行政院所屬各機關因公出國人員出國報告書

（出國類別：國際會議）

參加第 2 屆資通訊技術與永續發展國際會議(The 2nd International Conference on ICT for Sustainability, ICT4S 2014)會議報告

服務機關：行政院環境保護署
姓名職稱：朱雨其處長、黃素梅科長
派赴國家：瑞典斯德哥爾摩
出國期間：民國 103 年 8 月 22 日至 8 月 29 日
報告日期：民國 103 年 11 月 13 日

摘要

ICT4S(Information and Communication Technology for Sustainability)是專注資通訊科技對環境衝擊及促進永續發展機會的國際性學術團體(ict4s.org)，以「提升 ICT 對環境永續發展的貢獻(How to Improve the Contribution of ICT to Sustainability)」為宗旨。第 2 屆 ICT4S 國際研討會於本(103)年 8 月 24 日至 27 日在瑞典斯德哥爾摩舉行。

本次會議共有 34 國約 200 人與會，會議形式包括專題演講、短時集體創作(Hackathon)、工作坊(Workshop)、論文及海報發表等。本次會議共發表 47 篇論文及 27 幅海報（包括本處以環境雲及電腦機房節能為主題之 3 幅海報）。會議研討議題含括：ICT 契合環境永續精神(Sustainability in ICT)、ICT 促進環境永續發展(Sustainability by ICT)等，其中許多新觀念及作法對本署未來推展資訊業務極有助益，包含下列事項：(1).針對應用效能與耗用資源（電力使用、硬體配置）難符比例之系統，基於節能考量，應適時調整資源配置。(2).開發新系統或舊系統更新時，應加強系統模組化、可拆解式(decomposability)及可重用式(reusability)的軟體方法，並落實資料獨立性(data independence)，避免日後因軟體系統升級而導致大量硬體需求。(3).針對機房共構配置，應以系統思考方法，通盤考量因網路頻寬及管理作業所衍生的「能源及環境成本」，尋求最有利的部署方式。

目錄

一、會議背景及目的

ICT4S(Information and Communication Technology for Sustainability)是專注於資通訊科技對環境的衝擊及促進永續發展機會的國際性學術團體(ict4s.org)，以「提昇 ICT 對環境永續發展的貢獻(How to Improve the Contribution of ICT to Sustainability)」為宗旨。第 2 屆 ICT4S 國際研討會於 2014 年 8 月 24 日-27 日在瑞典斯德哥爾摩舉行，共有 34 國約 200 人與會，會議形式包括短時集體創作（Hackthron, 黑客松）、專題演講、工作坊(workshop)、論文及海報發表等。

本次會議共發表 47 篇論文及 27 幅海報，本處以環境雲及電腦機房節能為主題發表下列 3 篇海報（詳如附件 4）：

1. Improving energy performance of data centers through IT services consolidation.
2. Design of a cloud-based system to integrate and share data for environmental governance and sustainability.
3. Consuming less energy and using less floor space: Taiwan EPA’s data center reconstruction.

我國 ICT 產業曾是全球 ICT 產品主要供應商，也是我國 GDP 的主要貢獻來源。然時過境遷，世界正面臨碳排放與資源限制的新時代，全球經濟轉向低碳與綠色經濟，已是必然趨勢。ICT 產業能否成為低碳與綠色經濟的一項處方。其次，ICT 產業未來在永續發展的 3 面項（經濟、社會及環境）間得否保持平衡，抑或能否扮演促成者(enabler)角色，類此課題均是目前國際間各公私部門致力尋求發展的目標。

基於上述緣由，本次與會目的除現場發表上述 3 篇海報，分享本署工作經驗及成果外，[1]並藉由參加各項議程活動，與相關國際專業人士相互交流，研習國際間運用資通訊科技，促進環境永續發展之最新趨勢與潮流，作為本署後續推展相關業務參考

[1] 本署與現場發表的 3 幅海報，與會的英國南安普大學(Uni. of Southampton)及蘭卡斯特大學(Lancaster University)研究學者對本署環境雲計畫及開放資料作法尤有興趣，並表達肯定。

二、會議過程及內容重點整理

本次會議過程及形式包括短時集體創作（Hackthron, 黑客松）、專題演講(keynotes)、工作坊(workshop)、論文及海報(papers and posters)發表等。其中論文發表方式與傳統學術會議極為不同，採用所謂 ConverStation 方式，由作者以小組討論主持人的方式，分 3 次向與會者「簡報」其論文，讓作者與聽眾有充分溝通討論的機會。這種作法對作者與聽眾都是一種新的體驗方式，同時也充滿挑戰。其次，海報發表的方式，也非僅是靜態張貼海報；每位海報作者，必須上臺以 45 秒的時間，搭配 1 張事先繳交大會播放的 PPT 投影片，向與會者「推銷」自己的作品（招攬顧客）。根據會後大會所作的調查，與會者對這種新作法多表達肯定。這二種作法在國內尚屬少見，未來或可引介導入。以下謹就會議期間參與之各項議程，分別擇要說明：

（一）專題演講（資料詳附件 2，部分講者未提供書面資料或電子檔）

本次會議專題演講計有 8 場次，主講者多是該領域之知名研究人員，或負責該等工作之歐盟官員或 NGO 成員。各場次講題詳如附件 1 議程，以下謹就部分重要內容摘述說明：

1. Smarter 2020 計畫

當世界面臨碳排放與資源限制的時代,全球經濟轉型低碳與綠色經濟已是必然趨勢。過去 ICT 產業是全球各國 GDP 的主要貢獻產業。然時過境遷，ICT 產業是否能成為低碳與綠色經濟的處方提供者？

依據 SMARTer 2020 分析，ICT 產業具有協助其他產業減碳的龐大潛力，其中尤以應用於農業及土地利用、建築業、製造業、電力業、服務業、及交通運輸業的效益最佳。ICT 在 2020 的整體排碳量約為 13 億公噸 CO_2，佔全球總排碳量的 2.3%，但其可協助其他產業減碳的潛力卻高達 91 億公噸 CO_2，足足是本身排碳量的 7.2 倍。這麼龐大的低碳商機，可能在 2020 年前國際減碳政策框架中有更明確的方向。

全球暖化與氣候變遷已成為全球性關注議題，根據 2011 世界經濟論壇(World Economic Forum，WEF)研究指出，氣候變遷已被評選為全球最高風險指標，其次才為全球金融危機。在解決全球暖化議題上，資通訊科技(ICT)具有極大的影響力，全球電子永續倡議(Global e-Sustainability Initiative，GeSI)所發表的 Smart 2020 報告中便提出 ICT 產業之溫室氣體排放量僅佔全球溫室氣體排放量之 2.8%，然而透過 ICT 技術，卻可有效協助其他產業降低約 15%溫室氣體排放量。個人及產

業可以透過 ICT 技術達到監控、最佳化管理並改善能源使用效率，預計在 2020 年可節省將近 6,000 億歐元。

2. 資通訊科技與永續性的研究課題及趨勢(A research agenda for ICT4S)

本篇專題演講係由瑞士蘇黎世大學的 Lorenz M. Hilty 教授主講，Hilty 教授素來以資通訊科技與永續發展之研究著稱，在國際享有聲譽。他認為資通訊產業在產品生產、消費及廢棄物處理等對環境造成某種程度影響，但卻也是解決環境永續發展的處方。他認為在人類需求不斷增長的情況下，資通訊科技應該扮演某種替代(substitution)的角色。其中最為顯著的例子之一就是視訊會議應該扮演替代未來實質會議的角色，這樣可以減少差旅的需求，進而對節能減碳產生直接的效益。

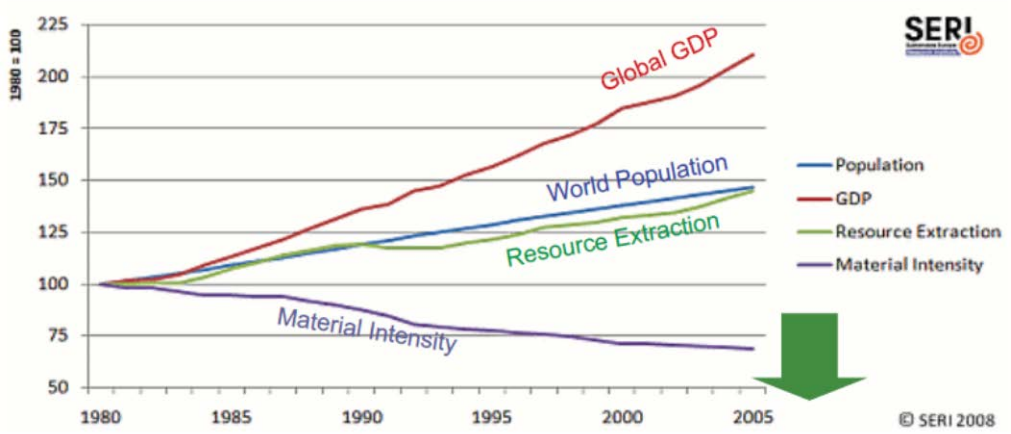
Hilty 教授對未來 ICT4S 的研究，提出下列 3 個重要的方向：

(1) 瞭解並改進資通訊科技在替代資源需求方面的角色與功能。

(2) 瞭解並強化「個體（微觀）與群體（巨觀）之間的鏈結」-- 從社會經濟系統的角度切入，如何藉由個體的「替代」作用，進而對群體產生社會經濟面的效益。也就是說，利用資通訊科技對個人行為或企業組織運作的替代效果（例如：視訊會議），使得整體社會永續發展得到正面的助益。我們目前對「個體的決定，如何改變群體行為」之間的連結，似乎並不能確切掌握，是以此項連結作用的學理與實務面課題均有待投入研發。

(3) 需要發展一種「附著性衡量(accompaning measures)」的方法。如果單純從技術性的角度發展衡量指標或方法，Hilty 教授認為這些方法可能形成「既永續，又不永續」的現象（也就是有論者認為，若從系統思考的觀點，雲端運算並不能算是節能減碳的一種措施），如果要實證資通訊科技對永續發展的貢獻，無可避免地需要政治層面的思考，是以如何導出政治面向的論述，遂成為一項極為重要的課題。

針對上述第 3 項研究方向，Hilty 教授認為一個國家為了改善人民生活，追求 GDP 成長是理所當然的，但是 GDP 成長不應該以資源的取用為主，GDP 成長必須與資源取用脫勾(decoupleing GDP from resouces extraction)。他提出物質強度(material intensity)觀點，也就是將資源使用的增長程度除以 GDP 成長幅度（如圖 1），物質強度愈低，則表示愈符合永續發展的原則。



$$\text{Material Intensity} = \frac{\text{Resource Extraction}}{\text{GDP}}$$

圖 1：物質強度概念：讓 GDP 成長與資源取用脫勾
(decoupleing GDP from resouces extraction)

（二）論文及海報發表

本次會議共發表 47 篇論文及 27 幅海報，本處以環境雲及電腦機房節能為主題發表 3 篇海報（詳如附件 4）。其中候選為最佳論文的 8 篇論文，由作者以 20 分鐘時間自行設計發表方式。各候選者極盡心思，有的以傳統的口語及視覺簡報，有的則以戲劇方式表現，最後由瑞典皇家理工學院的 “ICT4S Reaching Out: Making sustainability relevant in higher education” 獲得，其它論文都以 ConverStation 方式發表。至於海報發表的方式則由作者以 45 秒的時間，搭配一張 PPT 投影片，簡要介紹海報內容，而後有 2 小時時間，由與會人員自由參觀，作者則在旁解說。大會最佳海報獎則頒給丹麥科技大學“Energy Fingerprint “。以下謹就與會期間與本署業務較為相關之數篇論文簡要說明。

1. Big Data GIS Analytics Towards Efficient Waste Management in Stockholm, by Shahrokni, H., van der Heijde, B., Lazarevic, D. and Brandt, N.

