13 : 00 - 14 : 00 步驟四：行動計畫、執行和訓練的規劃
主講者：Ramesh Monga 副秘書長
14 : 00 - 16 : 00 改善方案的篩選和評估、行動計畫執行和訓練的規劃之分組討論
16 : 00 - 16 : 30 休息
16 : 30 - 18 : 00 改善方案的篩選和評估、行動計畫、執行和訓練的規劃之分組討論及分組簡報之準備

5月31日(星期五)

- 09 : 00 - 10 : 30 分組簡報
10 : 30 - 10 : 45 休息
10 : 45 - 12 : 00 步驟五和六：監督量測和評估、管理複審、各項改變併入管理系統、持續改善
主講者：Ramesh Monga 副秘書長
12 : 00 - 13 : 00 午餐
13 : 00 - 14 : 30 行動計畫的分組討論
14 : 30 - 15 : 30 行動計畫的分組簡報
15 : 30 - 15 : 45 研討會的評估
15 : 45 - 16 : 00 休息

16：00 - 17：00 結業式

包括研討會成果簡報、頒發結業證書、學員致謝詞、菲律賓生產力中心副總經理致歡送詞

19：00 - 22：00 菲律賓生產力中心的歡送晚宴(包括 KALAOK 歡唱聯誼)

參、訓練內容

一、課程及上課地點安排

本次「綠色生產力推動者之綠色生產力進階研討會」訓練活動之承辦單位「菲律賓生產力中心」對於課程的安排極為用心，住宿及上課地點均在馬尼拉 Pasig City 的 Astoria Plaza 飯店內舉行，該飯店為一 28 層樓高之新飯店，飯店內有游泳池、健身房等多項休閒運動設施，並提供各種餐點服務。每日午餐就在訓練教室的隔壁提供歐式自助式餐點及飲料。學員可藉用餐時間相互交談，以瞭解各國情況。

此一課程主要由二位講師負責授課，即泰國清邁大學環工系 Suporn Koottatep 博士及印度國家生產力協會副秘書長 Ramesh Monga 先生，承辦單位除了提供一份詳細的講義資料外，將所有課程內容之所有講義、講師投影片之電腦檔案及學員繳交之 Country paper 等作業，均燒錄成光碟，在課程結束前送給每一位學員攜回自己的國家。

課程之第一天上一整天的課，介紹永續發展及綠色生產力、綠色生產力的概念、綠色生產力的方法、工具及技術等，最後進行分組，將所有成員分成四組，每一組並選出一位組長，進行組員之工作分工，並以案例研究廠為例，討論如何執行綠色生產力工作，使每位組員負責其中一項工作，我被分配在第一組，負責製程改案工作。必須研究該廠椰果膠製程之改善，以達到綠色生產力的目標，另外有組員負責財務，有人負

責人事，有人負責採購，有人負責行銷。

課程之第二天下午參觀本次課程之研究案例工廠 - Jo Na 國際公司，該公司為一中型食品工廠，本次課程以其椰果膠生產製程為研究例子，在參觀前即提供該廠製程之書面資料，並放映該廠製程之錄影帶供學員參考。在參觀工廠前已將學員分組，每組學員在參觀工廠前已先做好分工，在參觀工廠時每人可針對自己負責的工作蒐集更詳細的資料，俾利後續課程討論。

課程之第四天下午，運用二小時的時間，各分組學員自行討論各國推動綠色生產力的情形，並整理出其異同，再派一位代表上台簡報該組討論的結果。對於綠色生產力各國推動情形之討論結果，部分國家尚未開始，有些國家正準備起步，我國在綠色生產力方面，於亞洲屬於領先地位。

課程的進行除第一天外，其餘均由學員進行分組討論，分組上台報告及問答，二位講師從旁協助各組討論之進行。此一課程之規劃有點像我國 ISO 14000 輔導人員訓練之模式。

二、亞洲生產力組織與綠色生產力

亞洲生產力組織（The Asian Productivity Organization, APO）是總部設於日本東京的國家與國家間的區域性組織，以協定方式設立於西元 1961 年。目標在亞太地區傳播生產力的意識，並扮演智囊團、催化劑、區域性顧問、制度的制定者及生產力知識的導師等角色，且提升及散播現代生產力技能、技術及在農業、工業及服務業方面的生產力經驗，並在會員間提升綠色生產力的觀念與實務。

APO 是一個非政治性、非營利性、無差別待遇的組織，有 18 個會員國，包括孟加拉、中華民國、斐濟、香港、印度、印尼、伊朗、日本、韓國、馬來西亞、蒙古、尼泊爾、巴基斯

坦、菲律賓、新加坡、斯里蘭卡、泰國和越南等。並開放給亞太地區聯合國亞太經濟和社會委員會的會員政府參加，在亞太地區以外的政府可以成為夥伴會員。

三、環境部的特別計畫（Special Program for the Environment, SPE）

經濟發展和環境保護是永續發展的重要關鍵，為了回應1992年地球高峰會的建議，APO在1993年起執行生產力與環境的二年基礎研究。

基於研究的結果，APO在1994年設立環境辦公室，也就是現在的環境部，並以環境部特別計畫引導其未來的方向及活動。

環境部的使命在透過其計畫及活動，促使社會重視生產力、職業安全衛生及環境方面，並建立範例，期望可以提升國際競爭力，由內部生產力提升，創造更多利潤，改善工作環境和職業安全衛生，促進更公平的價值系統，也期望這種發展策略，最後在大格局方面可以對減輕全球氣候變遷及臭氧層破裂等問題做出貢獻。

APO在1996年12月於菲律賓馬尼拉召開的亞洲生產力組織世界會議，會議強調應該發揚「環境保護不犧牲生產力的方法」。並在會議期間，與會代表皆簽署發布「馬尼拉綠色生產力宣言」，該宣言為所有利害相關者應該以下列方法提升綠色生產力的認知並共同合作：

- 主動地參與區域內的相關活動
- 交換構想點子和經驗
- 資料宣傳
- 鼓勵對綠色生產力活動的參與，並做為追求較好生活品質的策略

為了使綠色生產力能夠成功，將透過跨國及全球性的共同

合作，匯集所有的努力成果，並獲得各國認可推動。

四、永續發展與綠色生產力

(一) 課程與講義之安排特色

此一主題安排 40 分鐘授課時間，但提供了 40 頁的講義，講義內容前 2 頁說明此一課程的重點及目標，並建議講師如何介紹此一課程，課程的規劃在於訓練每一位學員均能成為綠色生產力的種子師資。