這篇論文主要分析斯德哥爾摩城市垃圾處理的效能，作者利用地理資訊軟體作為資料分析後之視覺化展示工具，可以協助診斷若干垃圾清運路線及處理地點的潛在問題。由於斯德哥爾摩的都市垃圾有 8 家民間企業負責處理，所以如何有效分配及規範各家公司間的處理範圍及效能，係市政府每年必須協商事項。

作者運用 GIS 工具，結合歷年統計資料，展示斯德哥爾摩市區的垃圾負荷分布情況。他主要以郵遞區號作為空間分布單位，加上人口統計及垃圾清運統計資料，得到視覺化極佳的圖示效果（如圖 2），藉由這樣的基礎性圖形展示和數據分析，就可以進一步分析及探討其它面向的因素及問題。

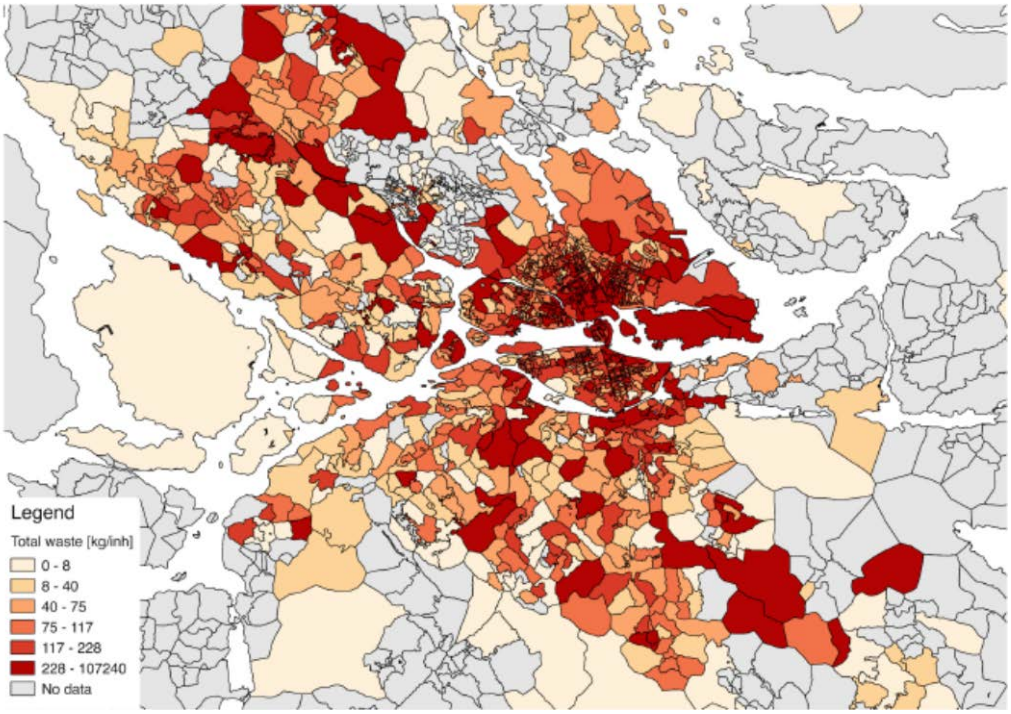


圖 2：斯德哥爾摩市區垃圾負荷圖

這篇論文只提出部分解決問題的方向，作者也同意離實際應用還有相當距離，尤其是資料品質問題更是難以克服，作者提到其在處理空間座標資料時，由於資料年代久遠，曾發現部分垃圾處理地點，經過套疊後居然落點在印尼的苔里島，所以必須付出很大的心力作資料的前處理。這項課題在應用地理資訊系統時十分普遍，唯尚難有理想的解決方案。

2. (1)From Computational Thinking to Systems Thinking: A conceptual toolkit for sustainability computing, by Steve Easterbrook

(2) A Systems Thinking View on Cloud Computing and Energy Consumption, by Michal Sedlacko, André Martinuzzi and Karin Dobernig

這 2 篇論文主要都在討論系統思考的重要性。第 1 篇論文著重探究傳統資訊科學教育過程中，由於過於強調訓練學生的「問題解決」(problem solving)能力，這些學生進入職場後，實際應用在發展資訊系統時，容易行生「偏狹、侷限」的現象，也就是說基於某種職業慣性，大部分由

資訊專業人員所發展的系統，缺乏全局考量，是以資訊系統必須經常異動更新，間接導致整體社會資源的耗用，不符永續發展理念。作者主張現行資訊科學教育必須加強學生系統思考能力的訓練，才有機會逐步將資通訊科技與永續發展相互結合。作者在展示其論文時，採取的互動討論方式，極為生動，令人印象深刻。

第 2 篇論文則質疑目前「沸沸揚揚」的雲端運算模式是否真正能減少電力能源需求？作者從系統思考角度評析，其論點認為企業將資料中心移往雲端後，固然減少其本身的電力需求，但提供雲端服務的業者，卻增加了電力需求，同時為了加速雲端資料存取的速度，網路頻寬的需求增加，同時也增加了電力需求。是以從「整體系統」的角度思考，雲端運算模式能減少電力需求的論點，不無疑問。作者以類似概念圖方式呈現系統思考的作法（圖 3）。

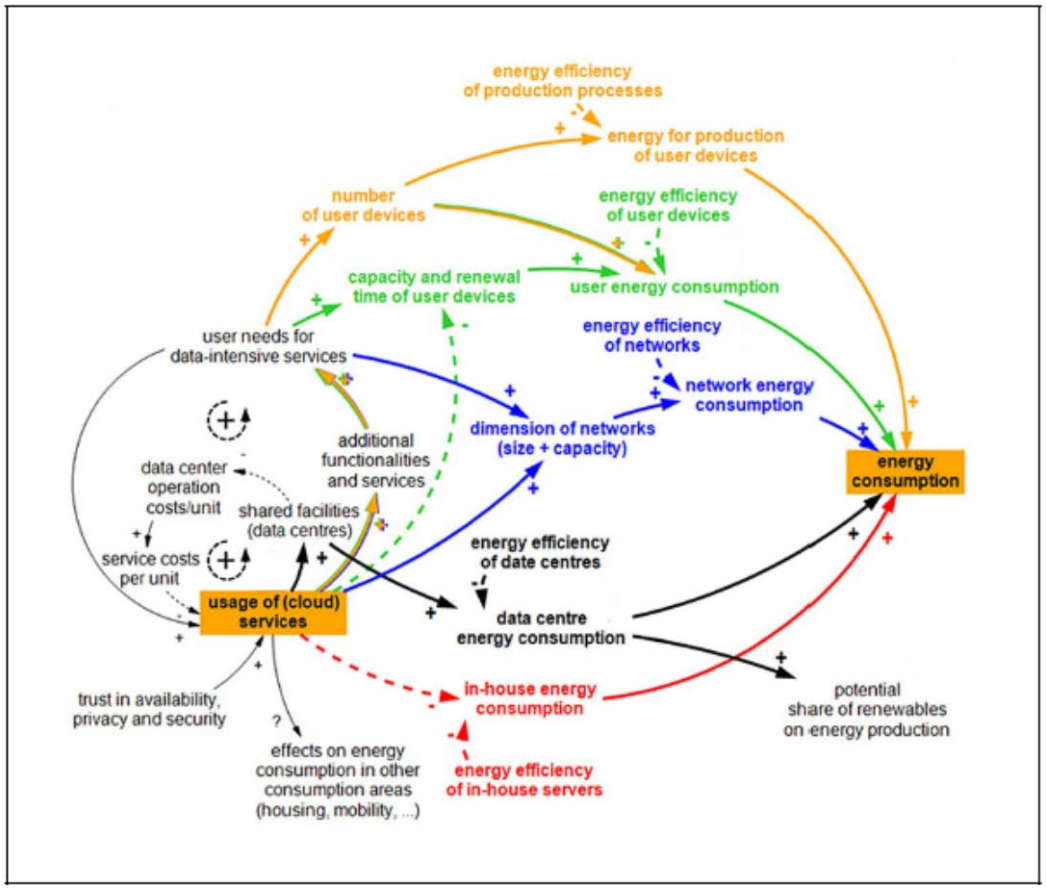


圖 3：從系統思考角度評估雲端運算的節能效益

3. Supporting Sustainability Decisions in Large Organisations, by David Stefan and Emmanuel Letier

這篇論文主要針對大型組織為標的，探討這類組織在導入或採行永續發

展相關決定（主要是節能及減廢措施）時，所需要的輔助性工具。作者主要以其就學之大學作為案例，感覺上適用範圍受到侷限。

作者從不同面向討論，認為在合宜工具輔助下，大型組織採行適當的措施，可以減少其能源需求及碳排放，進而節省組織的開支。其中，比較特別觀點是探討大型組織如何在業務正常運作(Business as Usual, BAU)情況下，因應未來碳稅或其它能源稅的開徵。在歐洲國家，這類課題近期被廣泛討論。

一般來說，大型組織在投入永續發展相關工作的資源配置要比中小企業寬裕，是以如何讓中小企業參與永續發展相關工作，似乎較大型組織更為迫切。

4. Addressing the Obsolescence of End-User Devices: Approaches from the Field of Sustainable HCI, by Christian Remy and Elaine M. Huang

資通訊科技產品的生命週期越來越短。新手機才用不到一年多，又要買新的了嗎？真有需要最新型號的手機才好用？或是你的手機故障連連，要維修比買新的還貴？不論從硬體或軟體的的角度來看，這種行為完全不符合永續發展精神和理念，同時對環境和社會產生很大的傷害。這類「為丟棄而設計」(designed for dump) 的行為， 聽起來很詭異，但如果從生產者的角度來看，卻變得似乎很有道理，因為這樣就可以多賣出一些產品，學界及產業界將廠商這種行為稱為(planned obsolescence)。

以往這種「計畫性過時效應」多針對硬體製造商，尤其是較大型主機或伺服器製造業者，但近年因著行動裝置普及，在使用者端的這種情形及軟體面向的效應，逐漸受到重視，例如：微軟 Office 刻意製造格式新舊不相容的現象，強迫消費者升級，造成軟體的「計畫性過時效應」。

本篇論文作者則專注於使用者端的設備的計畫性過時問題，他提出關於使用者端的人機界面(human-machine interface, HCI)應如何設計，才能減低計畫性過時效應所產生對環境永續及社會發展的衝擊。

作者倡議以互動的設計方式，緩解資通性產品的計畫性過時效應。他強調從(1)設計價值 (2)再利用(reuse) 及(3)使用壽命，三個面向改善現有的資通訊產品人機界面設計。近期類似的主張及研究已逐漸構成一個在人機界面設計領域一個新的研究主題，稱為「永續性人機界面(sustainable human-machine interface)」，而且有越來越多的學術界及產

業界投入。

5. Blinded by data: The risks of the implicit focus on data in ICT for Sustainability, by Jorge Luis Zapico

這篇論文提出一個值得深思的課題:「盡信資料，不如無資料」。其實，這項課題，不僅只突顯在永續發展課題上，在資通訊技術領域，這項課題由來已久。長期以來，藉由電腦蒐集資料的速度及儲存能量，我們累積大量的資料，但是這些資料是否可靠？始終是個問題。當人們完全依類資料來制定決策時，存在相當程度的不確定性和風險。

作者主張「永續性(sustainability)」是一個規範性的概念，建立在正義、平等及責任等原則上，同時要以人類的文化和社會為基礎。資通訊科技某種程度上是中性的工具，可以協助人們以量化數字，衡量事物。但是永續性課題或相關的指標是否得以完全量化是有問題的，比方說正義、平等就很難以量化數字表達。

作者認為完全以量化數字探究永續性課題，會忽略掉永續性的規範性價值(normative value)，有些無法量化的指標或課題，在永續發展領域中可能比可量化的指標更為重要。作者在文章中例舉了相當多的例子，其中有一個例子是以「空氣品質蛋(air quality egg)」網站，這個網站以社群網路及群眾外包(crowd sourcing)的技術理念，展現全世界各地的空氣品質。作者似乎質疑這種運用資通訊科技所發展出來的新型態資料蒐集展現方法，對永續發展或是環境保護的是否具有實質效益。

（三）工作坊

8 月 27 日全天有多場工作坊，分上下午場次。多數工作坊由會議贊助者主持，主要提供其實作面的經驗分享，參加者需自行前往現場。本次參加的工作坊分別均與斯德歌爾摩城市結合資通訊科技及綠能科技，在都市發展及舊港區都市更新方面的實際經驗。

斯德哥爾摩皇家港(Stockholm Royal Seaport)是瑞典主要進出港口，往年走海路進入瑞典，都以此港為首選停駐點。早年石化工業支撐斯德哥爾摩的發展，海運發達時代，此地區充斥儲油槽、瓦斯儲存桶、繁忙的貨物卸載。因應未來能源需求及環保永續發展目標，斯德哥爾摩自 2009 年開始推行「皇家港埠灣區開發計畫」，預計在 2030 年將此地區開發成新型態的綠色新市鎮，可容納 1 萬戶住家，並創造 3 萬個就業機會。這項計畫在 2012 年已有第一批家庭進駐。

斯德哥爾摩皇家港開發計畫有多項在環保方面的創新措施，整個皇家港區最主要的設計是完整的地下管線系統，各家戶的垃圾投入社區專門處理垃圾的管線。家戶必須使用特定的認證卡，同時依照不同分類（玻璃、鐵鋁罐及紙張等），才能投入[2]。廢棄物進入地下管線後，會再進行分類，燃燒廢棄物產生的熱能，轉化成供應住宅的能源及室內的暖氣。

圖 4：斯德哥爾摩皇家港現有資源回收設施

其次，皇家港全面建置智慧電網，讓電力平均使用，以減少對大型發電廠的依賴。他們計畫在 2020 年前將每人排碳量降至 1.5 噸以下，在 2030 年達到零石化燃料的目標。

斯德哥爾摩市之所以如此重視節能減碳工作，是因為歐盟因應氣候變遷訂定的減碳目標，在 2020 年前必須達到全歐盟至少 20%的能源來自再生能源。根據歐盟統計局統計的再生能源項目，包括利用太陽能、水力發電、風力發電、地熱及生質能源等。而根據數據顯示，歐盟會

[2] 有與會人員詢問，會不會有人不用認證卡，隨意棄置垃圾，或是有人分類錯誤，將酒瓶放到紙張的投入口這類情形？現場解說人員的回應是：他們覺得「應該不致於有這種情形，即便偶而發生，廢棄物處理系統的相關人員再將其重分類，並投入蒐集管線就好了。」這讓人有點詫異，突顯了不同國家的文化認知，也體認到國民對生活態度的涵養與素質，乃是提升環境品質的重要元素與指標。

員國中使用再生能源比例最高的國家是瑞典，達 51%，所以瑞典已經達到歐盟規定的 2020 年目標，而且成長速度最快的也是瑞典。

除了上述優異的節能減碳措施及先進的城市設計，斯德哥爾摩皇家港未來還將有各級學校、商業區、文化活動設施及運動設施等，同時他們也將保留煤氣廠房等當年石化工業興盛時的設施包括圓型的油氣儲糟，他們用紅磚建築將其圍住，將其改成博物館及陳列館，好讓居民能瞭解該地區的歷史。

三、參加會議心得及建議事項

（一）會議心得

本次會議連同工作坊(Workshop)及短時集體創作(Hackthron, 黑客松)為期 4 天，整體議程安排十分緊湊。與會人士約 200 人，除了歐洲國家外，據統計尚有美國、加拿大、紐西蘭及澳洲等國，亞洲地區則有我國、韓國及日本派員與會，與會人員主要來自學術研究部門，政府機關、NGO 及資通訊產業。本次會議本處以環境雲建置計畫及本署電腦機房節能措施發表 3 幅海報，藉此與相關國際專業人士相互交流學習。英國南安普大學(Uni. of Southampton)及蘭卡斯特大學(Lancaster University)研究學者對本署環境雲計畫及開放資料作法尤有興趣，並表達肯定。以下綜整參與本次會議見聞心得：

1. 整體而言，會議主要訴求「如何運用資通訊技術(ICT)，促進環境永續發展」，並且歸納為下列 2 項課題（詳如圖 5）。
   (1) ICT 契合環境永續精神(Sustainability in ICT)
      A. 軟體系統的發展會產生硬體的需求，進而衍生能源需求。軟體設計時必須將能源消耗列為「非功能需求(non-functional requirements)」項目，從而設計合乎節能原則的「軟體架構」。
      B. 軟體設計必須審慎評估功能性需求的必要性，許多軟體功能可能從未被使用，徒耗硬體、電力及其他資源。
      C. 電腦機房（資料中心）必須積極尋求降低能源需求，運用虛擬化及雲端運算技術或可減少伺服器之能源需求，但因網路頻寬需求增加，是否有助節能，必須以系統思考(system thinking)方式評估。
      D. 軟硬體設計均應關注「計畫性過時(planned obsolescence)」現象；以往這種現象主要著眼消費性電子產品（廠商故意讓產品生命週期縮短，或維修比新購貴），但近年發現軟體產品的設計更應該被檢討（例如：微軟的軟體版本更新方式）。
   (2) ICT 促進環境永續發展(Sustainability by ICT)
      A. 運用 ICT 蒐集、處理、整合及分析環境資料，提供環境治理科學論證基礎，支援環境政策制定。
      B. 政府開放資料(open government data)可能成為公眾參與環境治理的新型態，未來公部門將由服務導向轉為以資料為核心(data-centric)的運作型態。
      C. ICT 有機會促成智慧住家及辦公室(smart home, office)具體實現，特別是以 ICT 偵測電力及空調系統效能，在科研及實務面均有待推展。
      D. 進一步而言，ICT 有潛力促成智慧城市(smart city)的實現，包括運用

ICT 工具協助永續性都市發展規劃及推行永續性都市治理措施。

圖 5：運用資通訊技術促進環境永續發展概念示意圖

2. 永續發展與資通訊科技相連結的課題日漸受到重視，且範圍將擴及社會及經濟發展層面。

通常人們提到「永續發展」時，主要聯想到的是環境議題，但永續發展實則是「經濟、社會、環境」三個面向平衡發展的課題。藉由這次會議，我們觀察到歐洲國家對於資通訊科技在社會面向的衝擊反而更為重視，他們關注資通訊科技引發的教育問題（學童大量使用數位教材後，造成思考能力降低及認知能力「淺碟化」）及人際疏離課題（社群軟體或即時通訊軟體，固然方便聯繫，但同樣造成人們實際相處能力變得薄弱，同時數位落差也造成不同世代的代際溝通障礙）。歐洲國家（特別是北歐國家）顯然對於資通訊科技在社會層面的永續性衝擊課題更為重視。

3. 計畫性過時(planned obsolescence)課題逐漸由單純硬體的關注，轉向同時關注軟體設計技術所帶來的環境與經濟面衝擊。
「計畫性過時」通常指數位化設備的汰舊換新頻率過於頻仍。製造廠商故意採取某些措施，或是藉由不同規格的零件耗材，例如手機電池、印表機的碳粉、墨水匣等，讓產品的生命週期變短。製造廠商可藉此不斷推出新型樣，但功能卻相差無幾的產品，促使顧客不斷地購買新商品。這是資本主義經濟模式的原型，但卻造成整體環境成本的大幅增加[3]。

近年來發現軟體系統在「計畫性過時」現象的「貢獻」程度，較之硬體系統不遑多讓。例如蘋果公司(Apple)的作業系統(iOS)通常每半年即得更新，而微軟公司的 Office 軟體則平均 2 年就發行新版本（通常功能差異不大）[4]。這些軟體版本更新通常伴隨更高規格的硬體需求，驅使硬體設備隨之汰換，是以二者相互「擺盪」的結果，不僅增加使用者財務負擔，同時「過時」的軟硬體產品更對環境造成極大的負荷。

4. 以系統思考(System Thinking)方法，通盤檢視資通訊科技發展。
雲端運算(Cloud Computing)真的減少電腦機房(Data Centers)的電力需求嗎？行動裝置(Mobile Devices)真的提升組織效能嗎？如果從單一企業組織角度來看，將系統移置雲端，或許減少了主機伺服器的需求，但是對網路頻寬需求及其它網路設備功能的需求卻因而增加；其次，從整體社會資源來看，以系統方法評估，由雲端運算連網所增加的電力需求，恐怕較個別企業採行雲端運算後，所減少的電力需求總和還要多，所以我們還能說雲端運算是一種節能的運算模式嗎？這是值得思考的。本次會議至少有 2 篇論文倡議以系統思考方式，檢視各種資通訊科技所發展的新型態運算模式。

5. 結合巨量資料(Big Data)技術及地理資訊系統(GIS)技術，分析環境課題，作為環境治理的科學性工具。
巨量資料技術近年蔚為風潮，尤其在商業上的應用有許多成功的實例。由於商業應用的資料相對較為「結構化」，例如交易資料或

[3] 資本家藉由集中資本，研發「新」產品，促使商品的汰舊換新，提高企業獲利，積累個人財富，雖然是追求經濟發展的必然手段與過程，但是汰舊廢棄產品對環境造成的影響和傷害，卻是由全體人類共同承擔。有論者以「污染者付費」作為平衡經濟發展與環境保育的處方，以此作為資本家得以規避環境責任的藉口。但事實上，對有些環境的破壞是不可逆的，一旦失去即難以回復。
[4] 以微軟 OFFICE 2007 與 2010, 2013 版本比較，似乎僅是將各種功能界面作調整，實質功能較 2003 版本差異不大。

是銷售資料等，其蒐集整理過程相對容易，資料品質也容易掌握，是以巨量資料在類似領域的應用較為成熟。環境資料之特性較為複雜，通常涉及空間資料與屬性資料的交互參照應用，是以倘欲將巨量資料技術應用在環境保育領域，結合地理資訊系統技術似乎是無可避免的。本次會議有瑞典皇家理工學院(KTH)學者，結合地理資訊系統及巨量資料技術，分析評估斯德歌爾摩的廢棄物管理課題。[5]此篇論文雖有初步成果，作者坦承資料品質是影響巨量資料在環境保育課題應用的主要障礙，雖然資料清理(Data Cleaning)技術可以處理部分品質問題，但由於環境資料多係長年累積，有些資料誤植情況並不容易確認，從而增加資料分析結果的解讀困難。

6. 觀察本次會議的辦理方式與其他類似的學術性會議相較，有多項嘗試性的創新作法，值得參考學習：

(1) 會議議程設計跳脫傳統學術會議模式，其中尤以論文發表方式，改採 ConverStation 的作法，讓作者與聽眾有充分溝通討論的機會。這種作法對作者與聽眾都是一種新的體驗方式，同時也充滿挑戰。尤其是論文作者而言，因為要與聽眾直接面對面溝通，與傳統站在臺上就口語傳達的力式不同，如何引發聽眾對論文內容的討論遂成為重要的課題。本次會議有部分作者以大型海報、拼圖、道具等作為輔具，極為用心。亦有作者或許尚不熟悉新方式，還是以傳統 PPT 方式用平板或紙本表現，即容易發生「冷場」現象。根據會後大會主辦單位的問卷結果，據悉這種方式頗受肯定，未來其它的學術會議可能陸續採行這種作法，值得關注和學習。

(2) 聘用專業的會議主持人(moderator, facilitator) ，對掌控議程進行及活絡會議氣氛甚有助益。傳統的學術性或專業性的會議活動，多數依各不同場次，分別聘用主持人，由於主持風格各異，通常前後難以連貫，又或係臨時指派，對議題生疏，致會議成效不一。這次為期 3 天會議，大會聘請英國籍的專業主持人 PeterWoodward[6]主持整場會議，使原本沉悶冗長的會議過程，變得流暢。這種會議辦理方式，或值得參考，唯國內類似的專事於服務產業似並不多見（甚少有針對學術性，或公眾事務活動之公司組織）。

[5] Big Data GIS Analytics Towards Efficient Waste in Stockholm
[6] 請參考 http://www.questnet.co.uk/ 或 http://www.whatchado.com/en/peter-woodward

（二）建議事項

1. 運用資通訊技術以促進永續發展之相關課題，近年在國際間蔚為潮流，本署（或未來環境資源部）自當契合此趨勢，本處未來除持續關注相關議題發展外，規劃擬採行以下措施，並依技術趨勢滾動檢討：
   (1) 定期盤點本署各項資訊系統之成本效益，針對應用效能與耗用資源（電力使用、硬體配置）難符比例之系統，基於節能考量，適時調整資源配置。
   (2) 本署開發新系統或舊系統更新時，加強系統模組化(modulation)、可拆解式(decomposability)及可重用式(reusability)的軟體設計方法，並落實資料獨立性(data independence)，避免日後因軟體系統升級而導致大量硬體需求。
   (3) 規劃導入系統思考方法，針對未來環境資源部電腦機房之共構配置，通盤考量因網路頻寬及管理作業所衍生的「能源及環境成本」，尋求最有利的部署方式。
   (4) 考量環境相關資料增長速度，因應巨量資料時代，必須積極培植同仁環境資料分析及資料探勘(data mining)職能，藉以分析大量資料所隱藏之訊息及價值，從而促進環境永續發展業務創新。

2. 網路社群及行動裝置的普及，將構成「聯結的力量(nexus of forces)」，可能成為顛覆性科技(disruptive technology)，公私部門均須關注此演進過程對環境永續發展的影響。
3. 基於組織和職權分工，政府部門間之資料整合(data integration)容易衍生許多問題，這種問題在環境治理的領域特別明顯。以我國政府為例：同一條河川在上游歸農委會水土保持局管，下游則是經濟部水利署管，至於河川的水質則歸環保署，至於影響河川水質水量的降雨量，則歸交通部氣象局管。行政院組改完成後，這些機關雖然都納入環境資源部，但我們認為現階段有 2 個關鍵性的課題必須預為因應

   首先是環境資訊的整合，其次是環境資訊的公開與分享。特別是環境資訊的公開，已經逐漸成為各國貿易自由化的一項政策公具。不久前，歐盟就曾要求我們提供海域水質監測資料，否則他們就可能抵制我國的水產品輸往歐盟，我們必須就這 2 項課題及早因應，籌謀對策。

Improving Energy Performance of Data Centers through IT Services Consolidation

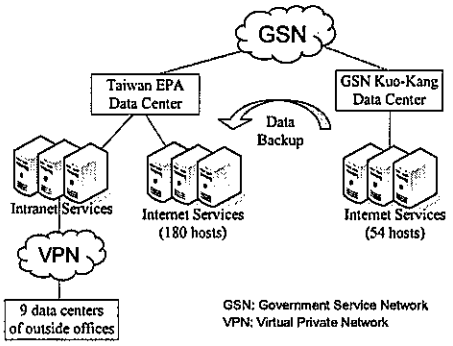
Yu-Chi Chu[1], Su-Mei Huang[1], and Chi-Fu Hung[2]
[1]Dept. Environmental Monitoring & Information Management, EPA, TAIWAN
[2]Dept. Information Management, Executive Yuan, TAIWAN

行政院環境保護署
Environmental Protection Administration
Executive Yuan, Taiwan, R.O.C.