講義內容是日本東京亞洲生產力組織所研擬的，其建議此一課程應為 60 分鐘，包括 40 分鐘的介紹及 20 分鐘的討論。建議課程各項主題介紹的分配時間如下：

1. 經濟和環境趨勢 5 分鐘
2. 全球環境議題 15 分鐘
3. 回應環境議題 5 分鐘
4. 環境管理趨勢 15 分鐘

最後 20 分鐘一定要留下來做為討論，以使參加者能夠清楚的瞭解這些主題和重點。

授課時要以敘述的形式，追溯到綠色生產力的歷史，講師於部分課程內容，可以利用已經實行綠色生產力的地區性特殊例子，來說明綠色生產力的需要性，惟需注意保持課程各節的均衡性。課程的核心在於確信使參加者能了解 GP 的重要性。

講義的每一頁分成左右兩邊，左邊約佔三分之一寬，用以提示講授內容的重要句子、參考的重要網站、相關國際組織及其 logo。講義右上方有一框框為 PowerPoint 的講義，做為介紹之用，右下方為講師所要介紹的參考內容。

參考上述之講義編排方式，可以做為未來本局編輯訓

練講義之參考，本局各計畫常花費許多經費在訓練方面，未來宜以訓練種子師資為目標，提供 PowerPoint 講義大綱供學員後續成為講師之用，並提供正式之講義，做為介紹 PowerPoint 講義內容之參考，使課程不致於偏離主題，提供講義內容所參考之網站及相關書籍資料，俾供講師自修或準備講授內容時進一步查閱，以便可以講的更精采。

(二) 課程大綱

- 4.1 經濟和環境的趨勢
 - 4.1.1 經濟活動與環境
 - 4.1.2 生產型態
 - 4.1.3 消費型態
 - 4.1.4 產業與環境的退化
 - 4.1.5 貿易環境
 - 4.1.6 貿易與發展中國家
 - 4.1.7 中小企業的重要性
- 4.2 全球環境關心事件
 - 4.2.1 自 1960 年代的環境議題
 - 4.2.2 自 1960 年代重要的環保里程碑
 - 4.2.3 全球環境議題
 - 4.2.4 區域性的情形
 - 4.2.5 區域性的情形 - 污染
 - 4.2.6 區域性的情形 - 環境惡化
 - 4.2.7 區域性的情形 - 資源消耗
 - 4.2.8 區域性的情形 - 生物多樣性
 - 4.2.9 環境破壞的代價
- 4.3 回應環境關心事件
 - 4.3.1 公眾關切的環境議題
 - 4.3.2 國際環境的條約和協定
 - 4.3.3 永續發展和 21 世紀議程

- 4.3.4 回應 21 世紀議程
- 4.3.5 企業界的回應
- 4.3.6 生態效益，因素 4 和 10
- 4.4 環境管理趨勢
 - 4.4.1 從環境保護到永續發展
 - 4.4.2 污染預防和資源減量
 - 4.4.3 超越污染和預防
 - 4.4.4 資源效率和永續性
 - 4.4.5 生產力實務
 - 4.4.6 從生產力到綠色生產力

(三) 課程內容重點

- 4.1 經濟和環境的趨勢
 - 4.1.1 經濟活動與環境

農業、工業及服務業等任何形式的經濟活動，包括水、能源、礦產或生物等自然資源的利用等，都將會導致環境的退化，控制資源運用到有用的貨品和服務的過程，是降低經濟發展對環境造成影響的方法。

環境和發展並非個別的挑戰，他們是緊密的連結在一起的，發展不能完全依存於環境資源退化的基礎上，當成長不考慮到環境破壞的成本時，環境即無法被保護，兩者係以複雜的因果關係緊密的連結在一起。其底線是自然資源被採取的速率必須降低到相當於其被補充的速率，這才是永續發展的重要核心所在。

- 4.1.2 生產型態

生產活動包括農業、工業和服務業提供消費

者重要的貨品和服務，工業尤其是現代社會經濟成長的重心，工業對於自然資源原始物質的萃取、開發到產品的使用及棄置的整個週期，有著重要影響，這些影響可能是正面的，如提高資源的品質和延伸其使用價值；但也可能是反面的，如在生產貨品和服務及使用、棄置時，產生資源的破壞、退化或造成污染。提升公眾對於農業、工業及服務業對自然資源的負面影響之認知，並形成經濟發展和成長的策略性重新思考方向，有一點是非常重要的，即“污染是廢棄物的一種形式及工業製程無效率的一種現象”。

4.1.3 消費型態

一些知識型消費趨使生產者負責任，促使發展朝向永續性之路方面，負責任的與民眾溝通扮演主要的角色，非政府組織及壓力團體是關鍵的角色。

一些著名的消費者杯葛包括：在奈及利亞對於殼牌石油產品對環境和社會破壞之抗議；美國三菱汽車公司及美國三菱電子公司使用熱帶地區木材所製的紙及木材包裝材包裝其產品，消費者所進行的八年消費杯葛。

綠色消費主義肇始於歐洲，德國於 1980 年代特別強烈，消費者對於環境友善產品的需求於 1985 年達到 37.6%，是 1977 年的 2 倍。

消費者開始喜愛購買對於產品棄置階段負責任的產品，如電冰箱、電腦、電池和汽車，而越來越多的消費者願意負較高價錢購買環境友善的產品和服務，包括經過證明的綠色產品、綠色標

籤產品及有機蔬菜等有機產品。

綠色消費主義促使生產者確認「環境」是一個具有競爭性的利基，綠色產品需要確保其可驗證性。

4.1.4 產業與環境的退化

產業對環境的影響包括貨品和服務的生命週期之每一階段，從物質的開採、純化開始到製造出產品，以及消費者使用後對於產品的棄置。

原料自採礦及其他萃取的程序，產生土壤、植被的退化，及空氣和水體的污染，製造過程產生的空氣排放，廢水及固體廢棄物的產生導致空氣、水、土地及其他伴隨生物的污染。最後消費者使用和棄置再一次產生空氣、水和土地的污染。