Introduction

- Data centers (or ICT facilities) consume huge amount of energy. According to Gartner, the the world's leading prestigious information technology research and advisory company, data center power consumption usually is 40 times the total power consumption of the office.
- Taiwan EPA used to deploy over 200 servers in 9 different data centers as shown in Figure 1. They need to budget a great deal of funds for the operation and maintenance of these data centers.
- Taiwan Central Government is currently reorganizing its organization structure. Some of the agencies in charge of natural resources management such as weather, water resources and forestry will be merged with EPA to form a new ministry called Ministry of Environment and Natural Resources (MOENR). It will make a real challenge for the IT department to perform effectively to assist business units without increasing energy consumption for the new ministry.

Some of the security services are outsourced to improve public services, but it causes more cost of maintenance of the network and information security environment.



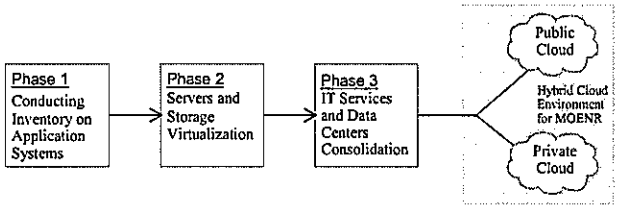
. Figure 1: The Past Data Centers Architecture of Taiwan EPA

The Process toward a Hybrid Cloud Environment

We propose a systematic process, as illustrated in Figure 2, for planning the migration from traditional data centers to an energy saving data centers in association with the cloud computing approach.

- **Phase 1: Conducting inventory on application systems.** Most organizations usually have a number of legacy systems, with a limited budget for maintaining and upgrading these systems. This involves decision making on the most appropriate strategy for evolving the systems. We adopt the common principles that have been used for legacy system management in the domain of software engineering.
- **Phase 2: Server and Storage Virtualization.** This phase provides a solution that several virtual machines (VMs) share the same server to run instead of having their own server. Virtualization enables to reduce the overall operation cost of data centers in terms of hardware, management for facilities and space.
- **Phase 3: IT Services and Data Centers Consolidation.** The distributed nature of Taiwan EPA's offices (or MOENR's offices after government reorganization) and the costs associated with long distance, high-speed network connectivity require us to balance data center consolidation with network cost and reliability factors.

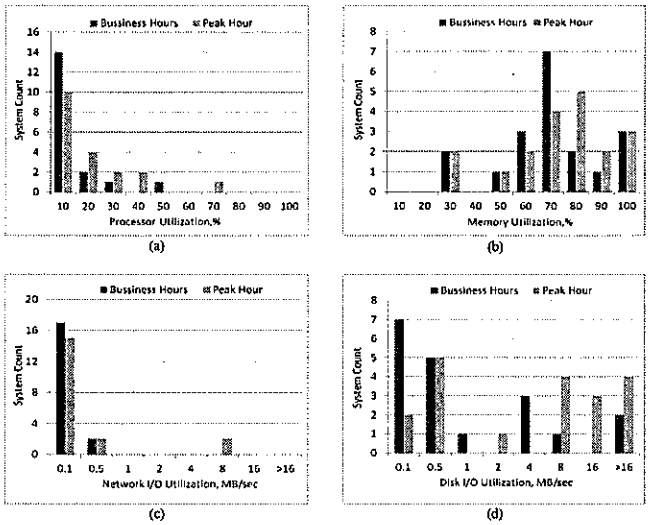
The enterprise e-mail and collaboration are one of the key platforms for consolidation and cloud migration. We have moved our e-mail and some of the common services such as shared-disk space, calendar to Google Enterprise Apps beginning at January 2014. For moving those IT to public cloud, we have reduced at least ten servers.



. Figure 2: The Process toward a Hybrid Cloud Environment

Contact:

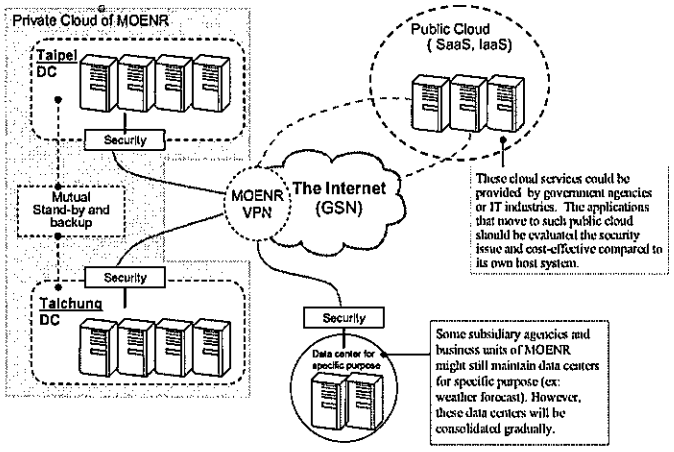
Phone: +886-2-23117722 ext. 2300, 2340
Email: ycchu@epa.gov.tw, sumhuang@epa.gov.tw, hcf@ey.gov.tw
Web: http://www.epa.gov.tw
Addr: 81, Section 1, Zhonghua Rd, Taipei, 10042, Taiwan (R.O.C.)



. Figure 3: The Usage of CPU, Memory, Disk and Network I/O

System Implementation

- There are four stages for the implementation process: (1) Platform construction, (2) Network infrastructure construction, (3) Application deployment, (4) Execution.
- According to Taiwan EPA's past architecture, we use server virtualization assessment tools to analyze the usage of CPU, memory, disk I/O and network I/O for each physical host.
- We collected all resource usages of servers in 5 days. The results showed the average usage of CPU was 15.88%. It means low utilization rate of CPU. The average memory usage was 70.64%. The average usage of page file was 8.91%. The sum of IOPS was 5,114.79. There are 5 hosts IOPS sum was reached 4052.05, up to 80% of the other 19 servers. The average Network Bytes per second was 27646.03 bytes/sec. The Network I/O usage was down to 0.1MB or less as shown in Figure 3 (a) to (d).



. Figure 4: The Hybrid Cloud Framework for Taiwan EPA (MOENR in the near future)

The Benefits and Lessons Learned

- **Architectural advantages:** Cloud computing uses innovation infrastructure which can be more effective usage of its IT hardware and software resources.
- **Technical advantages:** Cloud computing may easily handle peak loads without additional hardware infrastructure to maintain high utilization of information resources.
- **Advantages for the User:** the best advantage is that users no longer rely on traditional computer to develop applications, or to buy a special version of the mobile phone , PDA or other devices.

Design of a cloud-based system to integrate and share data for environmental governance and sustainability

Yu-chi Chu and Su-mei Huang
Dept. Environmental Monitoring & Information Management, EPA, TAIWAN

行政院環境保護署
Environmental Protection Administration
Executive Yuan, Taiwan, R.O.C.

Introduction

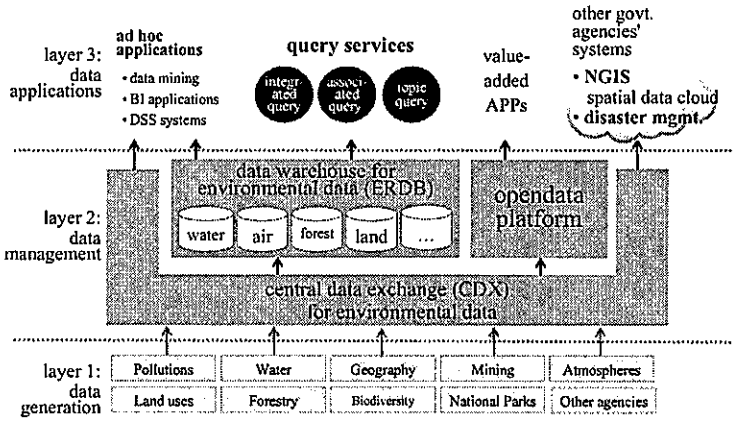
For making sensible, justifiable, and legally correct decisions, both government agencies and private sectors need detailed information regarding the current state of the environment and ongoing developments. Currently, it is very difficult to share environmental data since the information typically resides on geographically disparate and heterogeneous databases (systems).

These systems often do not facilitate access by secondary users and frustrate attempts to draw data together to form a more comprehensive understanding of environmental conditions and actions. Therefore, there is a major demand for appropriate systems and adequate tools to provide integrated information for managing the issues of environmental governance and sustainable development.

Missions

EnviroCloud project brought together 10 partners from 5 different federal agencies of Taiwan central government. Its aim is the requirement analysis and top level design of a comprehensive and cloud-based system which will collect, integrate, and share environmental information. The system has three missions:

1. establish a national wide data collection and gathering process and mechanism,
2. integrate and analyse collected data, transform the data to meaningful information, moving from information to insight,
3. develop a Data-as-a-Service cloud-based platform to disseminate information and support the decision making for environmental governance across agencies.



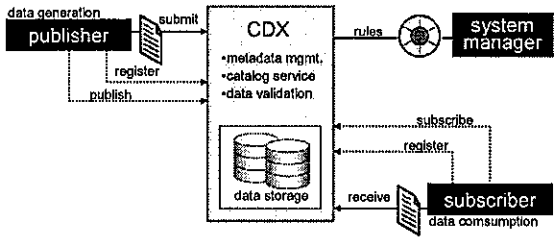
. Figure 1: The architecture of EnviroCloud

Publish-Subscribe Model for Data Exchange

Because the environmental data is collected by various government agencies, CDX provides a publish-subscribe solution for effective information delivery among these agencies. CDX enables Taiwan EPA and participating agencies to work with stakeholders - including local governments - to enable streamlined, electronic submission of data via the Internet. CDX also provides the capability for submitters to access their data through the use of web services.

Data that exchange through a publish-subscribe approach requires the senders to publish data without explicitly specifying recipients or having knowledge of intended recipients. Similarly, receivers must receive only those data that the subscriber has registered an interest in. Figure 2 illustrates publish and subscribe functionality of CDX. It provides participants with the ability to:

- Submit and receive data through one centralized point, in a variety of formats including Webs Forms, XML, or flat-file
- Utilize publishing services to share information collected by other stakeholders and exchange data with target systems using web services



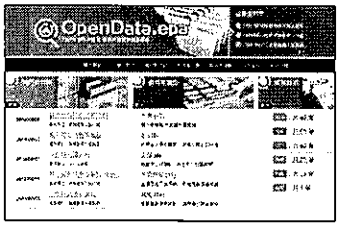
. Figure 2: The publish and subscribe functionality of CDX

System Architecture

The top level design of **EnviroCloud** project is three-layer architecture. Figure 1 depicts the architecture of the proposed method. We briefly explain the functions and its major components of each layer as follows.

1. **Data generation and collection.** In this layer, we select the sources of data and information that we consider relevant to the environment and natural resources, for example, atmosphere, air quality, water resource and quality, geology, forest and biodiversity, etc. These data and information are generated by participating partners that play as the "data publishers". They are also in charge of data quality assurance and provide metadata for the data they published.
2. **Data management.** This layer consists of three components that collaborate with each other to fulfil the missions of data management such as data transformation, data exchange, and data store. Firstly, the central data exchange (CDX) enables participating partners to work with stakeholders - including local governments to perform streamlined, electronic submission of data (machine to machine) via the Internet. Secondly, the opendata (OD) platform accesses metadata associated with the data that are allow to be used by general public from CDX. Components and modules of OD are maintained at opendata.epa.gov.tw. Thirdly, we will build a data warehouse which is dedicated to integrate environmental and natural resources data (called ERDB). The data warehouse will provide a foundation and play a crucial role for the operations of data analysis to next layer.
3. **Data applications and dissemination.** In this layer, we will develop a number of ad hoc and specific applications ranging from topic-oriented query systems to applications of business intelligence, as well as big-data related technologies. We encourage academic institutes and industries to "use" the data offered by opendata platform to develop software applications that might help environmental governance and sustainable development. We are also highly connected with the systems that are developed by some other government agencies, such as national geographic information system (NGIS) and disaster management systems. Therefore, EnviroCloud can benefit not only benefit participating partners but also other government agencies in the decision making process for environmental governance and sustainable development.

Opendata Platform



- Taiwan EPA views environmental data as a strategic asset to protect our environment. For bring tangible benefits to public, we are on track to fulfil the requirement of the opendata policy proposed by Executive Yuan, Taiwan central government in 2013.
- There are currently over 65 datasets on the opendata platform including hourly air quality monitoring data, UVI values, water monitoring data, etc. The datasets are in various formats such as JSON, XML, and KML for spatial data. We have taken a number of measures to encourage use of the datasets already published. For ensuring the data quality, we also establish a working group to oversee and provide input to the opendata efforts.

Future Works

EnviroCloud has been implementing a number of software systems and operation procedures. In the future, we will focus on the implementation of ERDB, a consolidated data warehouse system, to collect and materialize the data from CDX and other resources. In addition, we are currently investigating to employ big data technologies to analyse the vast amount data, both in structured and unstructured formats, collected from participant agencies and stakeholders.

Contact:

Phone: +886-2-23117722 ext. 2300, 2340
Email: ycchu@epa.gov.tw, sumhuang@epa.gov.tw
Web: http://www.epa.gov.tw
Addr: 81, Section 1, Zhonghua Rd, Taipei, 10042, Taiwan (R.O.C.)

Consuming Less Energy and Using Less Floor Space:Taiwan EPA's Data Center Reconstruction

Su-mei Huang, Yan-cin Wang, Yu-chi Chu

Department of Environmental Monitoring & Information Management,
Environmental Protection Administration Executive Yuan, R.O.C.(Taiwan)

行政院環境保護署
Environmental Protection Administration Executive Yuan, R.O.C.(Taiwan)

Introduction

- Since 2011, the Taiwan Environmental Protection Administration (TEPA) has implemented a series of measures to reconstruct its data center for improved energy performance. These measures include server consolidation, industry best management practices and virtualization across its data centers. Over the past two years, TEPA consolidated several data centers and server rooms with plans to gain more efficiency. The administration completed a successful project which included optimizing the use of floor space and installing an efficient cooling system. TEPA currently is hosting over 150 business applications in a shared hosting environment offering many features of private cloud service.
- The past plan of TEPA's data center is shown on the top in Fig.1. The computer room air-conditioning unit (CRAC) of TEPA's data center pushed cold air into the floor plenum and cold air ran through perforated floor tiles to cool the IT equipment in the racks. It couldn't prevent the mixing of the hot rack exhaust air and the cool supply air drawn into the racks. On the other hand, some IT equipment in the racks was far away from CRAC and was not cold enough. CRAC accounted for 47% of the total data center energy consumption, but the cooling capacity of the CRAC was not all supplied to the IT equipment in the racks.
- This poster presents the overall benefits and lessons learned from the actual work of the data center reconstruction, including air and energy management, cooling efficiency improvement, as well as floor space utilization of the data center.

Methods

- Air Management and Cooling Efficiency: TEPA adopted in-row RD cooling systems and all the equipment were installed into the racks to achieve a front-to-back airflow (as shown in the bottom of Fig.1). The rows of racks were placed back-to-back. The cold aisles were located in front of the racks, and would reject heat out through the hot aisles behind the racks. With the isolation, the temperature of the hot aisle did not impact the temperature of the racks (the cooling system configuration in B-B' section for No.3 and No.4 server rack is shown in Fig.2). The in-row RD cooling system was configured to supply cold air to the cold aisles and pull return air from the hot aisles and back to the cooling towers. In accordance with IT equipment operation, the in-row RD cooling system was capable of adjusting cooling performance dynamically to improve energy saving (the cooling system configuration in C-C' section for No.3 and No.4 cooling rack is shown in Fig.3). The new hot aisle/cold aisle configurations and air flow management can significantly increase the cooling efficiency of the cooling system of TEPA's data center.
- Energy Management and Energy Efficiency: TEPA installed a new Uninterruptible Power Supplies (UPS) system which enable to supply both 380Vac and 220Vac. The transformers between main supply (380Vac) and UPS were removed so as to reduce the losses during power distribution (new voltage transformation path is shown in Fig.4). The new power distribution units (PDU) were located in the racks. The conductor lengths from the PDU to the IT equipment were reduced, leading to the less power lost in the form of heat.

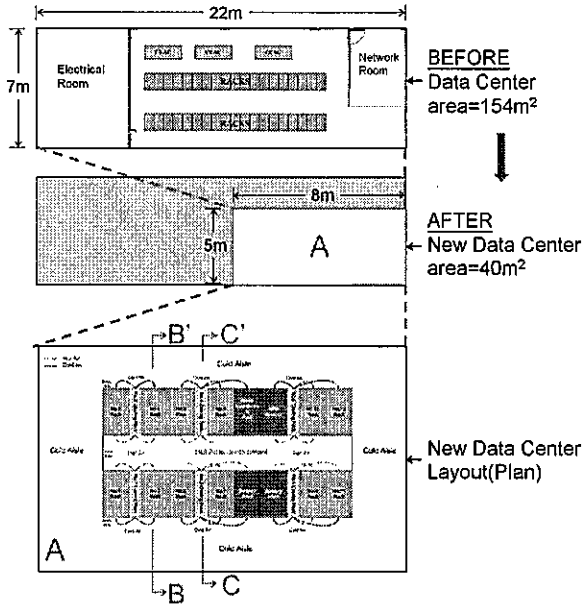


Fig. 1. Plan View of Taiwan EPA 's Data Center and the Reduction of Physical Space Utilization and Changes in the Energy and Cooling Management.

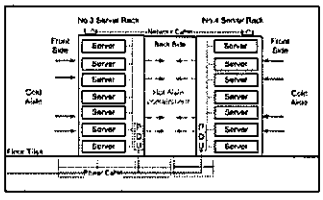


Fig.2. Cooling System Configuration in B-B' Section for No.3 and No.4 Server Rack.

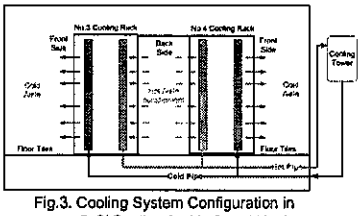


Fig.3. Cooling System Configuration in C-C' Section for No.3 and No.4 Cooling Rack.

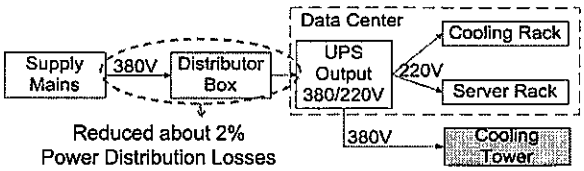


Fig.4. New Voltage Transformation Path.

Result & Future Work

- Floor Space Saving of Data Center: After TEPA has implemented a series of measures which include server consolidation, industry best management practices and virtualization across TEPA's data center, the demand for rack was reduced from 38 down to 12. The demand for TEPA's data center's space was reduced from 154m² down to 40m²(as shown in Fig.1(A)).The configuration of the data center was changed, and 74% of the space of the data center was saved.
- Effective air management and energy management is of crucial importance. The efficient cooling systems and UPS systems are helpful for energy saving. In Fig.5, the pie charts show the distributions of the energy consumption in TEPA's data center. For a fixed total energy consumption of IT equipment (after IT services consolidation), the cooling systems take up a much smaller share of total energy consumed (from 47% down to 27%). The new UPS systems in the rack allows greater flexibility and more efficiently. The UPS systems losses are reduced 13%.
- In Fig.6, the reconstruction of TEPA's data center was completed in February 2013. The monthly energy saving ranges from about 26,000 kilowatt-hours to more than 44,000 kilowatt-hours. The reconstruction has also reduced operating costs and helped reduce carbon emission.
- Power Use Effectiveness (PUE) , one of the energy performance metrics, is defined as the ratio of the total power to run the data center facility to the total power drawn by all IT equipment (lower PUE value is better)[2][3]. In the past, TEPA's data center had a PUE of 2.5. Now, the PUE is down to 1.7 and we will try to further achieve a PUE as low as 1.3.
- We are investigating the feasibility of direct current (DC) distribution into the rack, for the reduction of the power loss and wasted energy (TEPA's data center power is supplied from the grid as AC power and distributed throughout the IT equipment in the rack. However, the requirement of the UPS system is DC power, the power must go through multiple conversions). The renewable energy supply (such as Solar Power) is another goal.

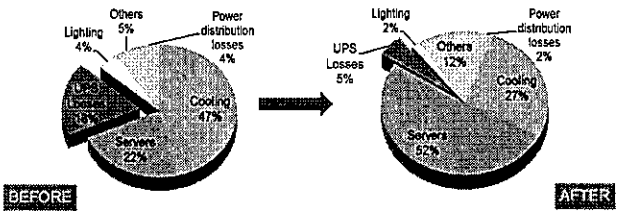


Fig.5. Comparison of the Change in the Proportion of Energy Consumption.

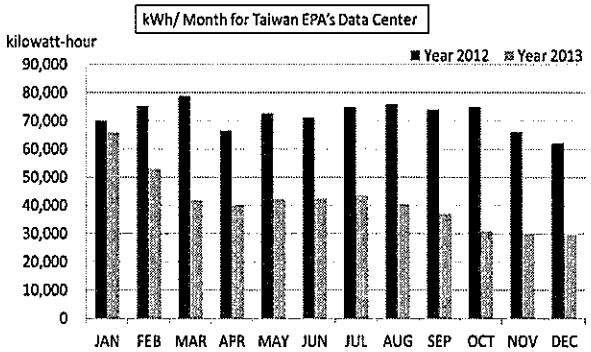


Fig.6. Comparison of Monthly Energy Consumption.

Reference

[1] Gartner Report, "Hype Cycle for Data Center Power and Cooling Technologies," 2012.
[2] VanGeet, O., "FEMP Best Practices Guide for Energy-Efficient Data Center Design," National Renewable Energy Laboratory, 2011.
[3] Grid, G., "The Green Grid data Center Power Efficiency Metrics: PUE and DCiE, " Green Grid report, 2007.

For further information please contact sumhuang@epa.gov.tw, yencwang@epa.gov.tw, ycchu@epa.gov.tw ; Ph: +886-23117722 ext. 2340,2337,2300 ; Web: http://www.epa.gov.tw

Smart Energy in Stockholm Royal Seaport

Johan Ander
Program Manager – Smart Energy
Stockholm Royal Seaport

Next generation energy company | Fortum

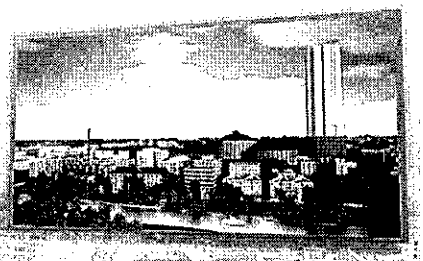
In 2009 the City Council decided that Stockholm Royal Seaport should become a new environmental profiled area. By 2030, the city district should become free of fossil fuels, climate positive and adapted to climate change

Fortum
Leading the program and responsible for the delivery of Smart grid and Active House

ABB
Supplier of relevant technical infrastructure and technical competence

ERICSSON
Technical integrator of IT and Communication

Electrolux
Supplier of the smart white goods in the Active House



KTH
Research, analysis, scientific reporting

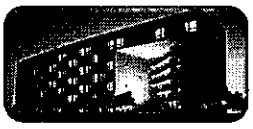
Energimyndigheten
Supports the program 25%

2

Next generation energy company | Fortum

Builders – with cutting edge building technology

NCC — Participates with 64 apartments



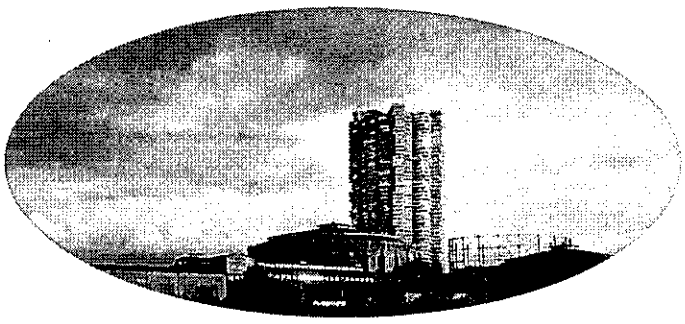
Wallin — Participates with 18 town houses

HEBA FASTIGHETS AB — Participates with 73 apartments

3

Next generation energy company | Fortum

Smart Energy in Stockholm Royal Seaport



4

Next generation energy company | Fortum

Background

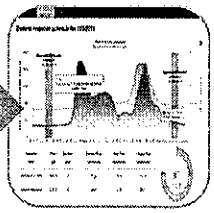
Massive Urbanization

The world is undergoing the largest wave of urban growth in history. In 2008, for the first in history, more than half of the world's population will be living in towns and cities. By 2030 this number will swell to almost 5 billion... *UNFPA

Smart City - Technology

The environmental challenges creates a demand for new technical solutions, especially in the energy area. This creates new business opportunities for Fortum

New Energy Solutions

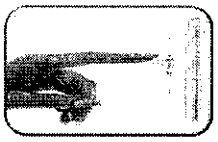


An area that has high potential is new systems in the energy measurement, visualization and energy efficiency for apartment buildings which has the potential of being a new business area. But also be a product extension for Fortums energy sales business

Fortum

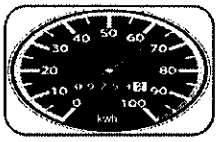
Behavior – Awareness - Change

Behavior



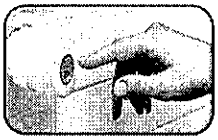
Today energy as a natural necessity. Very few people think about their energy behavior in apartment buildings even though the combined consumption in a building is large.