在 50 至 60 年代，這些工業活動的負面影響只是區域性的，但隨著工業活動的增加和擴散、貿易的全球化等，環境問題的腳步已經跨越了國家和區域的界線。

所有環境的損害漸漸都要以成本來計算，亞洲地區環境退化的成本約為每年 GDP 的 5% 以上，在中國可能高達 10%，在印度資源消耗的經濟成本超過 GDP 的 5%。由於快速的工業化和人口增加，1992 年世界銀行估計在 1990 年代東亞國家每年將花費超過美金 200 億元於清除環境的損害。

以上課程僅為一小部分之介紹，本課程內容介紹了許多企業永續發展協會推廣之生態效益觀念及國際環保的各

項主題，內容參考了世界銀行、聯合國等網站資料及相關書籍內容。

五、綠色生產力的觀念

(一) 課程目的

此一課程的目的在瞭解生產力的原理和觀念，並將整合於綠色生產力中。且提出綠色生產力的正式定義、內含原理及特性，並將提供組織內，綠色生產力的策略如何運作。

綠色生產力的原理是著眼於生態和生產力兩個領域，整合境保護和生產力改善，以達成社區和中小企業的永續發展是本課程的重要目標。

此一課程展現組織綠色生產力活動的所有過程，包括投入、生產量及產出。且提出綠色生產力的架構，以使綠色生產力的觀念具有可運作性，並總結出綠色生產力多方面的好處。

(二) 課程大綱

- 5.1 生產力的觀念和原理
 - 5.1.1 生產力的觀念
 - 5.1.2 生產力的原則
 - 5.1.3 多因素生產力
- 5.2 生態觀念
- 5.3 生產力和環境的關係
 - 5.3.1 資源效率和生產力
- 5.4 綠色生產力的觀念
 - 5.4.1 綠色生產力的定義
 - 5.4.2 綠色生產力的三個重點

- 5.4.3 綠色生產力的辨識特徵
- 5.4.4 綠色生產力實務與傳統性的比較
- 5.4.5 綠色生產力的多面向涵蓋範圍
- 5.5 綠色生產力的指導原則
- 5.6 邁向綠色生產力的趨使力
 - 5.6.1 外部的力量
 - 5.6.2 內部的力量
- 5.7 綠色生產力的益處
 - 5.7.1 綠色生產力提升生活品質

本課程運用一些圖來說明綠色生產力的原理和觀念、應用的重點、及其好處。

六、綠色生產力的方法論

（一）課程目的

此一課程在介紹綠色生產力的方法論及其內含觀念，綠色生產力的方法論包含三個組成分，第一個組成分是一步一步的問題解答架構；其次是工具、技術和科技，用來連結問題解答架構；第三個組成分是社會、經濟、環境和文化的原則及價值，引導綠色生產力程序的設計及所使用工具、技術和科技的決定，整合這三個組成分構成綠色生產力的方法論。

此一課程描述綠色生產力方法論，以舉例方式說明支援性的綠色生產力和環境管理工具及技術。在課程中提供適當的參考資料，並說明如何選擇執行綠色生產力的方法論。

科技的選擇決定於社會、經濟、環境的想法和技術的因素，此課程強調如何去做，使學習者對於綠色生產力方法學可以實際執行。但方法學可以運用在許多不同的情

況，本課程係以製造業為基礎。

(二) 課程大綱

- 6.1 綠色生產力方法論的概要和方法學的架構
- 6.2 引言
 - 6.2.1 不好品質的惡性循環
 - 6.2.2 變換的過程
 - 6.2.3 改變與創新
 - 6.2.4 從 PDCA 進行持續改善
 - 6.2.5 最高管理階層的承諾和參與——一個重要的必要條件
 - 6.2.6 承諾的障礙
 - 6.2.7 獲得承諾的方法
- 6.3 綠色生產力方法論的 6 個步驟和 13 個工作
- 6.4 步驟一：啟始
 - 6.4.1 工作一：團隊組成
中小企業的綠色生產力團隊之例子
 - 6.4.2 工作二：現場勘察
資訊收集、審閱現有的文件、一對一的會談、收集現場數據、鑑別各廢棄物流的價值
- 6.5 步驟二：規劃
 - 6.5.1 工作三：鑑別問題和原因
鑑別各種問題、鑑別各種基本原因、問題的優先性排序
 - 6.5.2 工作四：設定目標和標的
- 6.6 步驟三：綠色生產力方案的產生和評估
 - 6.6.1 綠色生產力方案產生和評估工作的層級
 - 6.6.2 審查現存的綠色生產力方案
 - 6.6.3 工作五：新綠色生產力方案的產生
 - 6.6.4 工作六：綠色生產力方案的篩選
方案的評估、方案特別資訊的收集
 - 6.6.5 工作七：執行計畫準備的原則

執行計畫的例子

6.7 步驟四：綠色生產力方案的執行

6.7.1 工作八：執行選定的方案

6.7.2 工作九：訓練、發展能力和建立共識

訓練和發展的方法

6.8 步驟五：量測和重新審查

6.8.1 工作十：結果的量測和評估

6.8.2 工作十一：管理審查

6.9 步驟六：持久性的維護綠色生產力

6.9.1 工作十二：將各項變更融入組織的管理系統

6.9.2 工作十三：鑑別新的及增加的問題範圍以供持續改善

6.10 綠色生產力方法論的總結

- (三) 綠色生產力方法論與執行 ISO 14000 的方法大約一樣，上過本局規劃辦理之環境管理系統輔導人員訓練課程的人，對綠色產力方法論並不陌生，可以駕輕就熟的協助工廠推展綠色生產力計畫。

七、綠色生產力的工具

(一) 課程目的

此一課程的目的在介紹及解釋用於鑑別問題和原因及設定目標和標的的工具，綠色生產力方法論的工作部份包含於此課程者包括：工作三：問題和原因的鑑別，以及步驟二：規劃之工作四：設定目標和標的。在工業界鑑別問題和原因需要儲存基線的情況，與標準運作實務或產業的標竿做比較，並研究產業運作的影響。設定目標和標的需要對問題設定優先順序，並且設定用最佳可行技術可以達成的實際目標。

(二) 課程大綱

- 7.1 綠色生產力方法論和工具
- 7.2 腦力激盪
- 7.3 流程圖
- 7.4 製程流向圖解 (輸入產出圖)
- 7.5 工廠配置
- 7.6 環境繪圖 (Eco Mapping) 及例子
- 7.7 集中度圖解
- 7.8 查檢表 (Check Sheets)
- 7.9 點檢表 (Checklist)
- 7.10 質量平衡
- 7.11 發展物質平衡的步驟
- 7.12 發展物質平衡的考慮因素
- 7.13 能量平衡
- 7.14 物質和能量平衡的例子
- 7.15 原因及影響分析 (Cause-Effect Analysis)
- 7.16 魚骨圖 - 繪圖 (Ishikawa Diagram)
- 7.17 柏拉圖式柱狀圖分析 (Pareto Chart)
- 7.18 管制圖 (Control Chart)
- 7.19 蜘蛛網圖 (Spider Web Diagram)
- 7.20 失誤模式影響分析 (Failure Mode Effect Analysis)
- 7.21 投入產出分析 (Cost Benefit Analysis, CBA)
- 7.22 無投資的 CBA 分析之例子
- 7.23 有投資的 CBA 分析之例子
- 7.24 標竿 (Benchmarking)
- 7.25 標竿的例子
- 7.26 能量消耗的標竿
- 7.27 決策矩陣 (Decision Matrix)

- (三) 本課程運用許多企業管理及工業工程方面相關工具於綠色生產力面，並介紹其使用原則及相關實例，故此等工具均納為綠色生產力的應用工具。

八、綠色生產力的技術

(一) 課程目的

執行綠色生產力方法論需要整合及應用各種生產力和環境管理技術，綠色生產力的核心最重要的是鑑別好的改善方案，本課程的目標在介紹學員一些潛在可以用在綠色生產力的技術，並試著說明可以引導產生改善方案的途徑和方法之綠色生產力技術。

(二) 課程大綱

- 8.1 綠色生產力技術的組成分子
- 8.2 改善操作程序
- 8.3 改善操作程序的例子
- 8.4 廢棄物流向分離 (廢棄物分類)
- 8.5 良好的工廠現場管理 (整理、整頓)
 - 8.5.1 5S 技術
 - 8.5.2 7 種廢棄物
- 8.6 預知保養 (Preventive Maintenance)
- 8.7 資源保護
 - 8.7.1 再循環、再利用、回收 (Recycle, Reuse, Recovery, 3R)
 - 8.7.1.1 當場回收及再循環
 - 8.7.1.2 異地回收及再循環
 - 8.7.2 能源保護
- 8.8 進料物質改變

- 8.8.1 例子：進料物質改變
- 8.9 製程/設備改變
- 8.9.1 例子：製程/設備改變
- 8.10 污染控制
- 8.10.1 空氣溢散控制
- 8.10.2 廢水管理
- 8.10.2.1 廢水管理實例
- 8.10.3 固體廢棄物管理
- 8.11 環境化設計
- 8.11.1 環境化設計的策略
- 8.11.2 環境化設計 - 以圖說明
- 8.12 生命週期評估 (Life Cycle Assessment, LCA)
- 8.12.1 生命週期評估 - 以圖說明日本情況
- 8.13 綠色採購
- 8.14 綠色生產力技術、改善的價格及層次

(三) 本課程介紹的綠色生產力技術，包括從產品設計、生產、使用到廢棄物所運用的技術面及管理面之所有技術，在我國均推廣了一段時間，業者也對這些技術均耳熟能詳；課程中也介紹其應用實例。

肆、心得

- 一、 本次訓練活動能結合課程講授、工廠觀摩與運用觀摩工廠的例子，做分組實例演練，透過分組討論方式，講師僅從旁協助，由各組分次報告各組討論的成果，並由其他組再提出問題來請教報告組，透過此種活動，各組的成員分工合作完成作業，培養感情與默契，透過交談，達到最好的經驗交流。在課程之外，也可以了解各國情況，增加個人國際視野。
- 二、 本局以前規劃了環境管理系統輔導人員訓練課程及職業安

全衛生管理系統輔導人員訓練課程，該兩課程即在訓練輔導人員如何輔導工廠執行工安環保管理系統，且已輔導上千家公司執行該二管理系統，並通過驗證。而綠色生產力的方法論與上二管理系統的執行方法幾乎完全一樣，僅再強調提升生產力之精神，故我國推廣綠色生產力已有相當扎實之基礎。

三、綠色生產力是綜合運用本局以往輔導的所有工安環保技術及工安環保管理系統，協助廠商進行生產力提升的改善工作。由於我國在此領域中，不論是法規面、輔導面或廠商執行面，均有豐富的經驗。若將綠色生產力的觀念和做法，擴大推廣於產業界，並廣宣至亞洲其他國家，增強此領域之國際合作，以亞洲區域性的合作方式，達成聯合國的永續發展目標。

四、本課程之內容，均為本局本局以往推廣至產業的環保相關觀念、技術及管理工具。綠色生產力觀念方面包括國際環保及永續發展議題，綠色生產力實施方法方面係運用環境管理系統的執行方法，綠色生產力的工具則運用企業管理及工業工程的相關工具，綠色生產力技術則運用環保技術、工業減廢技術及環境管理技術。總而言之，綠色生產力係運用各種環保技術、觀念、工具促使生產力提高，達成永續發展，改善人類生活品質之最高理想的理念和方法。

伍、建議

一、我國綠色生產力之推動情形，在亞洲地區與日本、韓國同屬較領先的國家，建議可以透過更密切的國際交流活動，將我國實施綠色生產力的成果介紹給其他國家，並趁機將我國的環保產業與環保技術服務業推銷到其他國家。

二、亞洲地區以英語為官方語言的國家不在少數，如菲律賓、馬

來西亞、印度、孟加拉、巴基斯坦、斯里蘭卡等，我國要將綠色生產力相關技術推廣到這些國家，並將環保產業帶到這些國家發展，必須強化英文技術資料及宣傳資料的散播，故鼓勵環保業設立英文網站，多舉辦以英文為背景之國際研討會，鼓勵我國廠商發表綠色生產力成果，並將該等英文文章在網路上公開。