Awareness



By smart energy metering in combination with individual consumption visualization there is a possibility to make people more aware of their energy consumption.

Change



The increased awareness will give the foundation for change – lower energy consumption, lower energy costs and a better climate is all pointing in the same direction.

Fortum

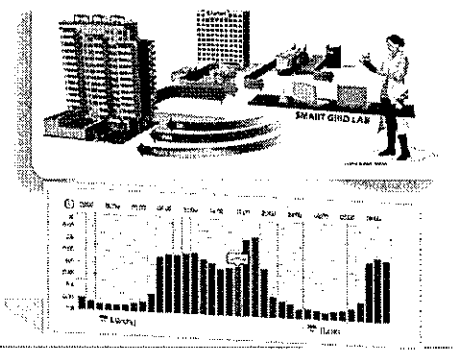
The Smart Grid will handle thousands of smart apartments

Information provided to consumers

- Demand/Response
- Advanced steering ICT
- Behavior analysis
- Reduced losses
- Hourly Prices
- Net measurament
- Real-time consumption

Expected benefits

- *For consumers*
  - Simplified sustainable life
  - Reduced risk of blackouts
  - Increased cost awareness and control
  - Possibility to reduce costs and footprint
- *For society*
  - More resilient energy system
  - Increased flexibility – lower cost
  - Higher share of renewables
  - Increased energy efficiency?

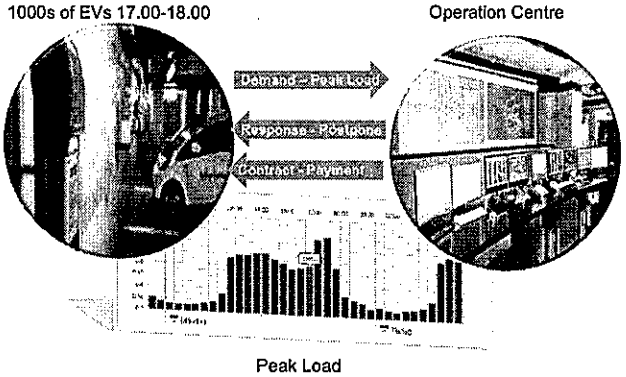


Fortum

Example – Demand Response

1000s of EVs 17.00-18.00

Operation Centre



Fortum

Active House – Behavior Change

25%

Energy Reduction

The Active house combines technology with new business models for a new approach to home energy

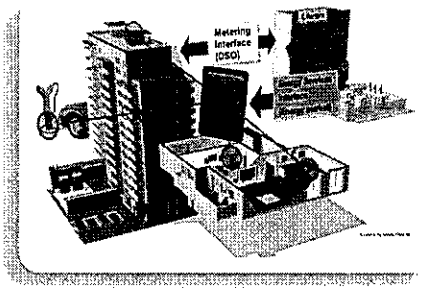
The Active house

Technology

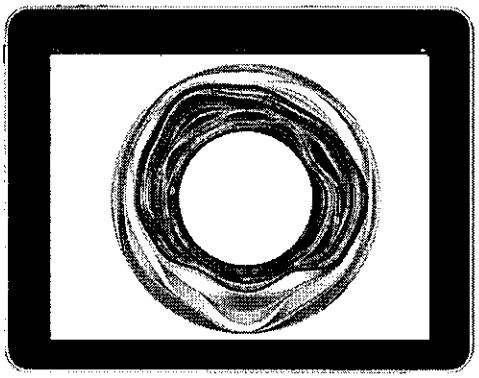
- Home automation
- Energy visualization application
- Real-time consumption monitoring
- Smart appliances
- Own production
- Scheduling based on signals

Business models

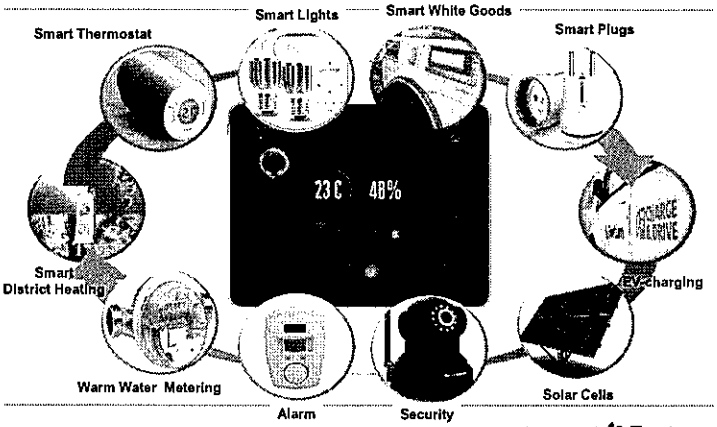
- Hourly metering
- Hourly prices
- Time differentiated tariffs
- Demand response



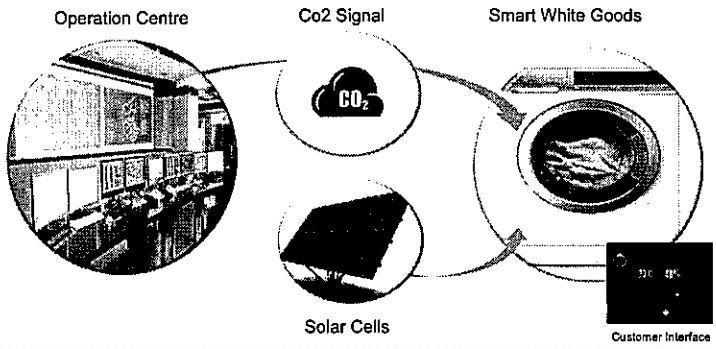
New visualization concept



New solutions



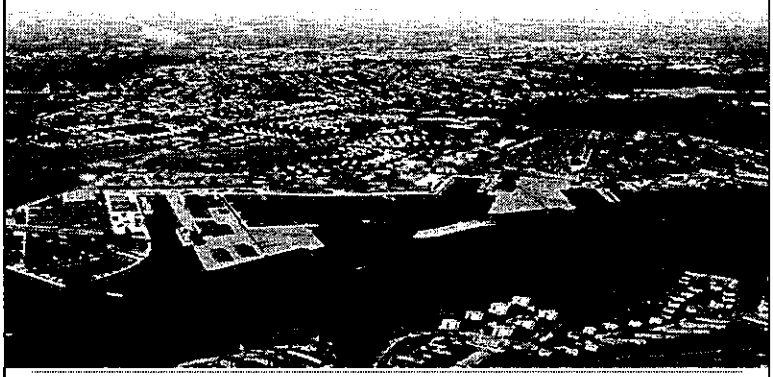
Example – Active House



13

Fortum

Thank You !!!



14

Fortum

Smart ICT for working and living in SRS - IoT@Home

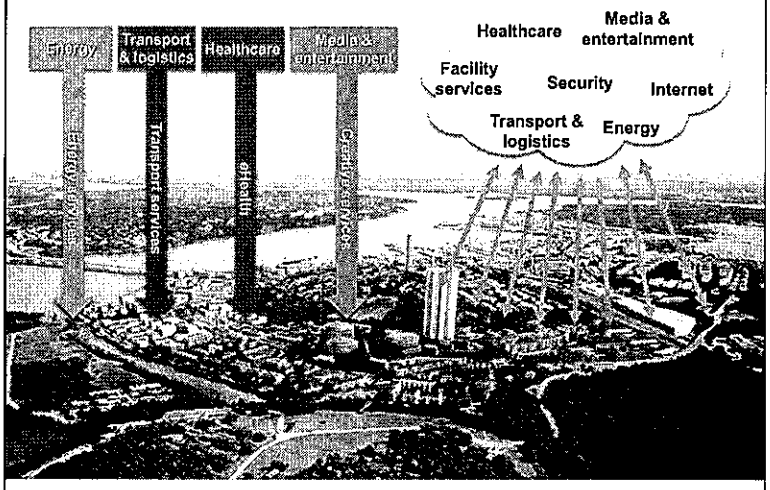
ICT4S
ICT for Sustainability

Smart and sustainable solutions in Stockholm Royal Seaport
27 Aug 2014

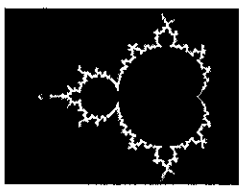
Claus Popp Larsen
Acreo Swedish ICT

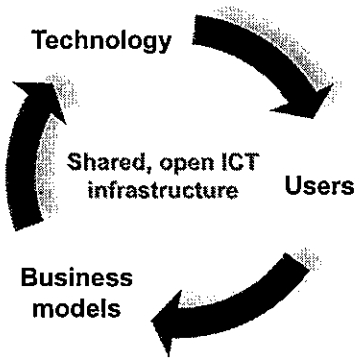
RI. SE SWEDISH ICT

Many *vertical* structures → One common, *horisontal* structure

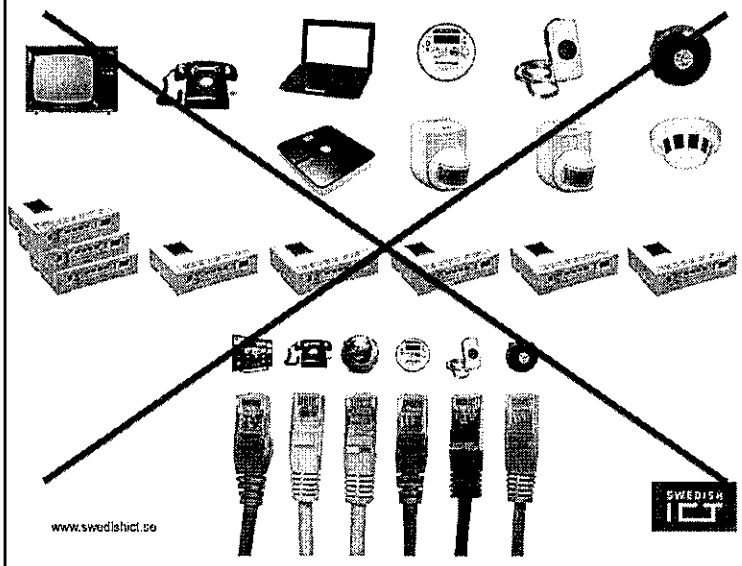


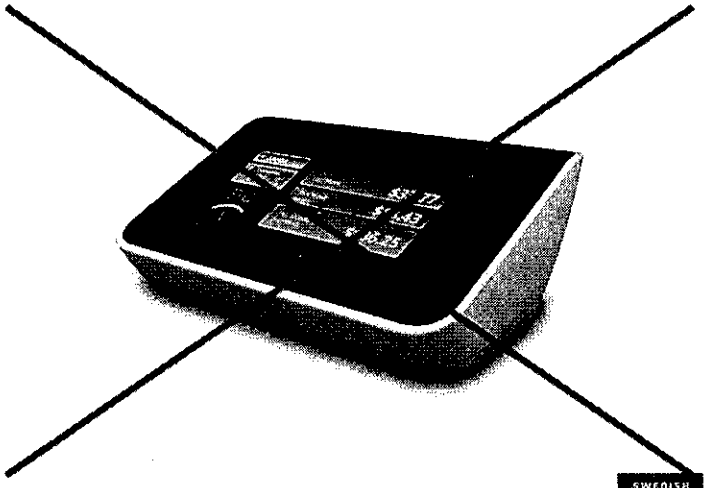
- In the city
- In the building
- In the home

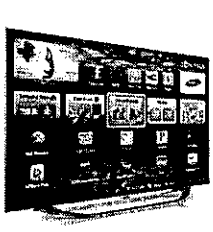




RI. SE SWEDISH ICT





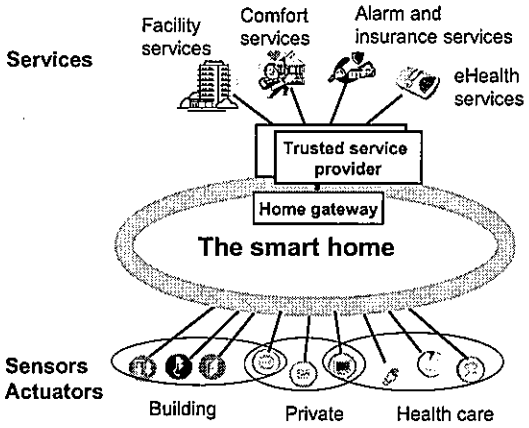


WE ARE NOT QUITE THERE YET

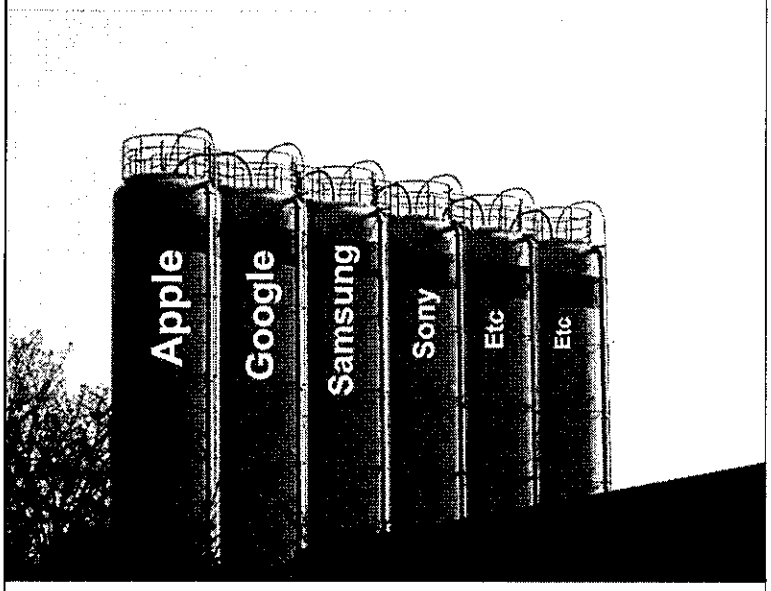
Step 1: Share infrastructure

Step 2: Data from every sensor in the home should be available for every trusted service provider