三、 本局委託台灣環境管理協會辦理之「綠色生產力輔導推廣與國際交流計畫」，其中國際綠色生產力協會(IGPA)之網站，建議其內容除IGPA季刊以外，增加聯結我國與綠色生產力有關公司或環保產業之英文網頁內容，並主動將網站內容E-Mail給其他國家綠色生產力相關人員參考，以提高其服務功能，並間接鼓勵我國環保產業增加英文網頁內容。

四、 本局各計畫內均規劃有為數眾多之人才培訓課程或研討會，大部分課程訓練時，均由辦理單位提供一本講義，內容可能是講師的一篇文章或PowerPoint的簡要講義內容，參加者受訓後僅是其個人獲益，較難有擴散知識的機制。建議人才培訓時，講義的編排方式可以像亞洲生產力組織本次訓練一樣，以培訓種子師資的方式，提供上課時PowerPoint的檔案光碟，並針對課程重點及時間分配等予以規劃，講義則包括每一頁PowerPoint內容之詳細說明，提供每一頁內容之參考網站或參考書籍，俾供參訓者更深入自修之參考，使每一位參訓者均能成為種子師資，運用提供的光碟及講義內容，在企業內部或其他場合講授該課程內容，並將各學員成為講師後之擴大訓練人數，可追蹤納入此種人才培訓之成果中。

五、 亞洲生產力組織的運作，雖然日本政府提供不少經費，但各會員國每年也均繳交年費，使其各種活動可以源源不絕的舉辦，活動舉辦地點平均分佈於各個國家，使各國家除享受成果外，也可以再盡一份力量，做東邀請會員國人員到該國參

加訓練交流，經費的分擔方式也很合理，各國參訓學員及講師的機票由總部以各國繳交的會費及政府提供給總部的補助款項支應，承辦國家則支付參訓學員的差旅、住宿及訓練費用，透過此種運作機制，真正達到技術交流、國際合作及聯繫交流的目的。建議以我國為總部的國際綠色生產力協會（IGPA），也能以此國際合作的方向設計，以活絡溝通管道。

六、亞洲生產力組織的訓練活動，與本局業務有關之項目，宜鼓勵本局同仁參加，可有效刺激同仁深入專業，鼓勵學習英語風潮，擴大國際視野，瞭解我國之優缺點，以便可以制定更符合我國需要之工業政策。

陸、我國綠色生產力之國家報告

COUNTRY PAPER

Green Productivity: Government's Incentive Programs to Improve Environmental Performance in Taiwan's Manufacturing Industry

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SUMMARY

Government has the role of very powerful catalyst in encouraging industry to improve environmental performances. During the last thirty years, Taiwan has experienced a fast industrial growth, contributing to substantial improvement of national wealth and living standards. Government agencies started in mid 1980s to establish numerous programs aimed to improving the environmental performance of industrial sector. Environmental Protection Administration (EPA) was established to formulate pertinent policies and oversight the environmental regulatory programs. The Ministry of Economic Affairs (MOEA), on the other hand, was given the responsibility of developing appropriate incentive programs, such as technology development, technical assistance and information services to encourage industries to practice proper environmental management.

Taiwan's industrial waste minimization (IWM) promotion program officially started in 1988 when the Joint Waste Reduction Task Force (JWRTF) was formed in the following year by EPA and MOEA. Since then, a number of promotion activities have been conducted through several technical assistance providers under the funding support of JWRTF.

At the beginning of IWM program in 1991, the focus of the government's incentive promotion programs was placed at public education, training, information service and technology demonstration. The thrust of the program was switched to providing technical assistance and financial incentives in the next 2 years. Furthermore, beginning in 1995, additional elements have been added to promote the environmental management systems (EMS) under ISO 14000, and corporate synergy systems (CSS) to encourage large size firms to form a supply chain management system to recruit their suppliers which are in most cases the SMEs, to practice IWM.

Toward the end of 2000, the government realized that the incentive programs implemented over the last two decades have not achieved the level as expected. With few exceptions, end-of-pipe (EOP) solutions still dominate in many firms. Being afraid of losing their small competitive edge, a great majority of SMEs is still reluctant to adopt IWM to improve their environmental performance. Many large firms, although have subscribed to IWM and EMS, have not begun to implement more sophisticated environmental management tools such as, environmental performance evaluation (EPE) methods, corporate environmental reporting (CER), environmental cost accounting (ECA), life cycle assessment (LCA), design for environmentally friendly products, and procurement of green products.

Therefore, beginning in 2001, IDB embarked a new program to promote sustainable industrial development by incorporating the concept of green productivity (GP) and formulating a 5-year GP plan. Taiwan government's incentive programs have successfully raised the awareness in the importance of environmental protection, pollution prevention and sound environmental management system. The successful factors include:

- High-Level Government Policy Commitment--A policy was established early on that high priority

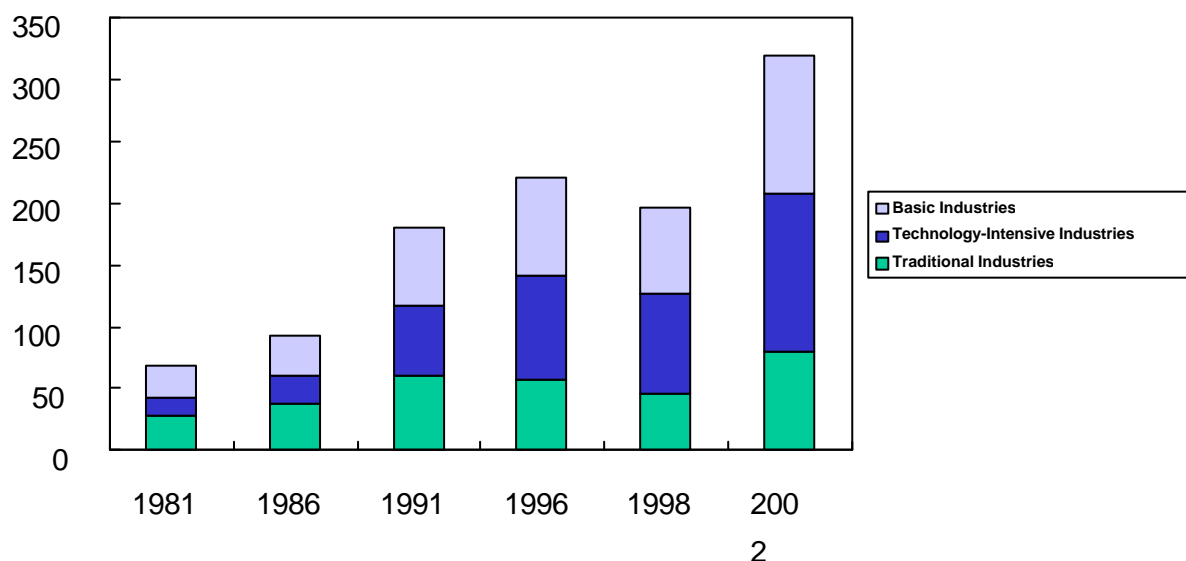
is being accorded to IWM.