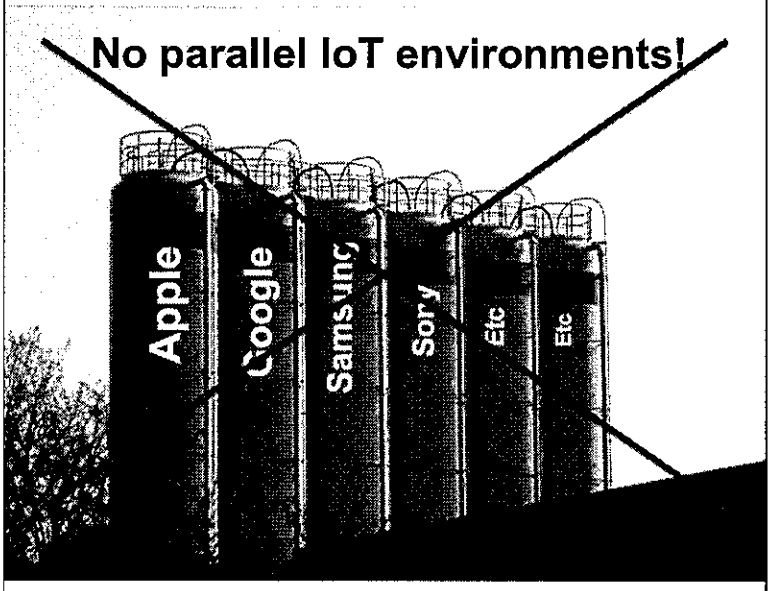
IoT@Home



www.swedishict.se



No parallel IoT environments!



ONE SHARED 'INTERNET OF THINGS'

- Share infrastructure
- All data available for anyone else
  - Saves money
  - Better for the environment
  - Stimulates innovation
- No technical obstacles today
- *But*: Fear, ignorance and above all lack of business models!

www.swedishict.se

WWW.SWEDISHICT.SE

Smart ICT for living and working in Stockholm Royal Seaport
www.swedishict.se/projects/smart-ict

Contact:
claus.popp.larsen@acreo.se

www.swedishict.se

RESEARCH INSTITUTES OF SWEDEN

RI. SE (SWEDISH GOVERNMENT)

SP · SWEDISH ICT · swerea · INNVENTIA

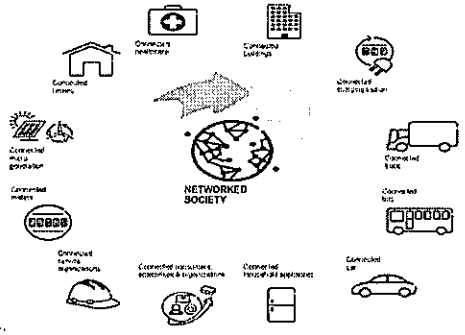
Acreo Swedish ICT | SICS Swedish ICT | Interactive Institute Swedish ICT | Viktoria Swedish ICT

ERICSSON

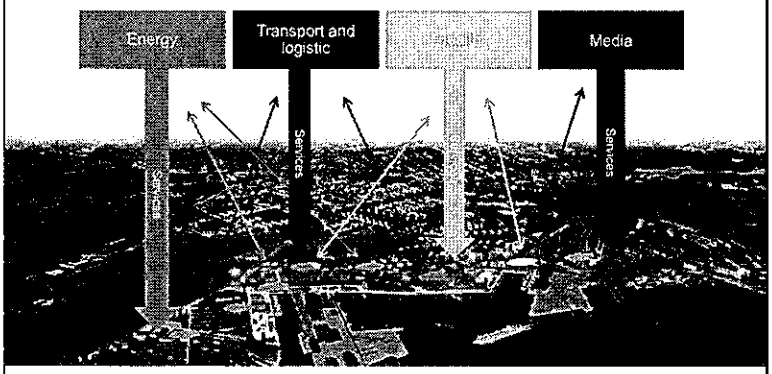
Smart Communication

Jörgen Rhodin
Head of Ericsson Innovations Russia

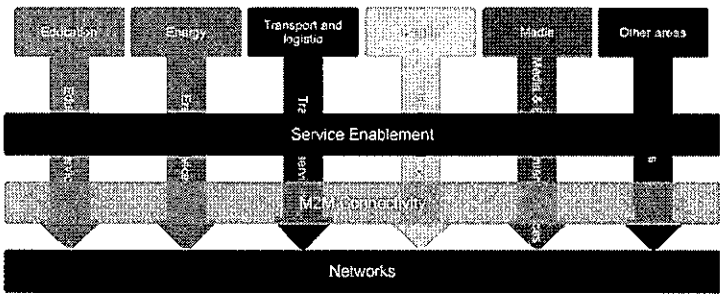
SHAPING SUSTAINABLE CITIES IN THE NETWORKED SOCIETY



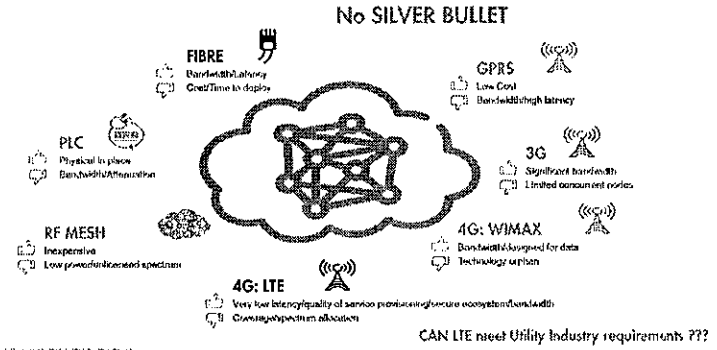
ICT infrastructure today



ICT Infrastructure IN the FUTURE



MANY Networking TECHNOLOGIES



CAN LTE meet Utility industry requirements ???

Research into LTE For UtilitiEs

- Standardized wireless technology will allow a rapid introduction of advanced smart grid functions
- New business models need to be explored with both Utilities and Telcos
- Continued research and pilots on suitability of LTE/4G will be done e.g. in SRS Urban Smart Grid project

- Can LTE meet Utility requirements for:

LATENCY
RELIABILITY
QUALITY OF SERVICE
THROUGHPUT

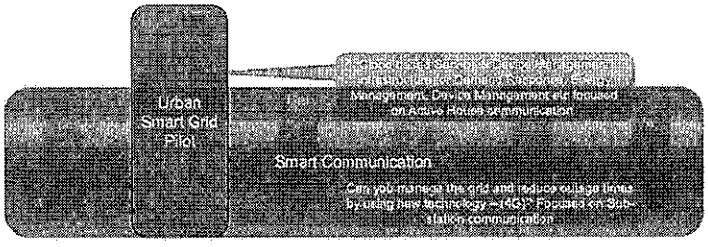
Depends!

YES!

Important considerations
- Careful radio planning required to maintain reliability
- QoS a must for mission critical applications
- In-door coverage in energy efficient buildings are often very poor

Efficient Use of ICT infrastructure

Ericsson is the ICT advisor to the SRS Innovation Center



Efficient Use of ICT infrastructure

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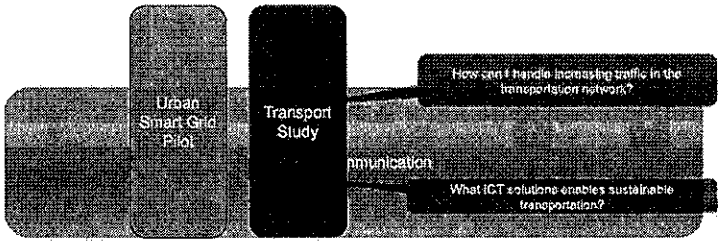
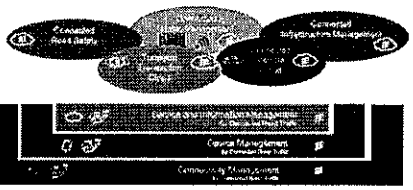


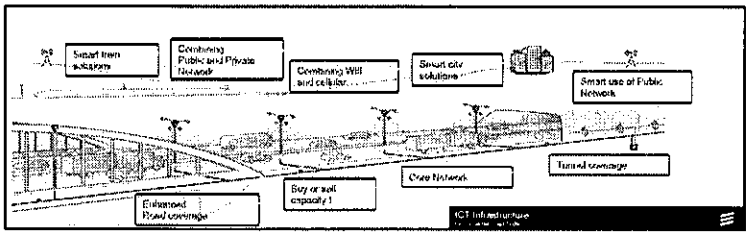
The full picture

intelligent transport

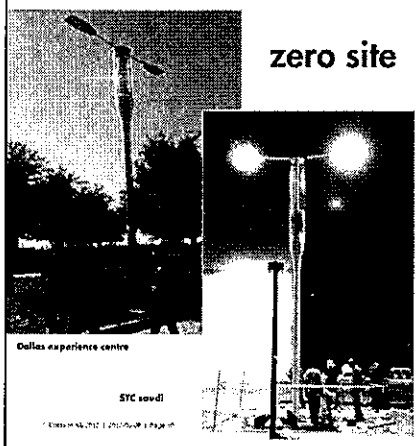
enabled by

Smart communication





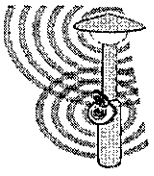
zero site



- Mulli technology/Operator
- 8-12 meter height
- Transmission Optical or mini-link PT
- Baseband, power , battery and transmission underground
- Cabling and cooling via pole
- One day deployment

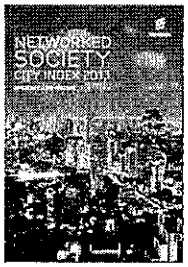
Smart streetlight

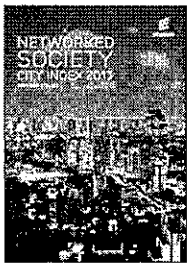
Standard armature for streets and parks with built-in Pico RBS (RBS6401) and Wi-Fi backhaul.