- Prominent Organization in Charge--A prominent high-level organization, JWRTF, takes charge of planning, developing and coordinating the overall IWM promotion activities.
- Well-Thought Promotion Plan--The first 5-year plan set the tone of the promotion program early on. The program as a whole has been under constant review and adjustments to meet new situations and additional needs.
- Stimulating Programs--With a continuous government funding, numerous programs have been and are being implemented to stimulate industries to practice IWM, EMS and CSS, such as offering of technical assistance, financial incentives, information services, training, and international cooperation.

1. Taiwan's Economic Development in Recent Decades

The economic development in Taiwan in recent years has been known as a "miracle". Taiwan is known for many years as one of the four "little dragons" in Asia. The manufacturing industries which have developed at a very fast pace during the last forty years, have played a key role in driving Taiwan's economic development. The industrial sectors moved from a focus of consumer commodity industries and light industries in 1950s and 1960s, to capital and technology intensive industries in 1970s, and to high-technology industries in 1980s and 1990s. The industry is now being upgraded to raise the level of technology and to speed up the development of high-technology sectors (Figure 1).

Fig.1 Structural Changes in Manufacturing Production



Unit: US\$ Billion

Source: Industrial Production Statistics Monthly

Over the period from 1950 to 1995, Taiwan's economy grew at an average rate of over 8 percent each year. The average per capita GNP increased from about \$100 US dollars in early 1950 to more than \$12,000 US dollars in 1995. The industrial segment of GDP increased by 350 times from \$260 millions US dollars in 1951 to almost \$92 billions US dollars in 1995, contributing to about 36% of total current GDP of the entire country.

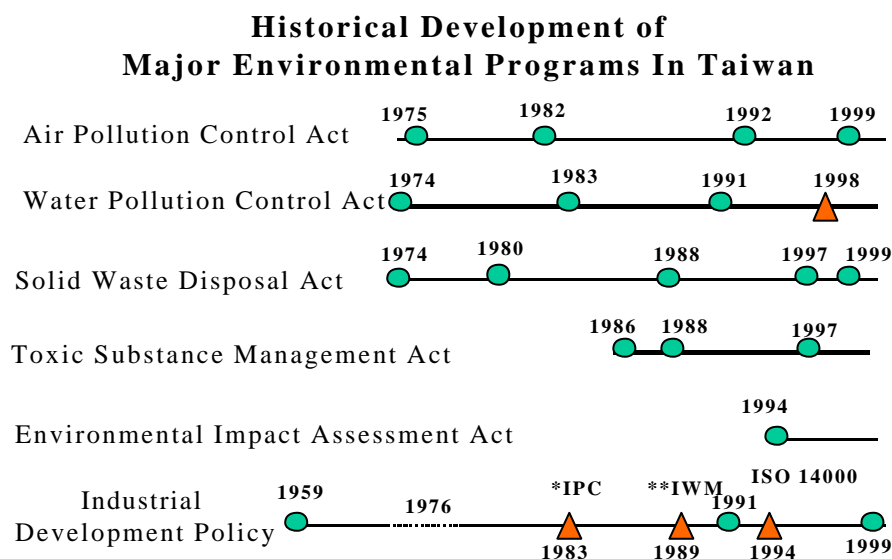
Some of Taiwan's industries, especially the chemical, computer and electronics are so successful that they are now world leading manufacturers which include the computer monitors, printed circuit boards, and image scanners produced in Taiwan exceed 50 percent global market share. The major industries based on production value (in billions of US dollars) in 1998 included electrical & electronic equipment (55.3), basic metals (19.4), chemical materials (16.2), vehicle (14.6), food (13.1), textiles (11.8), metal products (10.5), plastic product (9.7), machinery (8.6), oil & coal products (7.5), non metal minerals (5.9) and chemical products (5.0).

2. Environmental Regulatory Programs by EPA

EPA launched efforts to manage environmental protection work in Taiwan effectively by creating and implementing the "National Environmental Protection Action Plan". Legislative history may be partitioned into three distinct periods (Fig.2), namely 1974~80; 1980~90; and 1990 to the present. During the first period, the three cornerstone laws: the Air Pollution Control Act, the Water Pollution Control Act, and the Waste Disposal Act, were enacted. However, due to the

looseness of the regulations and lax enforcement, these Acts may best be viewed as efforts to stem further serious degradation and to begin engendering environmental awareness. During the 1980s the above three acts were tightened and revised and two new Acts, the Noise Control Act (1983) and the Toxic Substances Control Act (1986) came into being. The maturation of environmental laws in Taiwan was coupled during this decade with a large increase in environmental protection manpower and an improvement in legal enforcement. The net effect pressed industry to install pollution control equipment with strong positive impact upon environmental quality throughout the island. Concurrent with the 1990 Environmental Impact Assessment Act came a full-scale review and revision of all current environmental regulations. The result put Taiwan's environmental protection standards on par with those of the leading industrialized nations. Present laws lead Taiwan into the new millennium and are expected to gradually bear fruit after the start of the coming decade.

Fig.2: Development of EP laws in Taiwan.