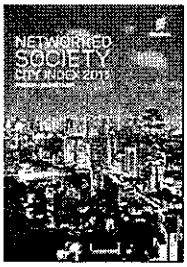


Concept trial with integrated charging for electric vehicles

Further reading

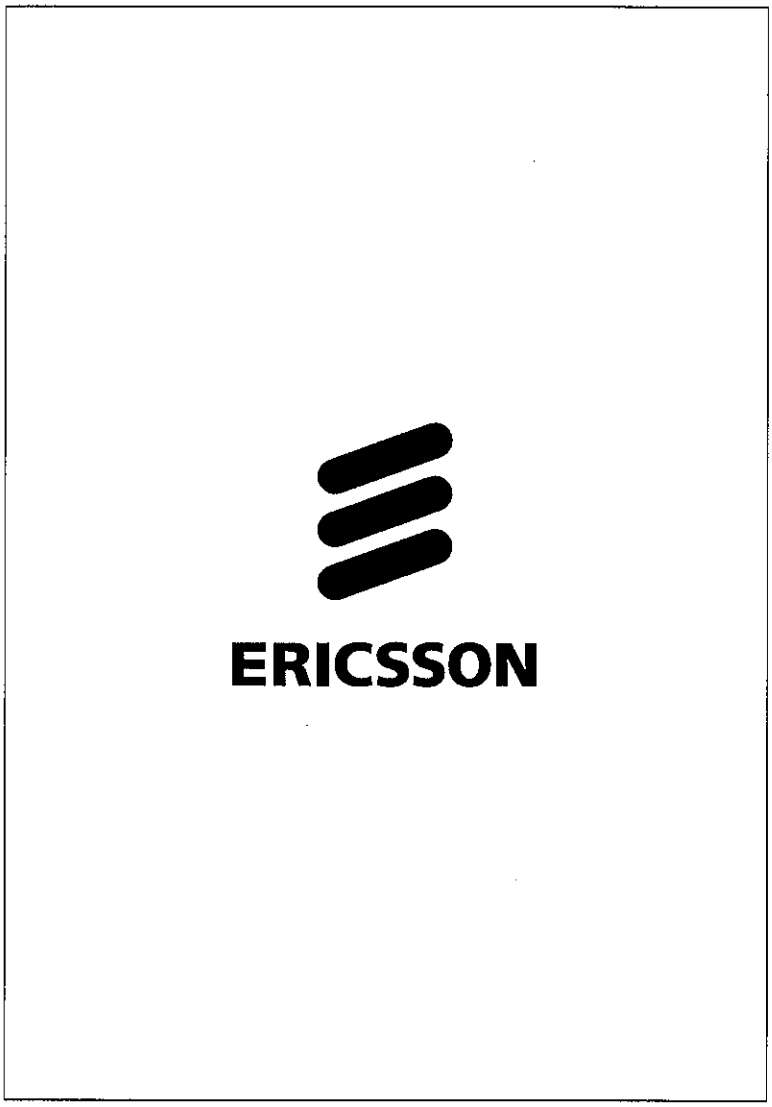






CITY PROFILES CITY CASES METHODOLOGY

http://www.ericsson.com/news/131119-networked-society-city-index_244129226_c


ERICSSON

Workshop on ICT for Sustainable Urban Development

Anna-Karin Stoltz Ehn
Stockholm Royal Seaport Innovation, The city of Stockholm
Box 8189, 104 20 Stockholm, Sweden
anna-karin.stoltz.ehn@stockholm.se

***Abstract*—This is the report on the workshop on Smart and sustainable solutions in the eco-district Stockholm Royal Seaport, held at the 2nd International Conference on ICT for Sustainability in August**

***Index Terms*—Sustainability, urban development, ICT.**

I. Introduction

On 27th of August 2014 Stockholm Royal Seaport (SRS) Innovation in collaboration with KTH organized a workshop with the theme *"Smart and sustainable solutions in Stockholm Royal Seaport"*. The workshop, held in conjunction with the ICT4S international conference, tried to address questions surrounding key challenges and opportunities in employing ICT as a means towards urban innovation. Experts presented the various ICT solutions embedded in the Stockholm Royal Seaport project and shared their experience on various challenges facing the large scale implementation of these solutions. Panel and group discussion focused on tackling the obstacles and identifying key opportunities both locally and globally.

Anna-Karin Stoltz Ehn, the head of SRS Innovation, presented an overview of the evolving needs of the City of Stockholm, the vision to create a vibrant, creative and living city raising the important question *"How can we fulfill the needs and vision for the citizens of Stockholm?"*

II. Long Time Environmental Planning

Tomas Gustafsson, sustainability strategist at SRS Innovation, highlighted the great focus on sustainability issues that has been a hallmark of the Stockholm region. Having the honor of receiving the first European Green Capital Award in 2010, the City of Stockholm's ambitions for environmental issues span over 40 years. The future vision of the city aims to accommodate the projected growth in the region focusing on becoming fossil free by 2050 and providing integrated sustainable solutions to achieve them. Here Hammarby Sjöstad and Stockholm Royal Seaport, with strong environmental focus, play a significant role in leading the way towards a more sustainable future.

III. ICT Friendly City District

Stockholm Royal Seaport is one of the newest and the largest urban city development project in Stockholm. The overall sustainability goal is to make the new city district fossil free and adapted to climate change considerations. In addition to the ambitious sustainability goals various state-of-the-art ICT solutions are being tested out to influence the user behaviors towards more sustainable alternatives.

IV. Entering the Interconnected Society

Amy Rader-Olsson from Royal Institute of Technology, KTH, who was the workshops moderator, stated that the growing rate of urbanization presents new challenges and requires state-of-the-art innovative solutions to address them. This coupled with the rapid pace of climate change requires a paradigm shift in the way we build cities and use resources such as energy, water and materials. At the same time we are entering a networked society where most of our infrastructure is already connected. This presents a great opportunity to provide integrated solutions in influencing our behaviors towards a more sustainable society. It also has the potential to provide new business opportunities contributing to a green economy.

V. Smart Energy Project

The Smart Grid and Active house project, which is a joint collaboration between Fortum, ABB, Ericsson, Electrolux, KTH and several building developers is a step towards this direction. Johan Ander, the program manager mentioned the importance of awareness driven change in behaviors.

"We all have an energy behavior but lack awareness which makes change more difficult. Focusing on demand response principle with connected household appliances, electric cars and local renewable production, the system will respond to peak load, price and CO2 emissions signals thereby, shifting the load and preventing emissions from marginal energy generation."

In addition, providing the end user with visualization and home automation possibilities will result in energy savings and greater awareness of the energy use. This will enable

managing and monitoring the grid in a much better way. The Active homes with home automation, visualization technologies and smart white goods will facilitate user behavior change, therefore contributing to energy efficiency and emissions reduction in the overall system.

"One of the key challenges is to find the right balance between automation and letting people make the decisions", Johan Ander commented and also pointed out as a challenge.

VI. Development of ICT requires adapted business models

Swedish ICT's Smart Living Group Manage, Claus Popp Larsen shed light on some of the key challenges related to achieving an interconnected society.

The present ICT infrastructure exists in the form of several vertical structures but in order to unleash the full potential of the "Internet of Things at home" there is a need for a common horizontal structure.

He mentioned that at present the infrastructure isn't being shared and creating a common infrastructure will enable cost savings and stimulate innovation growth while being better for the environment. The key hurdles in achieving this are not technical but rather lack of trust and effective business models.

Jörgen Rhodin, head of Ericsson Innovation Russia echoed these thoughts and pointing out that while most of the infrastructure we have built is connected there is a mishmash of ICT infrastructure. Mr. Rhodin also discussed several areas in which Ericsson is working with to achieve a networked society.

VII. Real-time data enables smart decisions

Hossein Shahrokni from the Royal Institute of Technology KTH presented the Smart City SRS project. The project aimed for the citizens, aims at a bottom up information flow paradigm and enables the end users to understand the system consequences of decisions thus providing greater insight into the impact of every day habits and actions.

VIII. Panel discussion

A. Business models are essential

During the panel discussion, the moderator of the workshop Amy Rader Olsson, asked the experts about the key challenges facing the integration of ICT in cities. There was consensus amongst the expert speakers that despite the great potential of these solutions and technology being in place, there are several organizational and structural challenges that still exist for large-scale implementation. First and foremost there is a need to provide strong and effective business models. This is necessary for innovation diffusion and implementation in larger society. Strong business models will ensure the continual improvements in the infrastructure and bringing new ideas and solutions.

B. Triple helix-model enables innovation

The participants also concluded that another obstacle is the difficulty in getting the different stakeholders on board, there is a need to strengthen the collaboration between research, business and administrative parts and projects such as the SRS Innovation can provide a great platform to achieve that.

Participation and long term perspective from the City of Stockholm is a step in the right direction and platforms such as SRS Innovation can help facilitate the process. Stockholm Royal Seaport offers a great playground to test new solutions in smart living where end user education and awareness are key aspects. The speakers stressed that regulation of technologies shouldn't be done by the cities but should rather be allowed to evolve in order to prevent technologies lockins.

In the breakout session, the participants of the workshop focused their discussion on related projects and experiences from around the world, scalability of the solutions to other parts of the city and the role the City of Stockholm can play in addressing the challenges.

C. Suggestions to high-light ICT

Participants agreed that concepts from Stockholm Royal Seaport are possible to implement in other areas in Stockholm but are more difficult to implement in other big cities in the world due to their size and their segregated population and different social levels. It was suggested that Stockholm Royal Seaport should compete with other smart sustainable urban development initiatives in the world in terms of sustainability.

Another suggestion was to introduce a sustainability index in the stock market in Stockholm since it's located in Stockholm Royal Seaport. The important role of grassroot level initiatives in bringing change was also brought up. The need for including ICT in the planning process of smart sustainable cities and inclusion of industrial groups was stressed. Issues related to the deregulation of ICT infrastructure and ownership of common infrastructure were also discussed.

At the end, the moderator, Amy Rader Olsson summed up the discussion by pointing out that it is important to understand how large systems interact with each other and how technology interacts with humans.

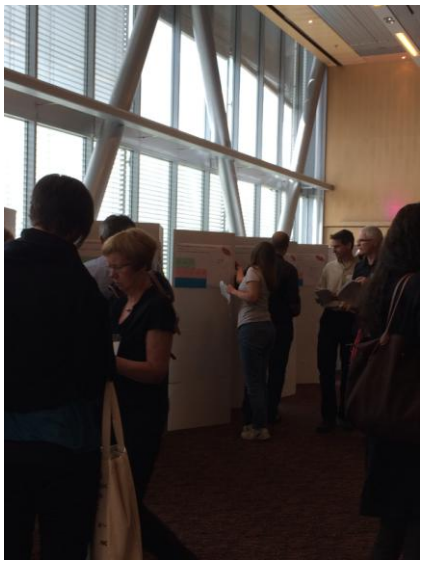
"The problem isn't at the technology level but rather there is a need to figure out how it can be scaled up. Institutional response to signals should be effective and help create support structures for technology", she said.

Projects like Royal Seaport provide a learning platform and test-bed where these solutions can be tested and calibrated for scaled up implementation both locally and globally. It also offers lessons in changing organizational structures to maximize collaboration and innovation development.

圖一：大會聘請專業主持人 PeterWoodward　主持整場會議，掌控議程進行

圖二：Best papers 發表實景

(a)



(b)

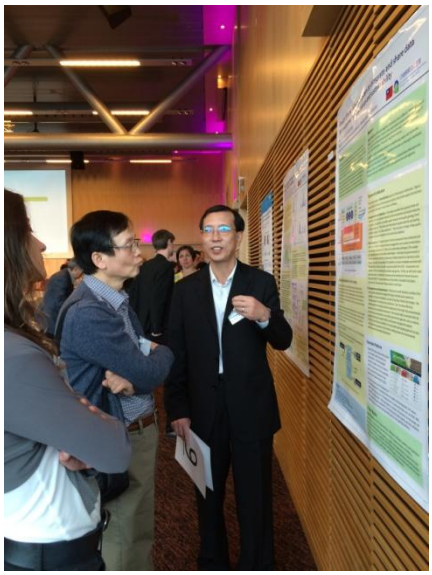
圖三：每場 ConverSation 論文發表前，由與會者先選擇想參與討論的論文，因為每一桌次有名額限制，論文的熱門程度，馬上見真章

圖四：ConverSation 論文發表方式，讓作者與聽眾有充分溝通討論的機會

圖五：大會安排每篇海報發表者上台，在 45 秒內進行宣傳

圖六：本署同仁上台說明海報

(a)



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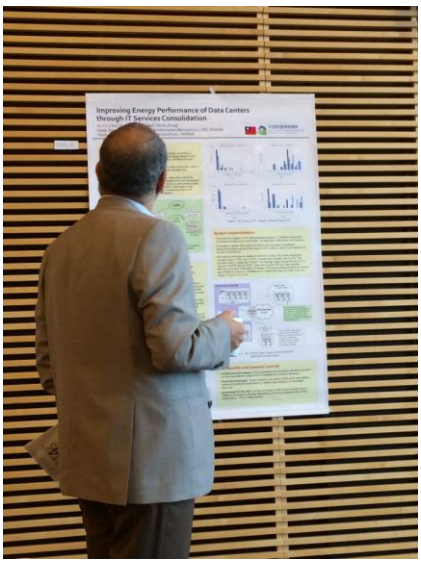

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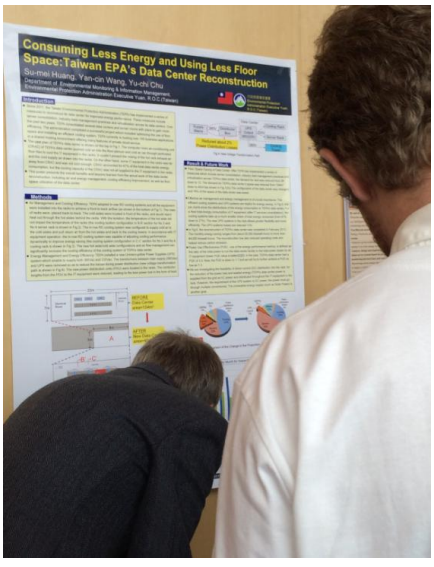

(f)

圖七：本署同仁向與會者說明海報以及與會者瀏覽海報實景

(a) (b)

(c)

(d)

圖八：實地參訪斯德哥爾摩皇家港(Stockholm Royal Seaport)開發區，此地預計在 2030 年開發成新型態的綠色新市鎮，可容納 1 萬戶住家，並創造 3 萬個就業機會。這項計畫在 2012 年已有第一批家庭進駐。