*Industrial Pollution Control Program

**Industrial Waste Minimization Program

3. Characterization of Taiwan's Environmental Problems

Taiwan's air pollution presently comes from two main sources – industrial production and motor vehicles. Official estimates say that of total emitted pollutants, 40% is due to the former and 60% to the latter. Principal water pollution sources include industry (20 million tons/day), livestock runoff (10 million tons/day), and household wastewater (8 million tons/day). Of the approximately 28 million tons of business solid waste noted in the same statistics, 17.5 million tons

were factory derived (defined as industrial waste). Taiwan already produces nearly 20 million tons of industrial waste each year, and 1.6 million tons (8%) of which are classified as hazardous. Principal generators include the metals sector (34%); the non-metallic minerals sector (11%); and the packaged foods sector (11%). With current disposal centers operating at full capacity and plans for new disposal center construction tied up in land acquisition problems and local citizen protests, much of Taiwan's industrial waste has no legal place to go and is too often simply dumped.

4. IDB's Incentive Programs in the First Phase (1980's): Focusing on EoP Treatment

Because of a lack of industry's capabilities to deal with the effluent control problems, little progress was reported in 1970s. In 1981, an Industrial Pollution Control Technical Task Force was established by IDB under MOEA to provide firms with suggestions in technical and management solutions centering on EoP treatment. The task force at this stage is operated with part-time involvement of environmental experts selected from academia, R&D institutes and consulting firms. Soon it was clear that the environmental problems are too complicated for and that full time staff was needed to deal with the issue. Under a contract with IDB, CTCI Corporation established in 1983 an "Industrial Pollution Control Corps (IPCC) to help industry in coping with their pollution control problems.

In the 10 years period from 1984 to 1993, IPCC's work went through an evolution characterized by three phases. The first phase covered the period to 1983 to 1987, where the major activities focused on awareness promotion and technical assistance to a few factories. The second phase, covering from 1988 to 1990, the environmental pollution problem escalated in the countries, causing social unrests and plant closure in many cases. It is also in this period that EPA was established under Executive Yuan to takeover the environmental conservation programs from several smaller agencies and to integrate regulatory activities into a more comprehensive one. To adjust to the needs of the industry, IPCC's work switched to providing technical assistance to highly polluting sectors, such as tannery, paper manufacturing, textile dyeing and finishing, and petrochemicals. Additionally, IPCC directed their work to assist industrial parks in compliance with effluent standards, and to speed up information services by publishing a monthly newsletter "Industrial Pollution Control Report". IPCC's work stepped into a new era in its 3^d phase, from 1991 to 1993, while the tasks were divided into 3 major groups: water pollution control, air pollution control, and waste management. A separate working group concentrated on IWM was also formed to promote preventive measure.

During its first 10-year, IPCC's accomplishments include 5000 plant visits providing technical assistants (50% in effluent controls, 30% gaseous emission controls, 10% waste management, and the remaining 10% in noise pollution control and other issues). Among these technical assistant projects, 1000 plant visits involved in planning and auditing the facility pollution control plans, 60 plant-visits concern with implementation of large-scale projects, 2000 plant-visits for solving problems in 22 target sectors, 500 plant-visits for dealing issues in selected industrial parks, 1360

plant-visits for support to continual improvements. To assist in its promotion work, IPCC also established 22 pollution control demonstration facilities among 13 sectors, published 40+ technical guidance manuals, organized 160 training workshops to provide training to more than 12,000 persons, and on behalf of IDB, established and operated a central waste treatment facility serving the metal finishing industry in the country

5. IDB's Incentive Programs in the Second Phase (1990s): Promoting Industrial Waste Minimization

The first 5-year (from 1991 to 1995) master plan was to promote IWM in the country. The master plan consists of the following elements:

- Establishing program goals, by identifying the key industries that should receive highest priority attention by the program, establishing general goals for IWM with these industries, and setting realistic timetables.
- Identifying constraints to IWM. This involves analyses of existing technical, informational, financial and regulatory factors that represent barriers to implementing IWM.
- Identifying and selecting program elements, such as training, information exchange, technical assistance, technology research and development, and financial incentives to promote IWM.
- Contracting independent nonprofit organizations to form technical assistance units for implementing IWM promotion programs.
- Securing funds for the programs. This also involves analyses of funding priorities, mechanisms, and sources of funding in- and outside the government agencies.
- Maintaining an overview of research and development needs. This involves an evaluation of research, development and demonstration (RD&D) results from domestic and foreign organizations, identification of key RD&D needs for particular industrial processes, and recommendation of research programs to meet these needs.
- Conducting periodic program reviews, and producing reports on JWRTF's activities, achievements, problems encountered, program adjustments, and future goals.

As of 1995, a total of 50 firms, 47 individuals and 17 organizations have received IWM awards. Between 1990 and 1995, 256 IWM training courses were offered in the country, benefiting more than 22,000 participants. The waste exchange system has facilitated nearly 200 cases of waste exchange between the waste generators and users, resulting in reuse and recycle of over 180,000 tons of industrial waste and an estimated benefit of over US\$54 million.

Funded by the government, China Technical Consultants, Inc., Foundation of Taiwan Industrial Services (FTIS) and Industrial Technology Research Institute (ITRI) provide technical assistance at no cost to industry. Each year, a number of firms are selected by these nonprofit organizations for in-depth technical assistance. From 1991 to 1995, 89 firms in 30 industrial sectors received in-depth technical assistance, hundreds of additional firms received general

consultation. With a total investment of US\$27 million, of which 11% supported by the government, and 89% paid for by the industry, the in-depth assistance cases were estimated to generate a benefit of US\$52 millions per year.

Under the research program, special attention has been given to developing specific technologies and detailed case studies demonstrating which IWM technologies suit domestic conditions. From 1989 to 1995, MOEA and National Research Council together sponsored nearly 80 RD&D projects geared toward IWM technologies. A majority of these projects are performed by ITRI. In years 1994 and 1995, more than 1,200 applications were approved of tariff exemption for imported IWM and pollution control equipment. The approved low-interest loans for the same period totaled approximately US\$ 150 millions.

Since early 1990s, increasing number of activities has been implemented in Taiwan to promote international cooperation on industrial environmental programs in the Asia-Pacific Region. Under the sponsorship of IDB and regional or international organizations such as US-Asia Environmental Partnership (US-AEP), Asian Productivity Organization, and US Environmental Training Institute, CP training workshops are organized in Taiwan for participants from Southeast Asian countries. Additionally, under the joint funding support of IDB, Asian Productivity Organization (APO), and China Productivity Center (CPC), numerous projects have been conducted since 1995 to prove the feasibility and benefits of CP and green productivity technologies.

6. IDB's Programs in the Third Phase (1996-2000): Promoting Corporate Synergy Systems and ISO14000

As with many developing Asian economies, Taiwan has a large segment of industrial production that comes from small- and medium-sized enterprises (SMEs). Among approximately 80,000 firms in Taiwan, more than 96 percent are SMEs. Between 1991 and 1995, though more than 200 firms applied and received assistance to implement waste minimization measures, less than 20 percent of these firms are SMEs. In an attempt to induce a change, IDB took an initiative in 1995 to adopt the CSS mechanism to promote CP in SMEs.

The TECO CSS-IWM system consists of four TECO's electric equipment assembly plants serving as the central firms, and 12 suppliers serving as satellite firms. An Environmental and Safety Promotion Team (ESPT) was organized among all these firms to run the CSS-IWM program, with technical assistance provided by FTIS. The satellite firms represent suppliers of data processing equipment, printed circuit boards, parts molding, etc. More than 60 percent of participating firms are SMEs. During 1995, the participating firms in the system implemented a total of 2,119 IWM options. Based on an incomplete data, these options required a capital investment of US\$453,000, and resulted in a benefit realized in FY1995 of US \$5 million. The TECO CSS-IWM system has been expanded to include 32 firms, many of them have reported greater than 20% reduction of production cost as a result of practicing IWM measures.

Cheng-Loong Paper Manufacturing Company organized the second CSS-IWM program in Taiwan. Established in July 1996 and with Cheng-Loong's Tayuan Paper Mill and Hsinchu Paper Mill as central firms, the CSS consists of 10 up-stream suppliers that provide waste paper, machinery, chemicals, energy, and transportation services, and 3 downstream buyers who are paper container manufacturers. With greater than 90 percent of participating firms as SMEs, the Cheng-Loong system in one-year period from July 1996 to June 1997 implemented 868 IWM options. These participating firms invested a sum of US \$991,000 in IWM measures, resulting in a benefit of US \$3.5 million in FY1996.

The positive results from 1995 to 1997 provided a strong incentive for furtherance of CSS-IWM program in Taiwan. From 1997 to 1998, five additional CSS-IWM systems were organized under the technical assistance provided by FTIS and CTCI under the sponsorship of IDB. As of today, a total of 18 CSS-IWM systems have been established and are operating in Taiwan (Table 1).

Table 1. Summary of CSS-IWM Systems in Taiwan

Name of Central Firm	Business Type	Number of Firms in CSS	Name of Central Firm	Business Type	Number of Firms in CSS
TECO	Appliances	32	BENQ	Computers	16
SAMPO	Appliances	15	Compal Electronics	Computers	11
Chunghsin Electric	Appliances	15	Acer	Computers	16
Sangyang	Automobiles	15	Fentay	Shoes	13
Ford	Automobiles	13	President-Pepsi	Food	11
Yulon	Automobiles	13	Cheng-loong	Paper	13
United Micro-electronics	Electronics	15	Supertex	Textile	14
Macronix International	Electronics	20	Walsin Lihwa	Basic Metals	12

Philips	Electronics	12	Victor Taichung	Precision Machinery	12
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7. Promoting Environmental Management Systems under ISO 14000.

Under the collaborated efforts of the government and the enterprises, ISO 14000 has gained a substantial ground in Taiwan. Promotion of ISO 14000 has been undertaken by IDB since 1995. Key elements of the IDB program include:

- Raising public awareness
- Providing information services
- Providing financial incentives
- Maintaining performance quality by certification
- Training of EMS professionals

As of March 20, 2002, 1013 firms in Taiwan were certified under ISO 14001. In terms of ISO 14001 certified firms, Taiwan currently ranks number 11 worldwide and number 3 in Asia following Japan and China. Table 2 indicates the annual increments of certified firms in Taiwan from 1996 to 2001. Among the certified industrial firms, the electronic and electrical equipment manufacturers make up the largest portion -- about 30% of the total -- followed by chemical manufacturers (approximately 20%). Table 3 shows the sector distribution of the certified firms.

Table 2 Increments of Certified Firms in Taiwan

Year	Increments	Cumulative
1996	34	34
1997	107	141
1998	275	416
1999	271	687
2000	194	881
2001	118	999

Table 3. Distribution of Certified Firms among Sectors

Sector	Percentage	Sector	Percentage
Electronic Parts	21.44	Basic Chemicals	9.11
Electrical Equipment	8.22	Telecommunication	8.09
Synthetic Resin and Plastics	6.68	Specialty Chemicals	4.88
Transportation Equipment	4.24	Environmental Management	4.11
Precision Machinery	3.98	Metal Parts Fabrication	3.85
Construction	3.34	Pulp and Paper	3.21
Textile and Garment	3.21	Food, Beverage and Tobacco	3.08
Machinery	2.82	Other sectors*	9.74

* Include rubber industry (1.67%), service industry (1.54%), ceramics and glass (1.54%), cement and stone (1.54%), basic metals (0.9%), printing (0.77%), furniture (0.39%), tannery and leather (0.13%), and others (154%)

8. Promoting Integrated Environmental Management

Starting in late 1990s, IDB's technical assistance providers (TAPs) have been instructed to promote pollution control, IWM and EMS in a more integrated manner. First, these firms have been required to "adopt" specific manufacturing sectors of which they would be responsible of providing environmental technical assistance. Second, each of these firms is to conduct a detail assessment of the environmental performance of these sectors and to devise an approach to provide more comprehensive environmental management solutions. These solutions generally involve establishing EMS under ISO 14001, followed by multimedia waste audits and pollution control solutions. Under this new approach, firms interested in establishing EMS would be given priority to receive technical assistance. Following the certification of EMS under ISO 14001, the firms would then receive assistance in waste minimization audits and pollution control assessment. The new approach enables industrial firms to address their environmental problems with a more holistic manner, resulting in more cost-effective solutions.

9. IDB's Incentive Programs in the Fourth Phase (Beginning 2001): Promoting Sustainable Development

Following a recent detailed assessment of the accomplishments of its environmental programs over the last two decades, and the needs of the industry to improve environmental performances and competitiveness in the international market, IDB determines to adjust its environmental programs to promote sustainable development by incorporating the concepts of green productivity (GP). IDB initiated its GP promotion in 2001. A 5-year plan was drafted to provide the road map.

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